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SUSTAINABLE AGRICULTURAL PRACTICES AND ALLEVIATING POVERTY IN THE POST-FUEL SUBSIDY ERA AMONG SMALL HOLDER MAIZE FARMERS IN PLATEAU STATE.

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ABSTRACT

Sustainable agriculture, in line with the 2030 Agenda for Sustainable Development, contributes to broader development of Sustainable Development Goals (SDGs). The study focused on Sustainable Agricultural Practices and Poverty Alleviation among Smallholder Maize Farmers in Plateau state, Nigeria. This study adopted Multistage sampling technique to randomly select 210 farmers. Primary data was obtained through structured questionnaire administration. Descriptive statistics, 5-point likert scale Multidimensional Poverty Index (MPI) and logit regression model. The result revealed that the average age of farmers was 52 years,85% of farmers were married, with an average household size of 5, 92% of farmers had education, with farming experience of 27 years and farm size was 3 hectares. The farm income was ₦603,742.86, and 58% of farmers were members of cooperative societies. The result further indicates that maize farmers exhibited a low frequency of adopting sustainable agricultural practices, with a grand mean value of 1.73. The result of Multidimensional Poverty Index indicate that male-headed households (HHs) had a Headcount Ratio (H) of 60.0% and an Intensity (A) of 38.2%, resulting in a Multidimensional Poverty Index (MPI) of 0.229, while female-headed HHs had a Headcount Ratio of 58.0% and a higher Intensity of 57.0%, leading to an MPI of 0.331. The results from the Logit regression model indicate adopting sustainable agricultural practices significantly reduces poverty. Challenges faced by the farmers in adopting SAPs were lack of awareness and technical knowledge, limited access to credit, poor infrastructure, lack of government support, and unpredictable weather patterns. The removal of fuel subsidies significantly increased input costs, leading to higher production expenses and reduced return on investment while sustainable agricultural practices have the potential to alleviate multidimensional poverty, their adoption remains low due to financial barriers, poor infrastructure, and inadequate technical support. Therefore, the study recommends: Farmers should diversify income sources through non-farm activities; Promoting farmer education, and encouraging knowledge-sharing on sustainable practices; and Government policies should focus on expanding access to credit and providing targeted subsidies for sustainable farming.

Key words: *Sustainable Agricultural Practices, Poverty Alleviation, Post-fuel subsidy, Maize farmers*

INTRODUCTION

Nigeria's economy depends heavily on agriculture, particularly in Plateau State, where a sizable portion of the population depends on farming for both employment and food (Neszmélyi, 2014). The foundation of this industry is made up of smallholder farmers, but because of their limited land ownership and resource constraints, they have been dealing with ongoing issues like low productivity, degraded soil, and susceptibility to outside shocks like shifting regulations and unpredictable weather patterns (Raimi et al., 2017). The need for sustainable agricultural practices (SAPs) to alleviate poverty among these farmers has grown more pressing since fuel subsidies were eliminated in Nigeria, which increased production costs. Additionally, experts generally concur that sustainable agriculture techniques offer a possible solution to the

continuing global discussion on mitigating the negative effects of climate change (Setsoafia, 2022; Bekele *et al.* 2021). The implications of fuel subsidy removal are broad on the agricultural sector. It has resulted to an increase in the costs of transportation and market inputs directly, disproportionately impacting smallholder farmers who are operating on low budgets (Gamette & Oteng, 2024).

The necessity for SAPs—innovative ways that promote efficiency without compromising environmental resources—is highlighted by this economic strain. Agroforestry, organic fertilisation, conservation agriculture, and intercropping are a few of these methods that have demonstrated promise for enhancing food security, lowering production costs, and improving yields over the long run (Ward *et al.,* 2018).

Sustainable agricultural methods offer prospects for both economic growth and environmental preservation. For instance, in a study carried out in Ogun State, beneficiaries of a SAP reported the adoption of improved crop varieties and agroforestry as sources of increased farm output and reduced farmers' vulnerability to climate and economic shocks (Oyewole & Sennuga, 2020). Likewise, climate-smart agricultural (CSA) strategies have proven to increase resilience to climate shocks and alleviate poverty (Makate, 2019). The need for SAPs (innovative approaches that enable productivity without sacrificing quality) is highlighted by this economic pressure. Plateau State can benefit from SAPs because of its diverse agroecological zones and temperate climate. However, regional adoption of these methods is hampered by structural issues such as limited access to market information, credit facilities, and extension services. Studies using geospatial data in Jos East Local Government Area, show that enhanced management of water resources and better infrastructure to assist irrigation is vital for smallholder farmers' production (Ibrahim et al., 2020).

In accordance with the 2030 Agenda for Sustainable Development, sustainable agriculture helps to advance the SDGs more broadly. By breaking the patterns of rural poverty, resource-conserving methods like zero-tillage and in-field water harvesting can dramatically increase yields at a minimal cost (Baiphethi et al., 2009). Policymakers must therefore create favourable conditions that support smallholder farmers' adoption of SAPs by lowering the cost of necessary technological inputs, such as access to improved seeds and biofertilizers (Raimi et al., 2017).

Against the backdrop of the post-fuel subsidy era, this study analyses various avenues for the development of SAPs and poverty alleviation among smallholder farmers in Plateau State. By investigating socioeconomic aspects, adoption determinants, and potential policy levers to improve SAP implementation, it seeks to offer insights to support agricultural sustainability and rural livelihoods. Sustainable agricultural practices (SAPs) have emerged as a key element in the fight against environmental degradation, poverty, and food insecurity that Nigerian smallholder farmers face. It is impossible to overstate how important these farmers are to the country's food supply, but they also face many obstacles, such as limited access to resources, financial limitations, and climate variability (Fan & Rue, 2020; Oyetunde-Usman *et al.,* 2020).

By increasing input costs and restricting farmers' access to SAPs, which have been shown to promote crop resilience and productivity, the federal government of Nigeria's recent policies eliminating fuel subsidies have imposed further financial strain on farmers. Ani et al., 2021; Siddig *et al.,* 2014). These issues are particularly evident in Plateau State, where over 90% of smallholder farmers do not have access to loans, extension services, or reasonably priced agricultural supplies. In order to tackle poverty and food insecurity in this region of the world, farmers are ill-prepared to implement sustainable practices (Igwe, 2019). Notwithstanding these obstacles, SAPs present a chance to raise household incomes, increase farm yields, and strengthen climate change resistance. While protecting natural resources, techniques like low tillage, mixed cropping, and organic farming can boost agricultural output

(Ume *et al.,* 2023). The use of these techniques is, however, constrained by socioeconomic and infrastructure issues, and the elimination of fuel subsidies exacerbates the problem by denying farmers access to reasonably priced seeds, fertilizer, and mechanization equipment (Adegbite & Machethe, 2020). The goal of this study was to promote SAPs and reduce poverty among Plateau State's smallholder farmers in the years following fuel subsidies. By identifying critical hurdles to SAP adoption and investigating solutions to minimize economic shocks, the research intends to give practical insights for policymakers to encourage sustainable agricultural development and improve the livelihoods of rural farming communities. Therefore, based on the aforementioned, the following particular objectives were developed: i. describe the socioeconomic characteristics of smallholder maize farmers in the study area, ii. identify the sustainable agricultural practices adopted by smallholder maize farmers in the study area, iii. determine the poverty status of the smallholder maize farmers in the study area, iv. estimate the relationship between sustainable agricultural practices and poverty status of maize farmers in the study area and v. identify the challenges faced by maize farmers in adopting sustainable agricultural practices.

METHODOLOGY

Study Area

Central Nigeria's Plateau State is known for its varied scenery and ideal climate. It is located between 8° 17' N and 11° 55' N latitude and 8° 10' E and 10° 35' E longitude. For the most part, the working population is made up of smallholder farmers. The Berom, Hausa, Fulani, and Birom are among the prominent tribes that call the state home. The state's economy is centered on agriculture, and these hard-working farmers from various tribes are essential to advancing agricultural activity and providing for a large number of families. With year-round average temperatures between 18°C and 25°C, the state has a temperate climate. For a variety of agricultural activities, this pleasant weather provides the perfect setting.

The rainy season, which runs from April to October, brings heavy rainfall to the state. The ground is enriched and there are plenty of water resources for agriculture thanks to the 1,200–1,800 millimeters of rainfall that fall on average each year.

Apart from agriculture, the state's primary activities are raising cattle, mining solid minerals, commerce, and handicraft. Members of several tribes participate in these varied economic endeavours, which support the region's thriving economy. Maize, millet, sorghum, rice, cassava, potatoes, and Acha (Hungary rice) are some of the main crops cultivated in Plateau State. Farmers from different tribes grow these basic crops, which are essential for the farming communities' revenue and sustenance. Additionally, growing a variety of fruits, vegetables, and legumes is part of the state's agricultural diversity.

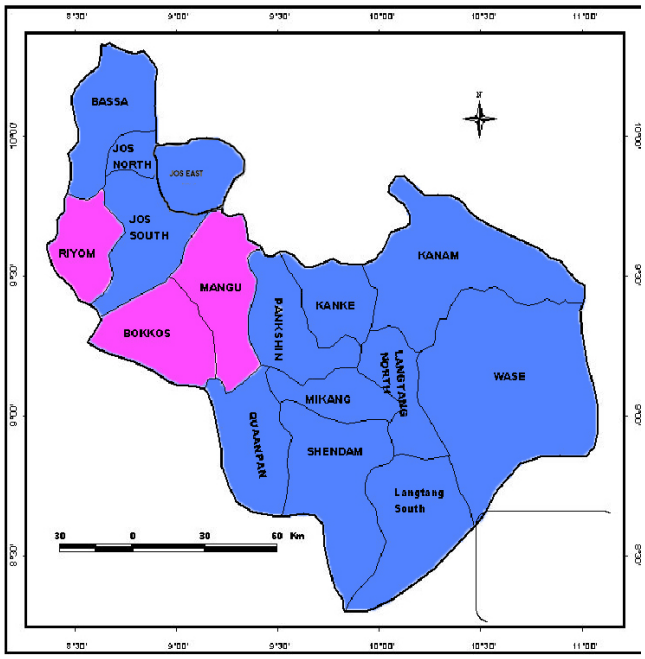

Figure 1 showing the map of Plateau state

Sampling Technique and Sample Size

To choose a representative sample of the 210 smallholder maize farmers in the study area, this study used a multistage sampling technique. The sample procedure was created to reduce selection bias and improve the findings' applicability to the region's larger population of maize farmers. Three Local Government Areas (LGAs), Mangu, Barkin Ladi, and Riyom, were purposefully chosen from the 17 LGAs in Plateau State for the first stage due to their high capability for maize production. The Plateau State Agricultural Development Programme's (PADP) agricultural production data was used to identify these LGAs. With expert consultations, guaranteeing that the chosen LGAs are the top three maize-producing LGAs and appropriately represent the state's maize agricultural dynamics. Alignment with the study's focus on regions with substantial maize agriculture was guaranteed by this intentional selection. Two communities were chosen at random from each of the three LGAs for the second stage, making a total of six communities. A list of every community in each LGA that grows maize was created using data from the local agricultural extension offices. To ensure that a variety of farming methods and environmental conditions were represented in each LGA, random selection was carried out using a random number generator to remove bias in community selection.

In the third stage, smallholder maize farmers were sampled from the six selected communities, with sample sizes proportional to the maize production output of each LGA. Based on PADP data, Mangu LGA contributed the highest maize output, followed by Barkin Ladi and Riyom. Accordingly, 90 respondents were selected from Mangu, 70 from Barkin Ladi, and 50 from Riyom, totaling 210 farmers. Within each community, farmers were identified using updated farmer registries maintained by community leaders and extension agents. Systematic random sampling was applied to select respondents from these registries, ensuring an unbiased representation of the farming population. Eligibility criteria included being a smallholder farmer (cultivating $\leq$5 hectares) actively engaged in maize production for at least three years.

Data Collection

Only primary data were used in the study. To ensure precise communication and high-quality

responses, data was gathered using questionnaires that were administered by skilled enumerators who were proficient in the local languages. The questionnaires gathered detailed data on income levels, adoption of sustainable agricultural practices (SAPs), farm-level practices (e.g., crop varieties, irrigation use), demographics (e.g., age, gender, education), and food security indicators (e.g., household dietary diversity, food access challenges). Enumerators received two days of instruction on data recording, ethical issues, and questionnaire delivery to improve reliability. The instrument was validated in a pilot test in a non-sampled group, with modest modifications made to enhance clarity and cultural relevance.

Analytical Technique

The following analytical techniques will be employed to achieve the objectives of the study. Descriptive statistics, 5-point likert scale, Multidimensional poverty index and logit regression model.

Model specification

The mathematical model can be represented as follows:

Binary Logit Regression Model

The research area's household food security and food price volatility were examined using a binary logit regression model (objective 4). The logit (logistic) regression model, as used by Omonona & Agoi (2007), was used to ascertain the association between the households' food price volatility and their food security status. It is said as follows:

$$\text{Ln}(i) = \ln(Pi/1-Pi) = Zi \quad \text{----------} \quad (1)$$

From the general model as specified in (4) above,

$$Zi = \beta 0 + \beta i\, Xi + \mu i \quad \text{----------} \quad (2)$$

Where i = 1, 2, 3 … 10.

The equation (5) above can thus be rewritten as;

$$\text{Ln}(i) = \ln(Pi/1-Pi) = \beta 0 + \beta i Xi + \mu i \quad \text{----------} \quad (3)$$

The explicit Logit model is expressed as:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots\ldots + \beta 10X10 + \mu \quad \text{-----} \quad (4)$$

Where;

Y = Multidimensional Poverty status (0 if poor and 1 if non-poor).

X_1 = Sustainable Agric. Practices (adoption index).

X_2 = Age of Respondent (years).

X_3 = Marital status (Married = 1; Singles = 0).

X_4 = Gender (Male = 1; Female = 0

X_5 = Household Size (numbers).

X_6 = Educational level of Household head (years)

X_7 = Farming Experience (Years).

X_8 = Farm size (Ha).

X_9 = Annual non-farm income (₦)

X_{10} = Access to credit (Access = 1; No access = 0)

μ = Error term.

$\beta 0$ = Constant term i.e. the value of Y when all independent variables equal zero. $\beta 1 - \beta 10$ = Coefficients to be estimated. This was used to achieve objective 4 of the study.

Multidimensional Poverty Index (MPI)

In 2010 the UNDP introduced the new Multidimensional Poverty Index (MPI) for measuring and describing household-level poverty. The dimensions are Education, Health and Standard of Living and the 10 indicators were intended to capture the MDGs. It was used to achieve objective 3 of this study. Below are the assessment criteria for being deprived i.e. poor:

Table 1; Multidimensional poverty Index (MPI) indicators

1. **Education** (each indicator is weighted equally at 1/6)	i.	Years of Schooling: deprived if no household member has completed five years of schooling
	ii.	School Attendance: deprived if any child failed attending school in years 1 to 8
2. **Health** (each indicator is weighted equally at 1/6	i.	Child Mortality: deprived if any child has died in the family
	ii.	Nutrition: deprived if any adult or child for whom there is nutritional information is malnourished

3.	1.	**Standard of Living** (each indicator is weighted equally at 1/18)	i. Electricity: deprived if the household has no electricity ii. Drinking Water: deprived if the journey to clean drinking water or clean water is more than 30 minutes' walk from home iii. Sanitation: deprived if they do not have adequate sanitation or their toilet is shared iv. Flooring: deprived if the household has a dirt, sand or dung floor Cooking Fuel: deprived if the household cooks with wood, charcoal or dung Assets: deprived if the household does not own more than one of: radio, TV, telephone, bike, motorbike, or refrigerator and do not own a car or tractor.

Source; Alkire, S.; Santos, M.M, 2010.

A person is multi-dimensionally poor if he/she experiences deprivation in at least 30% of the weighted indicators. One deprivation alone does not represent poverty.

Alkire and Foster

The MPI combines two aspects of poverty;

i. Incidence (H): the headcount ratio

H =q/n

=% of poor people

Where; q=number of multidimensional poor people; n= the total population

ii. Intensity (A): Deprivation in the indicators

A = Σ^n=1 Ci (k)/q

=% deprivation in the indication

Where; Σ^n=1 = summation of deprivation;

C_i = Censored deprivation score;

C_i = indicators weight

Individual or household is poor, if;

$C_i \geq 1/3$ (0.333) = Yes

$C_i \leq 1/3$ (0.333) = No

Therefore, MPI = H*A

H×A= % deprivation in the weighted indicators by the total population.

Likert scale

A Likert scale, as defined by Bhattacharya (1993), was used to gauge people's opinions regarding the elimination of gasoline subsidies. The following responses are scored on a 5-point scale: Strong disagreement (score of 1) suggests that the responder has risk aversion and is willing to use the risk management technique in question. Conversely, significant agreement (score of 5) denotes a willingness to take chances. Alternative responses that fell between the two extremes were agreement (score of 4), disagreement (scoring of 2), and undecided/neutral (score of 3). To prevent response bias, the schedule was administered with both positive and negative phrases. This served to accomplish goals one, two, and three. The questions attended by the respondents included; i. Lack of awareness and technical knowledge, ii. Limited access to credit and funding, iii. Land tenure insecurity, iv. climate change and unpredictable weather patterns, v. Low prices for produce, vi. High initial cost, vii. Cultural and traditional beliefs, viii. Poor infrastructure, and ix. Lack of government support or initiatives.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Smallholder Farmers in the Study Area

According to Table 1's results, farmers are 52 years old on average, with a sizable percentage roughly one-third, or 33%—falling between the ages of 50 and 59. An ageing farming population is highlighted by this trend, which may have long-term effects on agricultural sustainability and production. The prevalence of elderly farmers points to a possible drop in young people's involvement in agriculture, which could be brought on by rural-urban migration, a lack of incentives, or a preference among younger generations for non-agricultural jobs. If left unchecked, this demographic transition could make it difficult to maintain farming businesses, especially when it comes to implementing contemporary and sustainable farming methods.

The fact that a sizable percentage of farmers are elderly raises concerns about the ageing farming

community, as this stands in contrast to international standards where youth participation spurs innovation and productivity (John, 2025).

The fact that 85% of farmers are married further supports the idea that household dynamics and family obligations may be important factors in determining agricultural choices. Married farmers might have more financial obligations, which could affect their decisions about risk-taking, farm investments, and the adoption of sustainable farming methods. Furthermore, family and spouse participation in farming may increase labour availability and overall productivity, but it may also result in financial resources being spread across several demands, which could limit reinvestment in farm upgrades. Married farmers may prioritise household expenses above farm investments, which could influence savings behaviour. This conclusion is consistent with that of Folorunso *et al.,* (2023) who reported that 50.6% of the respondents were married.and Isiorhovoja *et al.* (2020) who also reported a high percentage of married respondents. Agriculture is gender sensitive and necessitates the use of physical power. With 76% of farmers being men and only 24% being women, there is a notable gender gap in the farming industry. This disparity draws attention to the ongoing gender inequality in land ownership, financing, extension services, and agricultural resources. Despite their vital role in food production and household nutrition, women frequently encounter obstacles such restricted access to agricultural training programs, financing, and land. This result is consistent with research by Folorunso & Bayo (2024) who examined the **efficiency** of labour use among maize farming households in Shendam LGA., plateau state, Nigeria and found out that 75.82% of maize farmers in the studied area were males while women made up the 24.18% of the remaining population. This clarifies that the male preponderance in farming operations may be ascribed to the laborious and difficult nature of the varied farm. The claim that women frequently encounter difficulties obtaining financing is supported by Isiorhovoja *et al.* (2020), who reaffirmed the notion that financial limitations disproportionately impact female farmers, aggravating gender-based disparities in agriculture, property ownership, and financial services, which can limit their capacity to save and invest in farm upgrades. With an average household size of five, the majority of farmers (98%), have between one and ten individuals. Because bigger families may have more family members available to help with farming tasks, lowering dependency on hired labour, household size is an important factor of labour availability for farm operations. Larger households, however, also entail higher household spending demands, which may put pressure on farmers to raise output or implement income-diversification techniques in order to support their families.

Furthermore, guaranteeing the food security of households becomes a top issue, highlighting the necessity of effective resource allocation, increased productivity, and availability of sustainable farming methods. By demonstrating how household size influences savings attitudes, which in turn shapes agricultural investment decisions and economic resilience, this study supports that of Isiorhovoja *et al.* (2020).

Technology adoption and agricultural decision-making are significantly influenced by education. According to the data, only 8% of farmers lack formal education, 33% have completed secondary school, and 48% have tertiary education. This suggests that farmers have a comparatively high literacy rate, which offers a chance to improve training and knowledge sharing on sustainable farming methods. Higher educated farmers are more likely to use contemporary farming methods, participate in agriculture, and use digital tools to increase market access and productivity. The notion that educated farmers are more likely to incorporate contemporary climate-smart technologies, use digital tools, and participate in agribusiness is supported by Oyewole & Ojeleye (2015) and Akinyemi *et al.* (2021), who highlight the role of education in encouraging technology adoption.

Another important component affecting farm productivity and flexibility in response to

shifting agricultural conditions is experience. According to the findings, 31% of farmers have between 21 and 30 years of experience, with an average of 27 years. This implies that the majority of farmers are quite skilled and have a wealth of traditional knowledge about crop management, climate variability, and agricultural systems. Even while experience is important, people may be resistant to change, particularly when switching from traditional to more environmentally friendly farming practices. This result is consistent with that of Okonji and Awolu (2020), who found that seasoned farmers had a wealth of traditional knowledge that aids in their efficient management of crop output and climate unpredictability.

Table 1: Socioeconomic characteristics of smallholder farmers in the study area

Variables	Frequency	Percentage
Age		
20-29	10	5
30-39	16	8
40-49	56	27
50-59	70	33
60-69	55	26
70-79	3	1
Total	210	100
Mean	52	
Standard deviation	10.927	
Marital Status		
Divorced	8	4
Married	179	85
Single	9	4
Widowed	14	7
Total	210	100
Sex		
Female	50	24
Male	160	76
Total	210	100
Household size		
1-10	205	97.6
11-20	4	1.9
21-30		
31-40	1	0.5
Total	210	100
Mean	5	
Standard deviation	2.974	
Educational Level		
No Formal Education	13	6
Primary	26	12
Secondary	70	33
Tertiary	101	48
Total	210	100
Farming experience		

1-10	22	10
11-20	48	23
21-30	65	31
31-40	50	24
51-60	25	12
Total	210	100
Mean	28	
Standard deviation	16.730	

Source: Field survey, 2024.

Only 1% of farmers oversee large farms between 20.00 and 24.00 hectares, according to Table 1, whereas 74% of farmers own small to medium-sized farms, which range in size from 1 to 5.99 hectares. With an average farm size of 3 hectares, majority of farmers are smallholders, who frequently deal with issues including restricted access to mechanization, limited economies of scale, and diminished negotiating power in input procurement and product marketing. Policies that increase smallholder farmers' resilience by providing them with access to better seeds, fertilizers, irrigation systems, and extension services are necessary because they are frequently more susceptible to market volatility, climate variability, and growing production costs. This is in line with Anderson *et al.* (2017), who highlight that most Nigerian farmers work on tiny farms, usually smaller than 5 hectares, and face obstacles such poor market connections, low economies of scale, and restricted access to mechanization. According to the data on income distribution, 32% of farmers make between ₦400,000 and ₦699,000 per year from farming, while just 11% make ₦1,000,000 or more, with an average of ₦603,742.86 each year. With an average yearly non-farm income of ₦437,447.62, 35% of people earn between ₦100,000 and ₦399,000, while only 8% make ₦1,000,000 or more. This implies that although farming continues to be the main source of income, non-farm revenue is crucial to the financial security of households acting as a safeguard against hazards associated with agriculture, such as crop failures, shifting market prices, and growing input costs. While farmers with minimal income diversification may find it difficult to implement innovations due to financial restrictions, those with larger non-farm income may have the financial capacity to invest in sustainable practices, agro-processing, or new technologies. This finding is consistent with Anderson *et al.* (2017), who point out that many farmers use their off-farm income to augment their agricultural earnings and emphasize the importance of non-farm income as a financial cushion for smallholders.

Table 1 shows that whereas 57% of farmers have access to funding, 43% do not. This illustrates how important financial inclusion is for encouraging investments in farms, input purchases, and operational efficiency.

It could be challenging for farmers without access to capital to scale their operations, embrace new technologies, or adopt climate-smart farming methods. High interest rates, strict collateral requirements, a lack of financial understanding, or cumbersome loan application procedures can all be obstacles to credit availability. Since many smallholders struggle with high interest rates, a lack of collateral, and complicated loan application procedures, Anderson *et al.* (2017) identified inadequate credit access as a major obstacle to agricultural investments. This finding is consistent with their findings.

The findings show that 42% of farmers are not affiliated with any cooperative organization, whereas 58% of farmers are members of cooperative organizations. Cooperatives are essential for expanding access to high-quality inputs, strengthening farmers' collective bargaining power, offering extension services, and fostering stronger market connections. Cooperative members frequently enjoy the advantages of common agricultural knowledge,

cheaper bulk input purchases, and simpler access to government assistance programs and loans. The 42% who choose not to join cooperatives, however, might have to deal with increased expenses, poorer market placement, and restricted access to important agricultural resources. This result supports Anderson *et al.* (2017), who emphasized the importance of cooperative organizations in helping smallholders gain access to market possibilities, extension services, and inputs.

Table 1: Socioeconomic characteristics of smallholder farmers in the study area cont'd

Variables	Frequency	Percentage
Farm size		
less than 1.00	20	9.5
1.00-5.99	155	73.8
6.00-10.99	25	11.9
11.00-14.99	6	2.9
15.00-19.99	3	1.4
20.00-24.00	1	0.5
Total	210	100
Mean	4	
Standard deviation	3.361	
Farm income		
less than 100000	60	29
100000-399000	34	16
400000-699000	67	32
700000-999000	25	12
1000000 and above	24	11
Total	210	100
Mean	603742.86	
Standard deviation	986569.8	
Non-Farm income		
less than 100000	42	20
100000-399000	73	35
400000-699000	59	28
700000-999000	20	10
1000000 and above	16	8
Total	210	100
Mean	437447.62	
Standard deviation	757733.65	
Access to Credit		
No	90	43
Yes	120	57
Total	210	100
Cooperative society		
No	88	42
Yes	122	58
Total	210	100

Source: Field survey, 2024.

Sustainable Agricultural Practices Adopted by Smallholder Farmers

According to Table 4, 35% of farmers adopted sustainable agriculture practices seldom, as

indicated by a grand mean score of 1.73 on a 5-point Likert scale. This implies that methods like rainwater collection, terracing, agroforestry, crop rotation, mulching, drought-tolerant crop types, integrated pest control, intercropping, crop rotation, and minimum/conservation tillage are not commonly used. Efforts to increase agricultural resilience, boost productivity, and reduce poverty may be hampered by the low adoption rate, which suggests that sustainability concepts are not fully integrated into farming systems. This result supports the findings of Oyewole & Sennuga (2020), who found that institutional obstacles hinder farmers' ability to adopt sustainable agricultural techniques, which may exacerbate rural poverty and food insecurity.

Table 4: Sustainable agricultural practices adopted by smallholder farmers

	Sustainable agricultural practices adopted								
Variable	N	R	S	O	A	Mean	Std. dev.	%	Decision
Use of Organic Manure	63	117	7	17	6	1.98	0.958	40	Low frequency
Intercropping	50	130	14	15	1	1.99	0.798	40	Low frequency
Crop Rotation	93	96	4	15	2	1.75	0.879	35	Low frequency
Mulching	136	55	16	1	2	1.47	0.739	29	Low frequency
Drought-Tolerant Crop Varieties	52	132	9	16	1	1.96	0.8	39	Low frequency
Integrated Pest Management	60	123	8	16	3	1.95	0.871	39	Low frequency
Terracing	117	66	20	7		1.61	0.795	32	Low frequency
Agroforestry	124	60	12	13	1	1.61	0.886	32	Low frequency
Rainwater harvesting	145	48	11	5	1	1.42	0.743	28	Low frequency
Minimum/Conservation Tillage	106	88	11	3	2	1.61	0.739	32	Low frequency
Grand mean						1.73		35	Low frequency

Note: N= Never, R= Rarely, S= Sometimes, O= Often, A= Always. Mean value of 1.00-2.49= Low Frequency, 2.50-3.49= Moderate Frequency, 3.50-5.00= High Frequency

Poverty Status of the Farmers

Table 5 shows that the Multidimensional Poverty Index (MPI) for male-headed households (HHs) was 0.229, with a Headcount Ratio (H) of 60.0% and an Intensity (A) of 38.2%, whereas the MPI for female-headed HHs was 0.331, with a Headcount Ratio of 58.0% and a higher Intensity of 57.0%. Male-headed households are not considered multidimensionally poor when the poverty threshold (MPI $\geq$ 0.333) is applied, while female-headed households are borderline but still below the poverty level. Despite this, HHs headed by women suffer from higher levels of poverty, especially in terms of living standards deprivation (33.1%), while having lower levels of health (10.0%) and education (6.0%) than HHs headed by men. According to the findings, multidimensional poverty affects both male- and female-headed households, but to differing degrees and in different ways. Female-headed families endure a much higher intensity of poverty, meaning that individuals living in poverty confront greater deprivation in a variety of ways, but male-headed households have a somewhat higher incidence of poverty (headcount ratio). Despite having a somewhat lower headcount ratio, research shows that households led by women experience greater poverty, especially in terms of living standards deprivation. In contrast to their male-headed peers, they show less disadvantage in terms of health and education. In a similar vein, the analysis shows that farmers who adopted improved practices had a Headcount Ratio of 23.8% and an Intensity of 25.0%, resulting in a Multidimensional Poverty Index (MPI) of 0.060, while non-adopters had significantly higher

levels of poverty, with a Headcount Ratio of 63.5%, an Intensity of 55.1%, and an MPI of 0.350. According to the poverty classification threshold (MPI ≥ 0.333), adopters are not multidimensionally poor, while non-adopters are classified as multidimensionally poor. Additionally, non-adopters are more deprivation in terms of living standards (53.1%), health (17.8%), and education (10.7%) than adopters, who have lower levels of deprivation in these areas.

Because farmers that implement improved agricultural methods have far lower headcount poverty, intensity, and total MPI scores than non-adopters, the data indicates that adopting these practices is highly connected with lower multidimensional poverty. It suggests that a lack of improved methods may contribute to these farmers' ongoing poverty because non-adopters are more susceptible to multidimensional poverty and suffer from more deprivation in terms of living standards, health, and education. This study demonstrates that although female-headed families have a lower incidence of poverty, they frequently experience deeper poverty intensity, supporting similar findings found in Obayelu *et al.* (2023) and Abasilim *et al.* (2024). Similarly, Orji *et al.* (2020) study provides empirical support for the claim that farmers who do not adopt improved agricultural practices are more vulnerable to multidimensional poverty, particularly in living standards, health, and education.

Table 5: Poverty status of smallholder farmers

Group	Headcount Ratio (H) %	Intensity (A) %	MPI (H × A)	Health Deprivation %	Education Deprivation %	Living Standards Deprivation %
Male-headed HHs	60.0	38.2	0.229	15.5	8.3	32.2
Female-headed HHs	58.0	57.0	0.331	10.0	6.0	33.1
Adopters	23.8	25.0	0.060	6.7	13.3	26.2
Non-adopters	63.5	55.1	0.350	17.8	10.7	53.1
Overall	51.3	43.8	0.225	12.5	9.6	36.2

Relationship between Sustainable Agricultural Practices and Poverty Status

There is a solid overall model fit, according to table 6's results from the Logit regression model evaluating the association between poverty levels, sustainable farming practices, and other important explanatory factors. With a p-value of 0.000 and a Wald chi-square value of 70.519, it is confirmed that the independent factors taken together significantly affect poverty levels. The pseudo-R-squared value of 0.57 implies that the model explains 57% of the variation in the dependent variable, demonstrating a respectable level of explanatory power for a logistic regression. Furthermore, the model's goodness-of-fit is indicated by the log pseudo-likelihood value of -104.5; a comparatively lower likelihood function value indicates that the calculated parameters increase prediction accuracy.

With a marginal effect of 0.021 and an odds ratio of 0.878, the results show that implementing sustainable farming methods greatly lowers poverty, as evidenced by the negative and significant coefficient at the 10% level. According to this, farmers that practice sustainable farming methods including organic soil management, agroforestry, and conservation farming are less likely to be classified as being in greater poverty levels. This may be explained by the long-term financial advantages of sustainability, which include increased yields, enhanced soil fertility, and resilience to climate shocks—all of which enhance livelihood outcomes. This result is consistent with Mugula *et al.* (2023), which shows that smallholder maize farmers' food security, nutrition, and poverty reduction are greatly enhanced by the implementation of sustainable agricultural practices (SAPs).

Similar to this, larger households appear to be more susceptible to poverty, as indicated by the negative and significant coefficient of household size at the 10% level (odds ratio 0.947, marginal impact 0.009). This might be because more dependents mean more money to feed, educate, and care for, which could put a strain on household finances. A bigger family may also result in land fragmentation in agricultural households, which lowers productivity and per capita land access. Larger families are more susceptible to poverty because of their greater financial obligations, according to the findings of Dia *et al.* (2023) whose findings indicated that household size had a negative impact on poverty status.

However, at the 10% level, farming experience shows a positive and significant effect (odds ratio 1.000, marginal effect 0.034), suggesting that farmers with more years of experience had a lower likelihood of living in poverty. It's possible that seasoned farmers have improved their farming techniques, adjusted to market changes, and established more robust networks for gaining access to markets, resources, and loans. This research supports the findings of Abdulsalam et al. (2024), who found that agricultural experience had a substantial impact on poverty status, with more experienced farmers having a lower likelihood of being impoverished.

Additionally, at the 10% level, farm size shows a negative and substantial influence (odds ratio 0.914, marginal effect 0.014), indicating that farmers who own smaller landholdings are more likely to be poor. Given that larger farms offer more chances for mechanization, diversification, and economies of scale, which raise productivity and revenue, this finding reaffirms the critical role that landholding size plays in economic stability. This result is in line with Dia *et al.* (2023) who found out that poverty status was positively impacted by farm size, indicating that greater landholdings allow for economies of scale and higher income.

The importance of farm revenues in raising living standards is demonstrated by the positive and substantial correlation between annual farm income and poverty reduction at the 10% level (odds ratio 1.000, marginal effect 0.055). Higher farm revenues enable households to invest in productivity-boosting technologies, purchase necessities, and strengthen their financial stability in the face of economic crises.

This finding is consistent with Olorunsanya (2016), who found that higher farm income was linked to better welfare and lower levels of poverty among farming households.

At the 1% level, access to credit is noteworthy because it is strongly positive and significant (odds ratio 1.558, marginal effect 0.422), suggesting that farmers who have access to credit are much less likely to live in poverty. Because access to finance allows farmers to invest in new seeds, fertilizer, irrigation systems, and other productivity-enhancing inputs, this study emphasizes the significance of financial inclusion in agricultural growth. This study concurs with Olorunsanya (2016) and Osabohien *et al.* (2020), demonstrating that access to financial resources empowers farmers to boost productivity, raise incomes, and better their overall welfare.

Table 6: Logit regression of the relationship between sustainable agricultural practices and poverty levels

Variable	Coef.	Std. Err.	T-value	Odds Ratio	Marginal effects
Constant	2.090	1.218	1.716	0.134	
Sustainable practices	-0.130*	0.070	-1.857	0.878	-0.021
Age	0.033	0.027	1.222	1.033	0.005
Marital status	0.048	0.220	0.218	1.049	0.008
Gender	-0.515	0.498	-1.034	0.597	-0.083
Household size	-0.059*	0.034	-1.735	0.947	-0.009
Education	0.016	0.044	0.364	1.016	0.003

Farming experience	0.210*	0.124	1.695	1.000	0.034
Farm size	-0.089*	0.048	-1.854	0.914	-0.014
Annual farm income	2.990*	1.600	1.869	1.000	0.055
Annual non-farm income	-2.799	1.900	-1.473	1.000	0.005
Access to credit	2.607***	0.463	5.631	1.558	0.422
Number of observations	210				
Wald $chi^2(11)$	70.519				
Pseudo r-squared	0.57				
Prob > chi^2	0.000				
Log pseudo likelihood	-104.5				

*Note: *** and * represent 1% and 10% levels of probability*

Challenges Faced by the Farmers in Adopting Sustainable Agricultural Practices

It is evident from Table 7 that farmers encounter a number of obstacles while using sustainable farming methods. 38% and 40% of farmers, respectively, cited low hurdles for land tenure insecurity (mean = 1.99), restricted access to credit and funding (mean = 1.98), and lack of awareness and technical expertise (mean = 1.91). Meanwhile, 52% of farmers reported a lack of government incentives or support (mean = 2.61), 53% reported insufficient infrastructure (mean = 2.63), and 58% reported climate change and unpredictable weather patterns (mean = 2.58) as moderate hurdles.

This illustrates the degree to which various obstacles impede the adoption of sustainable farming techniques, demonstrating that certain obstacles are thought to be less severe than others. Implying that although problems like awareness, finance, and land ownership are acknowledged as barriers, farmers face more significant hurdles from broader systemic issues like infrastructure, government assistance, and climate variability. These results corroborate those of Udousung *et al.* (2019) and Ekpa *et al.* (2021), who found that although awareness, financial access, and land tenure security are important barriers, more significant obstacles to implementing sustainable agricultural practices are caused by larger systemic issues like inadequate infrastructure, little government assistance, and climate variability.

Table 7: Challenges faced by smallholder farmers in adopting sustainable agricultural practices

Variable	Challenges								
	B1	B2	B3	B4	B5	Mean	std. dev.	%	Decision
Lack of awareness and technical knowledge	68	100	36	4	2	1.91	0.808	38	Low barrier
Limited access to credit and funding	62	103	35	7	3	1.98	0.853	40	Low barrier
Land tenure insecurity	76	84	37	2	11	1.99	1.026	40	Low barrier
Climate change and unpredictable weather patterns	36	82	78	4	10	2.58	0.952	52	Moderate barrier
Low prices for produce	37	83	84	1	5	2.51	0.849	50	Moderate barrier
High initial cost	31	70	98	5	6	2.55	0.875	51	Moderate barrier
Cultural and traditional beliefs	102	47	55	2	4	1.85	0.969	37	Low barrier
Poor infrastructure	19	60	117	7	7	2.63	0.826	53	Moderate barrier
Lack of government support or incentives	19	64	115	3	9	2.61	0.841	52	Moderate barrier
Grand mean						2.29		46	Low barrier

Note: B1= Not a barrier, B2= Minor barrier, B3= Moderate barrier, B4= Significant barrier, B5= Severe barrier. Mean value of 1.00-2.49= Low barrier, 2.50-3.49= Moderate barrier, 3.50-5.00= High barrier.

Conclusion and Recommendations

The findings highlight key structural challenges in Nigerian agriculture, with farmers predominantly middle-aged males operating small to medium-sized farms, facing limited access to credit and moderate education levels, which constrain productivity. The removal of fuel subsidies significantly increased input costs, leading to higher production expenses and reduced return on investment despite a slight improvement in absolute profit margins. While sustainable agricultural practices have the potential to alleviate multidimensional poverty, their adoption remains low due to financial barriers, poor infrastructure, and inadequate technical support. Farmers employ various coping strategies, relying on off-farm income and cooperative societies; however, cost-reducing methods such as irrigation reduction are underutilized, underscoring the need for targeted interventions to enhance resilience and sustainability. Based on the finding of the study, the following recommendations were made: i. Farmers should diversify income sources through non-farm activities, leverage cooperative societies for input bulk purchases, and gradually adopt sustainable agricultural practices to improve resilience and reduce poverty; ii. Strengthening cooperative societies, promoting farmer education, and encouraging knowledge-sharing on sustainable practices can enhance food security and economic stability within farming communities; and iii. Policies should focus on expanding access to credit, investing in rural infrastructure, and providing targeted subsidies or incentives for sustainable farming to mitigate the negative effects of fuel subsidy removal and foster long-term agricultural growth.

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