

<https://doi.org/10.33003/jaat.2025.1103.19>

## EFFECTS OF CLIMATE SMART AGRICULTURAL PRACTICES ON POVERTY STATUS OF STAPLE CROP FARMERS IN NORTH EAST, NIGERIA

Jonah Labaga<sup>1</sup>, H. S. Umar<sup>2</sup>, S. I. Audu<sup>2</sup>, O. E. Galadima<sup>2</sup>, H. I. Ibrahim<sup>3</sup>, Emmanuel Peter<sup>4</sup>

<sup>1</sup>Department of Agricultural Economics & Extension, Faculty of Agriculture, Federal University of Agriculture, Mubi, PMB 2025, Mubi, Adamawa State.

<sup>2</sup>Department of Agricultural Economics & Extension, Faculty of Agriculture, Nasarawa State University, Keffi, PMB 135, Shabu-Lafia, Nigeria

<sup>3</sup>Department of Agricultural Economics, Faculty of Agriculture, Federal University Dutsin-Ma, Kastina, Nigeria

<sup>4</sup>School of Biosciences, Department of Agriculture and Environmental Sciences, University of Nottinham, United Kingdom, LE12:5RA

Corresponding Author: Email: [labrosjonah@gmail.com](mailto:labrosjonah@gmail.com), Tel.:08036017640

### ABSTRACT

The study analyzed effects of climate smart agricultural practices on poverty status of staple crop farmers in North East, Nigeria. A Multistage sampling technique was used to select a sample size of 390 for the study. The primary data used were collected with the aid of structured questionnaire. The data were analyzed using descriptive statistics, Adaptation Strategy Use Index (ASUI), Probit regression models and Principal Component Analysis. The socio-economic characteristics result showed majority (67.2%) of respondents were male and large proportion (61%) married. The study revealed crop rotation (2.59), mulching (2.55), irrigation (2.48), crop diversification (2.29), and use of fadama land(wetland) (2.21) were the frequently adopted climate smart agricultural practices. The study revealed a significant relationship between Climate Smart Agricultural Practices (CSAP) and poverty status of the staple crop farmers with a Chi-Square Probability (0.0000) which was less than the alpha value (0.05). The study concludes that CSAP has significant influence on poverty status of the staple crop farmers. Lack of awareness of CSAP, and insecurity on the farm are the main constraints limiting the adoption of CSAP. The study recommends that Government, extension services and local authorities should step-up climate smart agricultural practices awareness drive, strengthen farm security measures, and provide adequate storage facilities to enhance CSAP adoption.

**Keywords:** *Climate-Smart, Poverty, Staple Crops*

### INTRODUCTION

Poverty is a state of lack of access to necessities of life such as food, shelter, and clothing (Alao *et al.*, 2020). From the income perspective, poor individuals can be referred to as persons who earn less than \$1.90 per day (World Bank, 2019). According to Ehinmowo *et al.* (2017), poverty is more prevalent among small-scale farmers and rural dwellers in developing countries, including Nigeria. Nigeria, according to Wagan *et al.* (2018), has a massive agricultural potential to produce variety of crops and which in turn can reduce poverty. To convert these agricultural potentials in Nigeria to poverty reduction mechanism among small scale farmers, Oni (2013) identified climate smart agricultural practices as the critical strategies. Onyeneke *et al.* (2021) estimated that a proportion of Nigeria's agricultural land is situated where climate related disasters are prevalent. Rapu (2016) reported that, changes in weather or atmospheric conditions, global warming, and greenhouse gas emissions, otherwise known as Climate Change, has negative consequences for agricultural production in developing countries which includes Nigeria. That is why there are global efforts and conventions to control the menace of climate change. One of such global efforts is the year 2016 United Nations Framework Convention on Climate Change (UNFCCC). Several countries subscribe to the UNFCCC to harmonize their policies to ensure that climate change does not adversely affect agricultural activities. Consequently, emphasis is now placed on CSA

(Climate Smart Agriculture) to checkmate the devastating effects of climate change on agricultural production. Mujeyi *et al.* (2021) defines Climate Smart Agriculture (CSA) as agricultural practices that sustainably increases agriculture production and farmers income, eliminates greenhouse gasses emission (mitigation) which heightens the accomplishment of national food security and reduced poverty among small scale farmers and rural dwellers. Baulch *et al.* (2010) reiterated that, agricultural experts and policy makers proposed the adoption of Climate Smart Agricultural practices with the view to combating the challenges of climate change such as poverty, food insecurity and environmental degradation. The Food and Agriculture Organization conceptualized CSA as an approach that helps in guiding actions to transform the agri-food systems towards climate resilient practices. Climate Smart Agricultural Practice aims to achieve three related goals namely, sustainable increase in agricultural production and incomes; enhancement in farmers' climate change adaptive capacity and resilience building; and reducing the emission of greenhouse gases (Kifle *et al.*, 2022). Common CSA practices according to Mujeyi *et al.* (2021) include: crop rotation, mulching, agro-forestry, use of organic manure, use of Fadama land (wetland), planting crop with early maturity, irrigation, intercropping, planting of cover crops among other practices continue to enhance the farmers ability to adapt to changing climate.

Climate change leaves many farmers vulnerable to poverty (Kijima and Seunkuuma, 2011). It is the major and most widespread challenge that poses a threat to agricultural production in the world and more importantly in developing countries including Nigeria. The challenge is more serious among economies that largely depend on agriculture and where agricultural production is mostly rain-fed and barely mechanized. Cline (2008) reported that Nigeria have relatively less capacity to curtail the negative impact and effect of climate change. It is against this backdrop that this study sought to determine the effect of climate smart agricultural practices on poverty status of staple crop farmers in North East, Nigeria. The study specifically sought to describe the socio-economic characteristics of staple crop farmers; identify the frequently adopted Climate Smart Agricultural Practices of staple crop farmers; determine the effect of climate smart agricultural practices on poverty status of the staple crop farmers; and identify the major constraints to adoption of climate smart agricultural practices by staple crop farmers.

### THEORETICAL FRAMEWORK

Kalu and Mbanasor (2023) identified CSA technologies adopted by root crop farmers as well as examined socio economic factors that influence the adoption these technologies among smallholder root crop farmers in South East, Nigeria. Using frequency distribution, the study found that the CSA technologies adopted by the root crop farmers in the study area include use of irrigation (12.62%), having diversity of production streams through livestock ownership (51.54%), crop rotation (87.03%) and use of improved crop variety (19.45%). The scope of the study was South East, Nigeria while this study was carried out in the Northeastern region of Nigeria.

A study was carried out by Ekpa *et al.* (2018) to identify the effect of climate smart agricultural practices on poverty status of maize rural farming household in Sokoto State, Nigeria. Multi-stage, sampling techniques was used to select three hundred and twenty (320) respondents who provided the relevant primary data for this study through a set of pre-tested structured questionnaires. The Instrumental Variable (IV) - probit regression model was used to ascertain the objective which is to examine the effect of CSAP on poverty status of the maize farming household. The principal component analysis was used to develop composite indices for the practice of CSA which includes: the use of organic manure, agro-forestry, conservation agriculture, integrated crops and livestock management, the use of improved varieties/hybrid of crops/animals and the use of irrigation for smallholder farmers. The regression analysis result shows that CSAP has effect on poverty status of maize rural farming household in Sokoto State were maize enterprises decreases the odds or probability of being poor significantly. The study only used five (5) climate smart

agricultural practices while this used twelve (12) climate smart agricultural practices to analyzed the effect of climate smart agricultural practices in North East, Nigeria.

### MATERIALS AND METHOD

#### Study Area

The North East is one of the six (6) geopolitical regions in Nigeria. It comprises six (6) States – Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe State. Geographically, the North East is the largest geopolitical zone in the nation, covering nearly one-third of Nigeria's total area. The region spans Latitude 6°28'N and 13°44'N and Longitude 8°44'E and 14°38'E of the Greenwich meridian (Ferdinand *et al.*, 2020). The region covers a land mass of about 272,395km<sup>2</sup> representing about 29.45 percent of the nation's total landmass. The area is bordered to Cameroon to the East, Niger Republic and Chad Republics to the North, North Central Nigeria to the West, and South Eastern Nigeria to the South.

The mean annual rainfall in the region varies from 290 cm<sup>3</sup> at Abadan in the far north of the zone to 1,125 cm<sup>3</sup> in the foothills of the Mandara Mountains near Mubi. The rain ceases rather abruptly at the end of September and the wind veers to the north to become what is known throughout West Africa as the Harmattan. The strength and regularity of this wind are in large part responsible for the encroachment of the desert sand along the northern borders of Borno and Yobe States. The most important crops grown are guinea corn, millet, cotton, groundnuts, and cowpea. However, yam, sweet potatoes, benni-seed and other minor grains are also grown for domestic use. The challenges facing agricultural production in this region include climate-related shocks and insecurity (Food and Agriculture Organization, 2021).

#### Sample and Data Collection

The target population for this study was the staple crop farmers in the North East, Nigeria. A multi-stage sampling technique was used to select the respondents for the study. In the first stage, three (3) States were purposively selected to include Yobe, Gombe and Adamawa. The reason for the purposive selection of the three (3) States bordered on the intensity of staple crops production. In the second stage, one (1) Local Government Area (LGA) was randomly selected using balloting from each of the three (3) agricultural zones of each of the three (3) States and that gave nine (9) LGAs used for the study. The random selection of the LGAs is to ensure that every LGA has an equal chance of been included in the sample for the study. The final stage involved simple random sampling technique using balloting to select 391 respondents from a sample frame of 18,403 registered staple crop farmers (Table 1).

**Table 1: Sampling frame of staple crop farmers in the study area**

S/No	State	Agricultural zone	Number of LGAs	LGA randomly selected	Sampling Frame	Random selection of the farmers
1	Yobe	East	6	Busari	2,066	44
		North	6	Bade	1,184	25
		South	5	Damaturu	1,282	27
2	Adamawa	Central	7	Fufore	3,288	70
		North	5	Madagali	2,674	57
		South	9	Guyuk	3,180	68
3	Gombe	Central	2	Akko	1,174	25
		North	5	Dukku	2,075	44
		South	4	Balanga	1,480	31
TOTAL					18,403	391

Source: Yobe, Adamawa and Gombe States Agricultural Programme, 2023

Primary data were collected using a structured questionnaire administered to 391 respondents although one (1) respondent did not return the questionnaire. The data collected include those on socio-economic characteristics of the staple crop farmers; frequently adopted climate smart agricultural practices among the staple crop farmers; and the constraints to climate smart agricultural practices of the staple crop farmers in the study area. Data collection took place between July and August, 2024.

**Measures**

**Probit Regression Model**

The Probit Regression Model was employed in this study to examine the effect of Climate Smart Agricultural Practices (CSAPs) on the poverty status of staple crop farmers in the study area. This approach was adapted from Nazifi *et al.* (2024), who used the Probit Regression Model to analyze the adoption of CSAPs and its effect on smallholder farming households in North-Western Nigeria. The dependent variable in the model was binary, where "1" indicated non-poor staple crop farmer and "0" indicated poor staple crop farmer.

The Probit Regression Model was explicitly specified as follows:

$$Y = \alpha + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + X_6\beta_6 + X_7\beta_7 + X_8\beta_8 + X_9\beta_9 + X_{10}\beta_{10} + X_{11}\beta_{11} + X_{12}\beta_{12} + \mu$$

In this equation:

Y represents the poverty status (binary: 1 for non-poor, 0 for poor).

X<sub>1</sub> to X<sub>12</sub> represent the independent variables, which are the Climate-Smart Agricultural Practices (CSAPs).

X<sub>1</sub> = Crop Rotation (Number of different crops rotated in a season).

X<sub>2</sub> = Mulching (Percentage of land covered with mulch).

X<sub>3</sub> = Agroforestry (Number of trees planted per hectare).

X<sub>4</sub> = Organic Manure Use (Amount of manure used per hectare (kg))

X<sub>5</sub> = Use of Fadama Land (Number of hectares under cultivation in Fadama areas).

X<sub>6</sub> = Planting Early Maturing Crop (Percentage of crops that are early maturing).

X<sub>7</sub> = Planting Drought Tolerant Crop (Percentage of crops that are drought tolerant).

X<sub>8</sub> = Irrigation (Number of times irrigation was applied in a season).

X<sub>9</sub> = Intercropping (Number of crop types intercropped).

X<sub>10</sub> = Cover Cropping (Percentage of land covered by cover crops).

X<sub>11</sub> = Conservation Agriculture (Binary or intensity measure (e.g., fully practiced = 1, partially practiced = 0)).

X<sub>12</sub> = Crop Diversification (Number of different crops planted).

α is the constant term,

β<sub>1</sub> to β<sub>12</sub> are the coefficients for each practice, and

μ is the error term.

**Principal Component Analysis**

As used by Ikyoosu *et al.* (2017), the Principal Component Analysis (PCA) was used to analysed objectives (v and ix) is specified as follows:

$$Y_1 = a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n \dots \dots \dots \text{equation 8}$$

$$Y_2 = a_{21}X_1 + a_{22}X_2 + \dots + a_{2n}X_n$$

$$Y_n = a_{n1}X_1 + a_{n2}X_2 + \dots + a_{nn}X_n$$

Where:

Y<sub>1</sub>, Y<sub>2</sub>...Y<sub>n</sub> = observed variables/constraints

a<sub>1</sub> – a<sub>n</sub> = factor loadings or correlation coefficients

X<sub>1</sub>, X<sub>2</sub>, ... X<sub>n</sub> = unobserved underlying factors constraining the effective utilization of climate-smart agriculture. The study selected factors with at least factor-loading scores ± 0.3 in line with Kaiser’s rule of thumb as adopted by (Maric *et al.*, 2016).

## Results and Discussion

### Socioeconomic characteristics of the staple crop farmers

**Sex of the respondents:** the sex of the respondents as presented in Table 2 revealed that majority (67.2%) of the respondents were male while 32.8% were female. This revealed that agricultural activities in the study area were male-dominated. This reflects broader socio-cultural norms and barriers that limit female participation in agriculture or restrict them to roles that are less visible or less profitable in the region. This could also be due to traditional gender roles where men were more likely to engage in agricultural activities, particularly those that involve more labour-intensive tasks or decision-making. The low proportion of women could influence the overall effectiveness and impact of CSAP on poverty alleviation. If women, who were often key contributors to household food security and income, were less involved in these practices, the potential benefits of CSAP may not be fully realized in the study area. This could mean that interventions aimed at promoting CSAP need to be more inclusive and gender-sensitive to ensure that both male and female farmers can equally benefit. Olakojo (2017) in his study of gender gap in agricultural productivity in Nigeria stated that men were more dominant in agricultural activities in rural areas particularly those that are more labour demanding.

**Age of the respondents:** the age distribution of the staple crop farmers in the study area, as presented in the Table 2, shows that larger proportion (35.9%) of the respondents were within the age range of 29 to 42 years. Furthermore, 28.7% were within the age range of 43 to 56 years, and the mean age was 42 years. The mean age of the respondents indicated that they were predominantly within their peak productive years, which is a critical phase for adopting and implementing Climate-Smart Agricultural Practices (CSAP). Being in this productive age bracket meant they were likely to have the physical capacity and energy to engage in labor-intensive practices associated with CSAP and commercialization efforts. This demographic profile is advantageous as it suggests that these farmers were well-positioned to embrace new techniques and practices that can enhance agricultural productivity and efficiency. If these practices are effectively promoted and supported, the potential for positive outcomes, such as increased agricultural yields and improved income, is significantly higher. Consequently, this age factor could play a crucial role in achieving more substantial impacts on poverty reduction by leveraging the potential of these productive individuals to adopt and sustain innovative agricultural practices. In a similar study, Ajewole *et al.* (2022) observed that young farmers were generally more receptive to adopting new agricultural practices compared to their older counterparts. They highlighted that farmer in their prime working years were often better positioned to implement innovative techniques in CSAP due to their readiness to invest in new technologies. This underscores the potential for significant impact on

poverty reduction through Climate Smart Agricultural Practices (CSAP) and commercialization among majority young farmers in the study area, while also emphasizing the need for targeted strategies to engage older farmers who may be less inclined to adopt these practices.

**Marital status of the respondents:** table 2 reveals that majority of the respondents were married (61.0%), 18.5% were single, widows were 7.9%, widowers were 6.7%, while divorced individuals were 5.9%. Marriage involves additional household responsibilities and financial obligations, which could influence the adoption of CSAP. According to Etim and Udofia (2013), marital status of respondents influenced their poverty status by affecting their access to resources, labour, and financial stability. Married individuals often have additional household responsibilities and financial obligations, which could support or constrain their ability to adopt Climate-Smart Agricultural Practices (CSAP) and engage in commercial agriculture. For instance, the presence of multiple family members may provide extra labour for agricultural activities, potentially enhancing productivity and reducing poverty. However, it can also lead to increased financial burdens and resource needs, which may hinder the adoption of new practices. Married farmers may have greater access to labour and resources, which could facilitate the adoption of CSAP and enhance their ability to engage in commercial agriculture. Conversely, these additional responsibilities might also constrain their ability to invest in or fully implement new agricultural practices that are climate resilience (Etim and Udofia, 2013).

**Household size of the respondents:** the respondents' household size as shown in Table 2 revealed that majority (69.7%) had between 1 and 6 persons, with 23.6% having between 7 to 12 persons per household. The mean household size was 6 persons per household. The mean household size of 6 persons suggests a small household size in the study area. Household size can be a significant factor in determining the effectiveness and adoption of CSAP, as well as the level of commercialization pursued by farmers. Small households may encounter significant labour constraints that hinder their ability to engage in intensive or diversified farming practices due to a limited number of available workers (Oluwatayo, 2018). With fewer family members to contribute labour, these households might struggle to manage the increased demands of intensive agricultural practices that require substantial time and effort, such as multiple crop rotations or advanced cultivation techniques. This limitation could restrict their capacity to adopt innovative farming methods or expand their farming operations, thereby impacting their productivity and overall income. Additionally, smaller households may find it challenging to implement diversified farming strategies, which often require a broader range of skills and labor inputs, potentially leading to reduced economic resilience and a slower response to market opportunities or environmental changes (Oyekale, 2019).

**Educational level of the respondents:** the educational level of the respondents in Table 2 shows that most of them (39.0%) had attended secondary schools, 28.7% had attended tertiary schools, 22.6% had attended primary schools, while just 9.7% had no formal education. Overall, 90.3% of the respondents had acquired one form of formal education or the other. This level of educational attainment suggests that the farming community was not only well-informed but also better equipped to navigate the complexities of modern agriculture, particularly in the context of Climate-Smart Agricultural Practices (CSAP). According to Ojo (2020), education enhances farmers' ability to access, interpret, and apply agricultural information, making them more adept at adopting innovative techniques and technologies that can mitigate the effects of climate change, improve soil health, and increase crop yields. Educated farmers are more likely to engage in critical thinking and problem-solving, enabling them to make informed decisions about resource allocation, pest management, and the adoption of sustainable practices that align with CSAP principles. Additionally, education fosters a greater understanding of market dynamics and the importance of commercializing agricultural outputs, which can further enhance their income-generating potential. As a result, farmers with formal education are more receptive to CSAP, leading to improved farming outcomes, higher productivity, and a greater likelihood of lifting themselves out of poverty (Fatuase and Ajibefun, 2014).

**Type of capital used on the farm:** table 2 shows information on the type of capital used by the respondents and it shows a heavy reliance on personal savings (70.5%). This reliance on personal savings indicates a significant limitation to adoption of Climate Smart Agricultural Practices (CSAP). Since these practices often require upfront investments in technology, inputs, and training, the lack of external capital could limit the ability of farmers to implement CSAP effectively, thereby reducing its positive impact on poverty alleviation. The relatively low percentage of farmers accessing loans from commercial banks (7.7%) and government alleviation programs (5.1%) shows a critical gap in financial inclusion for these farmers. The underutilization of formal financial institutions was as a result of barriers such as high-interest rates, lack of collateral, or stringent lending requirements, which deterred farmers from seeking loans. This limitation

restricts farmers' capacity to scale up operations and invest in more sustainable practices, further affecting their commercialization index and, subsequently, their poverty status. Ojo (2020) in his study of determinants of credit constraints and its impact on the adoption of climate change adaptation strategies among rice farmers in South-West Nigeria found that financial constraint could lead to underinvestment in CSAP, limiting the farmers' ability to improve their resilience to climate change, increase their productivity, and ultimately escape poverty.

**Distance from farm to market:** the distance from the farm to the market as shown in Table 2 shows a significant variation in the distances farmers travelled to reach markets, with the majority (26.9%) located 2-3 km from the market, and a considerable number (23.8%) 3-4 km away. The mean distance from farm to market was 2.7 km. This implies that most of the respondents were closer to market from the farm. Farmers closer to the market, particularly those within 1 km (22.1%), were likely to have better access to market information, reduced transportation costs, and quick turnover of produce, which can lead to higher incomes and low poverty levels. On the other hand, those farther away, particularly those over 5 km (20%) away, may face increased costs and logistics challenges, potentially limiting their ability to commercialize their products effectively. Also, farmers close to the market were more likely to adopt Climate Smart Agricultural Practices (CSAP) and engage in higher levels of commercialization due to their easier access to inputs, extension services, and markets. This proximity reduces the time and costs associated with getting their products to market, thereby improving their profitability and reducing their likelihood of falling below the poverty line. Conversely, those at greater distances might be less inclined or able to adopt CSAPs due to the higher costs and logistics challenges, which could hinder their commercialization efforts and exacerbate poverty. Reduced distance to market, could enhance the adoption of CSAPs, increase the commercialization index, and ultimately reduce the poverty status of farmers, especially those currently at a disadvantage due to their geographic location. These measures could help level the playing field, enabling more farmers to participate in and benefit from the economic opportunities that arise from better market access (Zadawa and Omran, 2020).

**Table 2: Socioeconomic Characteristics of the Respondents**

Characteristics	Frequency	Percentage (%)	Mean ( $\bar{X}$ )
<b>Sex</b>			
Male	262	67.2	
Female	128	32.8	
Total	390	100.0	
<b>Age</b>			
15-28	72	18.5	
29-42	140	35.9	42
43-56	112	28.7	
57-70	57	14.6	
71-84	9	2.3	
Total	390	100.0	
<b>Marital status</b>			
Married	238	61.0	
Single	72	18.5	
Divorced	23	5.9	
Widow	31	7.9	
Widower	26	6.7	
Total	390	100.0	
<b>Household size</b>			
1-6	272	69.7	6
7-12	92	23.6	
13-18	21	5.4	
19-24	3	0.8	
25-32	2	0.5	
Total	390	100.0	
<b>Educational level</b>			
Primary Education	88	22.6	
Secondary Education	152	39.0	
Tertiary Education	112	28.7	
Non-Formal education	38	9.7	
Total	390	100.0	
<b>Type of capital used on farm</b>			
Personal savings	275	70.5	
Loan from relation and friends	65	16.7	
Loan from Commercial Banks	30	7.7	
Government alleviation programme	20	5.1	
Total	390	100.0	
<b>Distance from farm to market</b>			
Less than 1km	86	22.1	
2-3km	105	26.9	2.7
3-4km	93	23.8	
4-5km	28	7.2	
Above 5km	78	20.0	
Total	390	100.0	

Source: Field survey, 2024

**Frequently adopted climate smart agricultural practices**

Results of the analysis on the frequently adopted Climate Smart Agricultural Practices (CSAP), as presented in Table 3 revealed that crop rotation (2.59), mulching (2.55), irrigation (2.48), crop diversification

(2.29), and use of fadama land(wetland) (2.21) have higher mean scores, indicating their frequent adoption by the respondents in the study area. Crop rotation, for instance, helps break pest and disease cycles, enhances soil nutrient balance, and reduces the need for chemical fertilizers. Mulching, on the other hand, improves soil

moisture retention and suppresses weed growth, leading to better soil fertility and increased crop yields. These benefits collectively contribute to a more resilient and productive farming system. According to Adebayo *et al.* (2019), improved agricultural productivity resulting from these CSA practices can create opportunities for surplus production, which may be sold in local or broader

markets. This increased marketable surplus can improve farmers' incomes and provide them with additional resources to invest in their farms or diversify their income sources. The frequent use of CSA practices not only mitigates the risks associated with climate variability but also empowers farmers to achieve greater economic stability and sustainability, which is essential for long-term poverty reduction.

**Table 3: Frequently Adopted Climate Smart Agricultural Practices**

CSA Practices	Mean Index	Score	Remark	Ranking
Crop rotation	2.59		Frequent use	1 <sup>st</sup>
Mulching	2.55		Frequent use	2 <sup>nd</sup>
Irrigation	2.48		Frequent use	3 <sup>rd</sup>
Crop diversification	2.29		Frequent use	4 <sup>th</sup>
Use of fadama land(wetland)	2.21		Frequent use	5 <sup>th</sup>
Planting of cover crops	1.96		Less use	6 <sup>th</sup>
Intercropping	1.94		Less use	7 <sup>th</sup>
Planting early maturing crops	1.88		Less use	8 <sup>th</sup>
Use of organic manure	1.82		Less use	9 <sup>th</sup>
Conservation agriculture	1.78		Less use	10 <sup>th</sup>
Agroforestry	1.77		Less use	11 <sup>th</sup>
Planting drought tolerant crop varieties	1.54		Less use	12 <sup>th</sup>
<b>Average index score</b>	<b>2.03</b>		<b>Frequent use</b>	

Source: Field Survey Data, 2024

**Effect of Climate Smart Agricultural Practices on Poverty Status**

The Probit regression result presented in Table 4 highlights the effect of climate smart agricultural practices on the poverty status of staple crop farmers. The Pseudo R-squared value (0.6831) implies that the model explains 68.31% variation in poverty status of the staple crop farmers. The log likelihood of -78.451483 and a chi-square probability of 0.0000 imply that the model is statistically significant, suggesting that climate smart agricultural practices were meaningful predictors of poverty reduction among staple crop farmers. Climate smart agricultural practices such as use of Fadama land (wetland), crop diversification, crop rotation, mulching, and irrigation significantly affect poverty status, as indicated by their statistically significant p-values and marginal effects. Among the CSA practices, use of Fadama land (wetland) and crop diversification, with coefficients of 2.630 and 1.941 respectively, were significant at 1% level of significance. Other CSA practices coefficients includes mulching (0.937), crop rotation (0.08), and irrigation (0.660) and were significant at 5%. This suggests that farmers who utilize Fadama land (wet land), crops diversification, mulching, crop rotation and irrigation were more likely to escape poverty. The marginal effect for use of Fadama land (0.286) implies that a unit increase in the use of this practice corresponds to a 28.6% increase in the probability of

improving poverty status, emphasizing the practice’s substantial economic benefit. Crop diversification has a similar effect, with a 21.1% increase in poverty alleviation likelihood. Crop diversification involves growing more than one crop in an area or integrating crops and livestock (Morel *et al.*, 2020). Mulching has a marginal effect of 0.102, indicating a 10.2% increase in the likelihood of escaping poverty for farmers who adopt this practice. Similarly, crop rotation and irrigation contribute significantly, with respective marginal effects of 8.7% and 7.2% respectively. These results suggest that they are valuable for promoting farmers income which could buffer farmers against poverty. Fadama Land (wetland) diversifies income sources and reduces the risk associated with crop failure (Nwalem *et al.*, 2019). Together, these practices contribute to improved farmers livelihoods, thus having a significant impact on the poverty status of the respondents. This finding highlights the potential of targeted CSAP as a strategy for poverty reduction in agricultural communities. The null hypotheses (H<sub>0</sub>): Climate smart agricultural practices has no significant effect on poverty status of the staple crop farmers. The chi-square probability of 0.0000 was less than the alpha value of 0.05, which implies that climate smart agricultural practice has significant effect on the poverty status of the staple crop farmers, hence, the null hypotheses was rejected.

**Table 4: Probit regression on the effect of climate smart agricultural practices on poverty status**

Variable	Coefficient	Std. Error	Z	p-value	Marginal Effect
Crop Rotation	0.800	0.397	2.020	0.044**	0.087
Mulching	0.937	0.368	2.550	0.011**	0.102
Agroforestry	0.152	0.331	0.460	0.646 <sup>NS</sup>	0.017
Organic Manure Use	-0.171	0.254	-0.670	0.500 <sup>NS</sup>	-0.019
Use of Fadama Land	2.630	0.359	7.320	0.000***	0.286
Planting Early Maturing Crop	-0.491	0.281	-1.750	0.080 <sup>NS</sup>	-0.053
Planting Drought Tolerant Crop	-0.670	0.428	-1.570	0.117 <sup>NS</sup>	-0.073
Irrigation	0.660	0.294	2.250	0.025**	0.072
Intercropping	0.140	0.261	0.540	0.592 <sup>NS</sup>	0.015
Cover Cropping	0.038	0.299	0.130	0.899 <sup>NS</sup>	0.004
Conservation Agriculture	-0.192	0.276	-0.690	0.488 <sup>NS</sup>	-0.021
Crop Diversification	1.941	0.337	5.770	0.000***	0.211
_cons	-1.766	0.405	-4.370	0.000	

Log likelihood = -78.451483  
Pseudo R2 = 0.6831  
Prob > chi2 = 0.0000  
Number of obs = 390

\*\*\*Significant at 1%, \*\*Significant at 5%, NS – Not Significant

**Constraints to Adoption of Climate Smart Agricultural Practices**

Table 5 presents results on the constraints to the adoption of CSAP among the respondents using Oblimin rotation with Kaiser normalization. Two main components are categorized based on their factor loading, and they were "knowledge and infrastructure constraints" and "security and resource access constraints". On constraints related to knowledge and infrastructure, high loadings were observed for "lack of awareness of CSAP" (0.920), and lack of access road to farm (0.320). These findings indicate that insufficient knowledge about CSAP, coupled with lack of access road to farm were significant barriers. A similar result could be found in the study by Katiyatiya *et al.* (2020), which examined the adoption of climate smart agricultural practices (CSAP) among smallholder farmers in Tanzania. Their findings revealed that key barriers to CSAP adoption included "lack of awareness of climate smart practices" (high negative loading of 0.810), "High

cost of implementing CSAP" (0.770), and "Limited access to supportive infrastructure" (0.685).

The second component is associated with constraints related to security and resource access. High loadings showed on variables such as insecurity on farm (0.840), and theft of farm produce (0.766) on security constraint. These factors suggests that farmers perceive security related issues and access to resources as significant barriers to adopting CSAP. The loading on "resource access constraints" showed high loading on variables such as lack of access to credit (0.594) and poor extension services (0.587). Farmers facing these challenges might struggle to invest in or maintain climate smart practices, as their resources are likely depleted or redirected to address immediate security concerns. Oluwole and Shuaib (2016) stated that credit access and insecurity were the major constraints to adoption of climate smart agricultural practices (CSAP) in North West Nigeria.

**Table 5: Oblimin with Kaiser Normalization on Major Constraints to Adoption of Climate Smart Agricultural Practices among the Respondents**

Constraints	Components	
	Security and Resource Access	Knowledge, and Infrastructure
Insecurity on farm	0.840	
Pest and disease attack		
Theft on farm produce	0.766	
Lack of access to credit	0.594	
Poor extension services	0.587	
Lack awareness CSAP		0.920
High-cost labour		
Population pressure on land		
Lack of access road to farm		0.320

Source: Field Survey Data, 2024.

## CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, the research work concluded that effect of climate smart agricultural practices has significant influence on poverty status of the staple crops farmers in North East, Nigeria. Also, crop rotation followed by mulching were the frequently adopted climate smart agricultural practices. Lack of awareness of CSAPs and insecurity on farm were the main obstacles to climate smart agricultural practices in North East, Nigeria. Based on the findings of the study, it was recommended that, since lack of awareness is a major barrier to CSAP, government agencies, NGOs, and extension services should step-up awareness campaigns and training programmes. These training should focus on educating farmers about the methods of CSAP, particularly crop rotation, and mulching. Such initiatives will empower farmers with knowledge to reduce poverty. Also, the study highlighted farm insecurity as significant barrier to CSAPs in the study area. Local authorities and agricultural organizations should work collaboratively to improve security measures in farming communities, which may include community policing initiatives or the establishment of local watch groups to protect farmers' assets.

## Conflict of Interest

The researchers support that this work does not conflict with the interest of others.

## Acknowledgement

The researchers thank the department of Agricultural Economics and extension, Faculty of Agriculture, Federal University of Agriculture, Mubi, Adamawa State, Nigeria for the assistance they gave which contributed to the completion of this article.

## REFERENCES

- Adebayo, A. E., & Ojogu, E. O. (2019). Assessment of the Use of Climate Smart Agricultural Practices among Smallholder Farmers in Ogun State. *Acta Scientific Agriculture*, 3(6), 47-56.
- Ajewole, O., Eyitayo, O., Ojehomon, V., Agboho-Noameshie, R., Diagne, A. (2022). Gender Analysis of Agricultural Innovation and Decision Making among Rice Farming Household in Nigeria. *Journal of Agricultural Informatics*, 6(2),72-82.
- Alao, O. T., Bamiwuye, O. A., & Adedokun, J. A. (2020). Poverty status among farming households in Ogbomoso South Local Government Area of Oyo State, Nigeria. *Nigerian Journal of Rural Sociology*, 20(1), 105–111.
- Baulch, B and Hoddinott, J. (2010). “Economic Mobility and Poverty Dynamics in Developing Countries”. *Journal of Development Studies*, 36, (6): 1 – 24.
- Cline, W. R. (2008). Global warming and agriculture. Finance & Development publication, March, 3, 23–27.
- Ekpa, D., Tsado, E. K., & Bodaga, T. (2018). The effect of climate smart agricultural practices on poverty status of maize rural farming household in Sokoto State , Nigeria. *Journal of Agricultural Science and Practice*, 3(10), 97–106.
- Etim, N. A., & Udofia, U. S. (2013). Analysis of poverty among subsistence waterleaf producers in the tropic. Implications for household food and nutrition security. *American Journal of Advanced Agricultural Research*, 1(2), 62-68.
- Fatuase, A., & Ajibefun, I. (2014). Perception and adaptation to climate change among farmers in selected communities of Ekiti State, Nigeria. *Gaziosmanpaşa Üniv Ziraat Fakültesi Dergisi*, 31(3),100–113.
- Ferdinand, C., Kenneth, D. S., Narasimha, R. V. (2020). Voice of farmers in the agriculture crisis in North-East Nigeria: Focus group insights from extension workers. *International Journal of Development*, 45(8), 12-35. DOI: 10.1108/IJDI-08-2019-0136.
- Ikyoosu, B. M., Ezihe, J. A. C., & Odoemenem, I. U. (2017). Climate change farm-level adaptation measures among soybean farmers in Benue State, Nigeria. *International Journal of Environment, Agriculture and Biotechnology*, 2(5), 2361–2373.
- Kalu, C. A., & Mbanasor, J. A. (2023). Factors influencing the adoption of climate smart agricultural technologies among root crop farming households in Nigeria. *Fara Research Report*, 7(57),744–753.
- Kifle, T., Ayal, D. Y., & Mulugeta, M. (2022). Factors influencing farmers adoption of climate smart agriculture to respond climate variability in Siyadebrina Wayu District, Central highland of Ethiopia. *Climate Services*, 26(12), 100-290. <https://doi.org/10.1016/j.cliser.2022.100290>
- Kijima, Y. K., & Seunkuuma, D. (2011). An enquiry into constraints on a green revolution in sub saharan Africa: The case of NERICA rice in Uganda. *World Dev.*, 39(9),77-86.
- Morel, K., Revoyron, E., Cristbal, M. S., &Baret, P. W. (2020). Innovating within or outside dominant food systems?. Different challenges for contrasting crop diversification strategies in Europe. *PLoS ONE*, 15(3), e229910.
- Mujeji, A., Mudhara, M., & Mutenje, M. (2021). The impact of climate smart agriculture on household welfare in smallholder integrated crop–livestock

- farming systems: Evidence from Zimbabwe. *Agriculture and Food Security*, 10(1), 1–15. <https://doi.org/10.1186/s40066-020-00277-3>
- Muriithi, L. N., Onyari, C. N., Mogaka, H. R., Gichimu, B. M., Gatumo, G. N., & Kwena, K. (2021). Adoption determinants of adapted climate smart agriculture technologies among smallholder farmers in Machakos, Makueni, and Kitui Counties of Kenya. *Journal of Agricultural Extension*, 25(2), 75–85.
- Nazifi, B., Hussaini, Y. I., Buhari, N., Akinyemi, M. (2024). Adoption of climate-smart agricultural practices and its impact on smallholders farming households in some rural areas of North-Western, Nigeria. *Agricultura Tropica ET Subtropica*, 57(OV),23-24. DOI:10.242478/ats-2024-0003
- Nwalem, M. P., Asogwa, B. C., & Aye, G.C. (2019). Analysis of climate change manifestations among sesame farmers in Benue State Nigeria. *J. Sci. Res. Rep.*, 22 (2), 1-7.
- Ojo, T.O. (2020). Determinants of credit constraints and its impact on the adoption of climate change adaptation strategies among rice farmers in South-West Nigeria. *J Economics Structure*, 7(9), 123-131
- Olakojo, S.A. (2017). Gender gap in agricultural productivity In Nigeria: A commodity level analysis. *Journal of Economics of Agriculture*, 64 (2), 415-435.
- Oluwatayo, I. B. (2018). Explaining inequality and welfare status of households in rural Nigeria: Evidence from Ekiti State. *Humanity & Social Science Journal*, 3(1), 70-80.
- Oni, T. O. (2013). Challenges and prospects of agriculture in Nigeria: the way forward. *Journal of Economics and Sustainable Development*, 4(16): 2222–1700. <https://www.iiste.org>
- Onyeneke, R. U., Amadi, M. U., Njoku, C. L., & Osuji, E. E. (2021). Climate change perception and uptake of climate-smart agriculture in rice production in Ebonyi State, Nigeria. *Atmosphere*, 1(2), 1–21.
- Oyekale, A. S. (2019). Climatic variability and its impact on agricultural income and households' welfare in Southern and Northern Nigeria. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 8(1), 13-34.
- Rapu, S. C. (2016). *Evaluating the impact of policies on production efficiency of Nigeria's rice economy. A PhD Dissertation submitted to the College of Social and Behavioral Sciences, Walden University.*
- Wagan, Z. A., Chen, Z., Seelro, H., & Shah, M. S. (2018). Assessing the effect of monetary policy on agricultural growth and food prices. *Agricultural Economics - Czech*, 64(11): 499–507.
- World Bank (2019). *Agricultura, Valor Agregado (% del PIB); Technical Report; World Bank Group: Washington, DC, USA, 2019.*
- Zadawa, A.N, & Omran, A. (2020). *Rural development in Africa: Challenges and opportunities. Sustaining our environment for better future: challenges and opportunities.* Springer, Cham, pp 33–42.