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Determinants of climate-smart agriculture technology adoption among smallholder rice farmers in Gwagwalada Area Council, Federal Capital Territory, Nigeria

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Abstract

Small-scale rice farmers face significant farming challenges posed by climate change, particularly in Nigeria where the major source of their livelihood is agriculture. This study examined the determinants of climate smart agricultural (CSA) technologies adoption among small-scale rice farmers in Gwagwalada Area Council, Federal Capital Territory, Nigeria. The specific objectives of the study were to describe the socioeconomic characteristics of small-scale rice farmers, evaluate the various climate smart agricultural (CSA) technologies adopted by small-scale rice farmers, analyze the factors influencing the adoption of climate smart agricultural (CSA) technologies among small-scale rice farmers and describe the constraints faced by small-scale rice farmers in the adoption of climate agricultural (CSA) technologies. A well-structured questionnaire was used to gather data from 80 small-scale rice farmers. The data were analyzed using descriptive statistics and probit regression model. The results revealed that conversational agricultural practices and mixed cropping had mean values of 3.21 and 3.61 respectively and were the most widely adopted climate smart agricultural (CSA) technology used, while drought resistant varieties had a low mean of 2.37. Experience in farming positively influenced CSA adoption ($p < 0.05$), whereas larger farm negatively influenced CSA adoption ($p < 0.01$). The constraints they faced include poor infrastructure, lack of credit facilities, inadequate extension services and limited awareness. The study highlights the urgent implementation for some targeted intervention such as improved access to extension services, credit and infrastructural development which will greatly enhance the adoption of CSA technologies.

Keyword: Climate Smart Agriculture, Small-scale Rice Farmers, Adoption, Constraints, Gwagwalada, Nigeria

Introduction

Agriculture plays a crucial role in the global economy (Prasanth & Sivanantha, 2022). It remains one of the most fundamental gears for reducing poverty level, creating jobs and ensuring that there is enough food available for consumption, particularly in developing countries where a prominent share of the population actively depend on farming for their livelihood (World Bank, 2024). Globally, a significant majority, comprising about 80% of the

world's poor live in rural settings, where small-scale farming operation serves as the fundamental source of income and livelihood (Arendonk, 2015). Nigeria remains Africa's most populated country with approximately 213.5 million people actively benefiting from agricultural production, accounting for about 40% of the Gross Domestic Product (GDP) and employing two-third of the labour force (Musa, 2014). In Nigeria, agriculture is one of the major drivers, facilitating national development by

providing raw materials for industries, contributing to household and national income, creating employment opportunities, particularly for the small-scale farmers (Osai-Azubuike, Nwogwugwu & Nwokoye, 2023). Among the widely grown staple crops, rice (*Oryza sativa*) holds a significant importance, underscoring its functions in food security and generating revenue for millions of households (Mohammed et al., 2019).

Rice is a vital cereal crop predominately grown in continents such as Africa and Asia, providing food to over 50% of the global population (Dogara & Jumare, 2014). Production of rice in Nigeria was nearly 8.34 million metric tons in 2021 alone, indicating a marginal increase from 8.17 million metric tons the previous year (Sasu, 2025). Despite being the most cultivated cereal crop in terms of yearly output and land area, accounting for more than 70% of States in Nigeria, actively involved in cultivating rice, with Kebbi State making a yearly contribution between 1.51 million metric tons and 2.05 million metric tons, there is still a shortfall in production (Sasu, 2025). This shortfall in production can be traced to several underlying challenges, such as rapid population growth which is actively increasing demand and low productivity among the small-scale rice farmers, failing to meet the rising demand. Small-scale farmers, forming bulk of the rice producers frequently face barriers such as high cost of inputs, limited irrigation facilities and inadequate access to climate smart agricultural (CSA) technologies which further aggravate their constraints (Saito et al., 2023).

Climate smart agriculture (CSA) is an integrated approach that employs adaptative strategies to mitigate the effects of climate change while ensuring agricultural production is sustainable (World Bank,

2023). This approach is aimed at curbing the problem of greenhouse gas emission, improving the resilience of our agricultural systems to climate change and enhancing food security through farming practices such as conservation agriculture, crop diversification, efficient water management that are adequate, adaptative and sustainable for improved production (Lipper, Thornton & Campbell, 2014). In Nigeria, the importance of climate smart agriculture (CSA) is particularly pronounced because issues like variability in climatic, erratic rainfall patterns, extreme temperature rise often threaten our agricultural output, disproportionately affecting the production of small-scale rice farmers (Ologeh, Akarakiri & Adesina, 2016).

In Nigeria, small-scale rice farmers heavily depend on local farming techniques, making them highly prone to risks induced by the effects of climate change such as long period of drought, floods and infestation of pest (Touch, Tan, Cook, Li-Liu, Cross, Tran & Cowie, 2024). A sustainable pathway for mitigating these risks is the adoption of climate smart technologies which in the long run will improve the productivity of small-scale rice farmers. However, notable socio-economic and institutional factors influence the widespread of these technologies by small-scale rice farmers (Berhanu, Ayele & Dagnew, 2024). These factors such as educational level, household size, farming experience, farm size, infrastructural facilities and financial constraints play a crucial role in determining to what extent will small-scale rice farmers adopt climate smart practices (Berhanu et al., 2024).

Despite efforts put into conducting extensive research on climate smart agriculture (CSA) and its benefits, the adoption rate among small-scale rice farmers in Nigeria remains relatively low. Previous studies such as Gabriel et al. (2023) and

Usman and Bello (2021) have identified the general impact of climate change on rice production in Nigeria's North Central and North Western regions. However, these studies paid less attention to the impact of climate variability and general CSA practice awareness, without necessarily addressing the specific socio-economic, institutional, and information factors influencing the adoption of CSA technology by small-scale rice farmers.

This present study bridges that research gap by pointing to Gwagwalada Area Council within the Federal Capital Territory, using a structured approach in investigating the way variables such as the educational level, age, farm size, household size etc., influence CSA adoption.

Furthermore, the concern about food security will keep on growing as climate change intensifies. Addressing the factors influencing the adoption of climate smart agriculture (CSA) is important to produce enough food and reduce Nigeria's over-reliance on local farming techniques.

Nigeria has begun developing several policies aimed at ensuring that climate smart agriculture (CSA) is adopted. Policies such as the National Climate Change Policy Framework and Agricultural Promotion Policy (APP) stress the need for climate adaptative strategies and practicing modern agricultural techniques. Furthermore, international bodies such as Food and Agricultural Organization (FAO) and World Bank have implemented programs to actively support climate resilience in agriculture. However, these policies can only be effective when they are implemented on the grassroot level, where the small-scale rice farmers operate. Examining the determinant factors influencing the adoption of climate smart agricultural (CSA) technologies among small-scale rice farmers in Gwagwalada

Area Council, Federal Capital Territory, is essential for bridging research and policy gaps and ensure that small-scale rice farmers benefit from climate smart innovations. This study will seek to achieve the following broad objectives which are to:

- (i) describe the socio-economic characteristics of small-scale rice farmers in Gwagwalada Area Council.
- (ii) describe the various climate smart agricultural (CSA) technologies adopted by small-scale rice farmers in Gwagwalada Area Council.
- (iii) analyze the factors influencing the adoption of climate smart agricultural (CSA) technologies among small-scale farmers in Gwagwalada Area Council.
- (iv) describe the constraints faced by small-scale rice farmers in the adoption of climate smart agricultural (CSA) technologies in the study area.

Materials and Methods

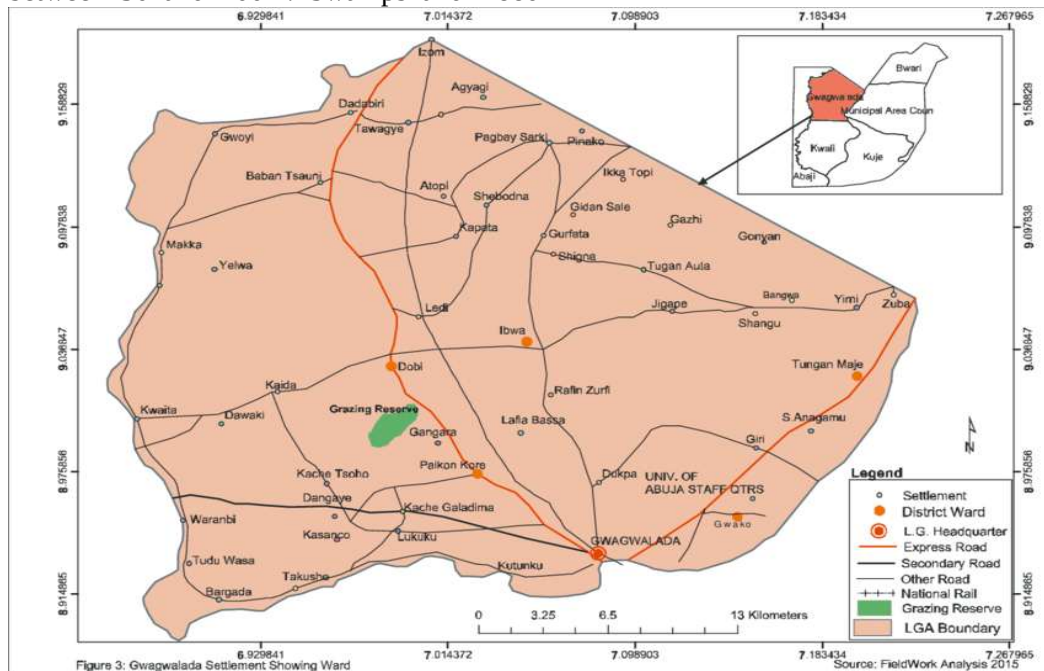
Study Area

The study was conducted at Gwagwalada Area Council. It is among the six (6) area councils that make up the Federal Capital Territory (FCT) Abuja. The area council is situated at the North-Central part of Nigeria. It is strategically located approximately 55 kilometres southwest of Abuja, the nation's capital. Gwagwalada covers a land area of approximately 1,043sq km and lies between latitudes 8°55'N and 9°00'N, and longitudes 7°00'E and 7°05'E that covers a total mass land of 2,316sq km out of 8,000sq km of the total FCT land mass. With 5 districts and 14 villages and a population estimated at 537,000 people with 60% of the indigenes as farmers (Simon & Samuel, 2021). It is bordered by Kwali Area Council to the south, Kuje Area Council to the east, Abaji Area Council to the west, and Niger State to the north. These borders highlight its strategic location within the

FCT and its proximity to neighbouring states. The terrain consists predominantly of flat land dissected by streams, with swamps and flood plains prominent, particularly in the extreme southwest near the Gurara River. The elevation ranges between 150 meters and 250 meters, and the soil type is reddish, well-drained sandy loam, supporting various agricultural activities. The climate is suitable for the cultivation of crops such as sorghum, millet, yam, cassava, and rice, as well as vegetables like tomatoes, onions, and okra. In addition to crop cultivation, the area is known for rearing animals such as cattle, goats, sheep, and poultry, which are vital for both subsistence and commercial purposes. Livestock farming complements crop farming, providing an additional source of income for the rural population. The area consists mainly of monotonously flat land dissected by streams that barely have distinct channels. The elevation ranges between 150m and 250m with relative relief of between 50 and 200m. Swamps and flood

plains are a prominent aspect of the landscape of these areas especially of the extreme south west towards the river Gurara which transverses the territory from North-South at an elevation of 70m above sea, the soil is made up of reddish well drained sandy loamy soil which supports the farming of major crops like sorghum, millet, yam, cassava and rice cultivation, vegetables such as tomatoes, onions and okra and although the climate of Gwagwalada can be tagged as suitable for the production of rice there are certain measures that can be taken to greatly improve rice production (Sanni, Offiong & Airede, 2021).

Gwagwalada is comprised of ten wards which are, viz Dobi, Giri, Gwako, Ibwa, Paiko, Kore, Kutunku, Tunga and Quarters (Phases 1, 2 and 3) with subsistence agriculture as the main economic activity of the rural populace. Civil service and petty trading occupy the minor sector (Nicholas & Patrick, 2015).



Map of Gwagwalada Area Council, showing the study area.

Source: Simon, Yerima and Samuel, (2021).

Sample Techniques and Sample Size

A multi-stage sampling was used for this study. Gwagwalada area council was purposefully selected due to its prevalence of farming households in this area at the first stage. The second stage involved a random selection of three wards in the Area Council. The selected wards involved were Dobi, Paiko and Zuba. Finally, from a simple frame of 100 farming households, 80 were randomly selected as the sample size guided by the Yamane (1967) formula for the study. Which is specified as follows:

$$n = \frac{N}{1+N(e^2)} = 80 \quad (1)$$

Where;

n = The sample number size of small-scale rice farmers (Unit)

N = The total population of small-scale rice farmers (Unit)

e = Level of precision (5%)

1 = Constant value

Method of Data Collection

Primary data were used for this study. The Primary data were collected by researcher and trained enumerators through interviews with a well-structured questionnaire. The questionnaire has three sections (A-C). Section A: covers the socio-economic characteristics of the respondents such as level of education, sex, age, and farming experiences, access to credit, membership of cooperative, household size of rice farmers in the study area; Section B: covers the various climate smart agricultural technologies adopted by small-scale rice farmers in the study area; Section C: covers the constraints faced by small scale rice farmers in the study area.

Descriptive Statistics

The properties of a data set are arranged and summarized using descriptive statistics. A group of observations or

answers from a sample or the complete population is called a data set. In quantitative research, describing response characteristics, such the average of a single variable (e.g., age, sex, education level, e.t.c.), comes first in the statistical analysis process after data collection. (Yellapu, 2018). This was used to achieve specific objective (i) stated to describe the socio-economic characteristics of small-scale rice farmers in the study area, objective (ii) stated to describe the various climate smart agricultural technologies adopted by small-scale rice farmers in the study area and objective (iv) stated describe the constraints faced by small-scale rice farmers in the adoption of climate smart agricultural technologies in the study are.

Probit Dichotomous Regression Model

A probit model, often known as probit regression, is used to model binary or dichotomous outcome variables. The inverse standard normal distribution of the probability is represented in the probit model as a linear combination of the predictors (Shehadeh & Alitani, 2021). The Probit Dichotomous regression model is stated thus:

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu_1 \quad (2)$$

Where;

Z = Adoption of climate smart agriculture (CSA) technologies adopted (1=Adopted; 0=otherwise)

X_1 = Age (Years)

X_2 = Household size (Number)

X_3 = Farming Experience (Years)

X_4 = Farm Size (Hectare)

X_5 = Level of Education (Years)

β_0 = Constant term

β_1 - β_5 = Regression Coefficient

μ_1 = Error Term

This was used to achieve specific objective three (iii) to analyze the factors

influencing adoption of climate smart agriculture (CSA) technologies among small scale rice farmers in the study area.

Results and Discussion

Socio-economic Characteristics of Small-Scale Rice Farmers in the Study Area

Table 1 shows the distinct socioeconomic characteristics of small-scale rice farmers in the study area that were sampled. The result showed that 87.5% of the respondents were male while 12.5% of the respondents were female. This finding means that majority of the farmers were male. This gender disparity aligns with similar research conducted by Kuwornu et al. (2013) and Aryal et al. (2018), suggesting that male farmers tend to have greater access to land and resources, such access can impact adoption rates of climate-smart practices as men often control farm resources and decision-making which influences their role in farming activities.

Also, 33% of the respondents were within the age bracket of 35 – 44 years, 21% respondents fell between 25 – 34 years, 19% of the respondents' fell between 45 – 54 years of age, and 7% of the respondents fell between 55 – 64 years of age. The mean age was approximately 40 years, implying that most of the small-scale rice farmers were in their active years. This finding is in consonance with the findings of Aryal et al. (2018), who reported that young and middle-aged farmers are more willing to adopt multiple CSA practices in farming. This is because young farmers are perceived as more risk-taking and more inclined to new methods of farming. The older farmers may practice CSA with an aim of maintaining his/her productivity to the later ages.

Also, 70% of the small-scale rice farmers were married, 21% were single, 5% were divorced and 2.5% are widows, which agrees with studies conducted by Olorunwa

(2018) and Vusi and Oladele (2013) who similarly reported that majority of their respondents were married, accounting for about 80% and 61.7% respectively. This consistency across these studies implies that marriage is a common socio-economic characteristic among small-scale farmers.

The result of household size showed that 43.8% of the small-scale rice farmers had 1 – 5 persons, 36.3% had 6 – 10 persons, 17.5% had 11-15 members and 2.5% had 16-20 members with a mean household size of 8 member. This finding is in consonance with Ohajianya (2020)

and Olorunsanya (2015) who stated that large size of household could be an advantage to the household head where the members are sources of labor supply to rice farming a times; otherwise, it affects the farmer's income negatively. The size of the household could be an important variable, especially in a situation where human power is a main source of labor for carrying out different farming activities.

The education level distribution among the respondents revealed that majority of respondents had secondary education of 63.8%, followed by tertiary education amounting to 13.8%, 12.5% of farmers had primary education, 6.3% of the farmers had adult education, 2.5% of the farmers had Quranic education and 1.3% of small-scale rice farmers had no formal education. This implies that 98.7% of the sampled small-scale rice farmers had formal education. This implies that CSA adoption could be easy for small-scale rice farmers because nearly all sampled rice farmers were educated. Education levels are critical in CSA adoption, as they enhance farmers' understanding and openness to adopting new technologies. This is supported by the study carried out by Berresaw et al. (2013) posited that higher educational attainment positively correlates with CSA adoption due to

improved comprehension of complex practices and in rural Tanzania.

The result on source of capital revealed that 27.5% of the respondents in the study area borrowed capital from cooperative societies, 23.8% of rice farmers used personal savings and another 23.8% of small-scale rice farmers used friends and relatives. Furthermore, 12.5% of rice farmers made use of commercial banks and another 12.5% made use of money lenders. This showed that the sampled respondents minimally rely on the formal financial sectors, and while this may help support emerging technologies it also limits it through its high capital costs. This is in consonance with the findings of Mwangi and Kariuki, (2015) who emphasized that access to the cooperative's funds help to fund the CSAs since it becomes easy to access the resources needed.

About 82.5% of small-scale rice farmers showed a high level of engagement in the use of farmers' associations or cooperatives while 17.5% did not engage in farmers' cooperatives. Investigations conducted reveal that through membership in associations, farmers can benefit from information disseminated about climate-smart agriculture. Findings from Aryal et al. (2018) support this, highlighting that farmers that belong to cooperatives or associations will benefit from knowledge sharing opportunities, collective resources and trainings on climate smart agricultural technologies.

In addition, 45.24% of sampled rice farmers had farming experience between 1-5years, 35.71% of rice farmers also had farming experience between 6-10 years, 11.90% and 7.143% had farming experience between 11-15 and 16-20 years respectively. The average years of farming experience was 10 years. The result agrees with Ariyo et al. (2020) who reported that the mean years of farming

experience of respondents was 10 years in Ogun State, Nigeria.

Climate Smart Agricultural Technologies Adopted by Small-Scale Rice Farmers in the Study Area

Table 2 presents the results from adopted climate smart agricultural technologies. A mean score of 2.37 of the respondents was recorded for heat and drought-resistant varieties suggesting that while there is some adoption, widespread adoption by farmers remain limited. This result agrees with Newell and Taylor (2018) who stated that climate-smart agriculture (CSA) encompasses innovative farming practices and agricultural technologies, such as agro-forestry systems and drought tolerant crops varieties, that aim to address three pertinent challenges of the twenty-first century: climate change adaptation, mitigation, and food security.

A mean score of 3.0 suggests that planting of pest and disease resistant varieties was high in level of adoption. Majority of respondents reported incorporating these varieties into their practices at between a moderate to a frequent use. This reflects a generally positive attitude toward using resistant varieties to address pest and disease challenges. The mean score of 3.21 suggests that, on average, conservation agricultural practices were consistently used, with a notable portion of respondents frequently employing these practices. This reflects a positive trend towards sustainable agriculture techniques among the respondents. This agrees with Molua et al. (2023) which states that conservation agriculture techniques within climate-smart practices show benefits for smallholder farmers through improvements in soil health, soil moisture retention and increased crop yields.

Table 1. Socio-economic characteristics of small-scale rice farmers

Variables	Frequency	Percentage (%)
Gender Distribution		
Male	70	87.5
Female	10	12.5
Age Distribution		
25-34	21	26.3
35-44	33	41.3
45-54	19	23.8
55-64	7	8.8
Mean	40.375	
Marital Status		
Single	17	21.3
Married	56	70
Divorced	4	5
Widowed	2	2.5
Household Size		
1-5	35	43.8
6-10	29	36.3
11-15	14	17.5
16-20	2	2.5
Mean	8	
Level of Education		
No Formal Education	1	1.3
Primary Education	10	12.5
Secondary Education	51	63.8
Tertiary Institution	11	13.8
Adult Education	5	6.3
Quranic Education	2	2.5
Source of Capital		
Commercial Banks	10	12.5
Cooperative Society	22	27.5
Friends and Relatives	19	23.8
Money Lenders	10	12.5
Personal Savings	19	23.8
Farmers Association/Cooperative Society		
Yes	66	82.5
No	14	17.5
Farming Experience		
1-5	19	45.24
6-10	15	35.71
11-15	5	11.9
16-20	3	7.134
Mean	10.9	

Source: Computed from Field Data, 2024.

The mean score of 3.61 suggests that mixed cropping was widely and consistently used among respondents, reflecting a high level of preference and integration of this practice in their farming systems.

The mean score of 3.08 suggests that companion planting practices were relatively high among respondents, highlighting it is a

commonly practiced approach to enhancing crop growth and pest management. This is in line with Midega, Bruce, Pickett, Pittchar, Murage and khan (2015) which states that companion cropping system known as ‘push–pull’ overcomes constraints faced while providing additional soil fertility and forage grass benefits to smallholder farmers.

Table 2. Climate smart agricultural technologies adopted by small-scale rice farmers

Practices	Mean	Remarks
Planting of Heat and Drought Varieties.	2.37	Disagree
Planting Resistant Varieties to Pests and Diseases.	3.0	Neutral
Conservation Agriculture.	3.21	Neutral
Mixed Cropping.	3.61	Agree
Companion Planting.	3.08	Neutral

Source: Computed from field data, 2024

Factors influencing the Adoption of Climate Smart Agricultural among Small-scale Rice Farmers in the Study Area

Table 3 presents the estimate of the probit dichotomous regression model. The variables under consideration were Age (X_1), Household Size (X_2), Farming Experience (X_3), Farm Size, (X_4) and Level of Education (X_5). The estimated coefficient of farm experience was (0.096625) and was statistically significant at ($P < 0.05$)

probability level. This implies that a unit increase in farm experience will result in a 2.59% increase in climate smart agriculture. The estimated coefficient of farm size was negative (-0.177746) and was statically significant at ($P < 0.010$) probability level. This implies a unit increase in farm size will result in a 5.6% decrease in climate smart agriculture. The R^2 value was 9.96% and suggests modest explanatory power.

Table 3. Factors influencing the adoption of climate smart agricultural among small-scale rice farmers in the study area

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Age (X_1)	0.0321	0.02108	1.522781	0.1278
Farming Experience (X_2)	0.096625**	0.043366	2.22811	0.0259
Farm Size (X_3)	-0.177746*	0.093008	-1.911093	0.056
Household Size (X_4)	-0.017009	0.045566	-0.373281	0.7089
Education Level (X_5)	0.199154	0.198247	1.004579	0.3151
Constant	-1.760234**	0.839745	-2.096153	0.0361
R-squared	0.099551			

**** Significant at 5%, * Significant at 10%**

Source: Computed from field data, 2024.

Constraints Faced by Small Scale Rice Farmers in the Adoption of Climate Smart Agricultural Technologies

Table 4 shows the constraint faced by small-scale rice farmers in the adoption of climate smart agricultural technologies. The farmers agreed that lack of access to infrastructure, poor infrastructure, lack of awareness, lack of credit facilities, inadequate extension services, lack of farm inputs and lack of access to internet facilities were major constraints limiting their farming activities and adoption of climate smart agricultural technologies. These challenges were discovered to be principal hindrances that restricted agricultural systems efficiency and sustainability.

Poor infrastructure and lack of adequate facilities were widely acknowledged by the farmers as a major constraint. Farmers highlighted that the absence of infrastructure facilities has made their ability to access markets, get inputs and implement climate smart techniques difficult. Lack of awareness, as reported by many small-scale rice farmers to be an emerging constraint is as a result poorly informing farmers on the benefits of climate smart agriculture and how it is being done.

Farmer's inability to access credit facilities was another major constraint that limited them from investing in climate smart technologies. Finding from a similar study conducted by Danji et al. (2024), clearly supported that farmers' access to funds has

remained a long-term constraint for rice farmers, limiting their ability to invest in climate smart technologies. Inadequate extension service, highlighted by the farmers because of receiving little to no contact with extension agents, has limited farmers access to useful information and climate resilient technology. Lack of farm input and their high purchasing cost has rendered production difficult, making farmers rely heavily on traditional and inefficient methods.

Lack of access to internet facilities limits the spread of modern agricultural knowledge, techniques and innovations. Farmers indicated that their inability to access the internet and other digital facilities limits their exposure to new ideas, prices and real time weather. This is in line with the finding of Atsiaya (2017) who reported that small-scale farmers lack digital and internet platform that will equip them with necessary information to adopt climate smart agriculture.

Overall, these constraints highlight the need for targeted interventions in infrastructural facilities development, credit availability and access, extension service delivery, internet and digital access. Unless these multi-layered challenges are addressed, small-scale rice farmers will remain constrained, their productivity will be hindered, and long-term sustainability in the context of climate change will be as well constrained.

Table 4. Constraints faced by small scale rice farmers in the adoption of climate smart agricultural technologies

Constraints	Strongly Agree	Agree	Strongly Disagree	Disagree	Mean	Remark
Lack of Access to Infrastructure.	5 (6.25%)	76 (95%)	0 (0%)	1 (1.25%)	3.025	Neutral
Poor Infrastructure.	2 (2.5)	78 (97.5%)	0 (0%)	0 (0%)	3.025	Neutral
Lack of Awareness.	35 (43.75%)	48 (60)	1 (1.25%)	4 (5%)	3.275	Neutral
Lack of access to Credit Facilities.	43 (53.75%)	44 (50%)	0 (0%)	7 (8.75%)	3.275	Neutral
Inadequate Extension Service.	32 (40%)	50 (62.5%)	2 (2.5%)	4 (5%)	3.225	Neutral
Lack of Farm Inputs.	39 (48.75%)	50 (62.5%)	0 (0%)	9 (11.25%)	3.15	Neutral
Lack of Access to Internet Facilities.	35 (43.75%)	44 (55%)	8 (10%)	7 (8.75%)	3.075	Neutral

Source: Computed from Field Data, 2024

Conclusion and Recommendation

This study on the determinants of climate smart agricultural (CSA) technologies adoption among small-scale rice farmers in Gwagwalada Area Council, Federal Capital Territory, Nigeria concludes that farming experience and farm size significantly influence the adoption of climate-smart agricultural technologies. Farmers with more experience and education are more likely to adopt these technologies, while larger farms face challenges due to higher management demands. The study also found that farmers prefer technologies that fit their existing farming systems, with mixed cropping and conservation agriculture being the most adopted. However, the adoption of drought-resistant varieties is low, highlighting the need for programs to improve access to these varieties. The study identifies poor infrastructure, lack of awareness, inadequate extension services, and limited access to credit as major constraints to adopting climate-smart agriculture. These findings underscore the importance of addressing institutional and structural barriers to support small-scale rice farmers in transitioning to climate-smart practices.

To support small-scale rice farmers in adopting climate-smart agricultural practices, several key steps are necessary. Firstly, agricultural extension services need to be strengthened and expanded, providing farmers with professional training on climate-resilient techniques such as improved seed varieties, water conservation, and soil management. Secondly, access to credit facilities should be improved through farmer-friendly schemes with low interest rates and flexible repayment terms, alongside financial literacy programs to help farmers manage loans effectively. Finally, telecommunication companies and research institutions can collaborate to create mobile

advisory services that provide real-time weather forecasts and best farming practices, enabling farmers to stay informed and adapt to climate change.

References

- Arendonk. (2015). The development of agriculture in GDP and employment: A case study of China, Indonesia, the Netherlands and the United States. *Leibniz Institute of Agricultural Development in Transition Economics*, 1(1), 6-7.
- Ariyo, A. M., Sotayo, O., Olurin, T. & Eni-Olurunda, T. (2020). Sexual communication between parents and adolescence: Perception of secondary school students in Abeokuta, Ogun State, Nigeria. *Mediterranean Journal of Social Sciences*, 11(4), 112.
- Aryal, J. P., Rahut, D., Maharjan, S. & Erenstein, O. (2018). Factors affecting the adoption of multiple climate-smart agricultural practices in the Indo-Gangetic Plains of India. *Natural Resources Forum*, 42(10), 1111-8947.
- Atsiaya, G. O. (2017). Response to effects of climate variability and willingness to pay for insurance by smallholder farmers in Laikipia West Sub-County, Kenya (Doctoral dissertation, Egerton University). *International journal of economics, commerce and management*, 5(5), 11-13.
- Berhanu, A. A., Ayele, Z. B., & Dagnaw, D. C. (2024). *Impact of climate-smart agricultural practices on smallholder farmers' resilience in Ethiopia*. *J Agric Food Res* 16: 101147.
- Berresaw, M., Jaleta, Moti., Shiferaw, B., Mmbando, F. & Mekuria, M. (2013). Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. *Technological Forecasting and Social Change*, 80(1), 525-540.
- Danji, M. B., Zubairu, A. I., Hassan, C. K. &

- Garba, E. J. (2024). Evaluation of Agricultural Credit Utilization Among Rice Farmers in ADP Zone I of Taraba State, Nigeria. *UNIZIK. Journal of Agricultural Economics and Extension*, 1(1), 65-73.
- Dogara, A. M. & Jumare, A. I. (2014). Origin, distribution and heading date in cultivated rice, *International journal of plant biology and research*, 2(1), 2–6.
- Food and Agriculture Organization [FAO]. (2018). Sustainable rice based production and people's livelihood, *International Rice Commission Newsletter (Special Edition)*, 52(1).
- Gabriel, Olajuwon, Klauser, Michael, & Renn. (2023). State of climate smart agriculture (CSA) Practices in the North Central and North West zones in Nigeria. *CABI Agriculture and Bioscience*, 4(33).
- Kuwornu, J., Al-Hassan, R., Etwire, Prince. & Osei-Owusu, Y. (2013). Adaptation Strategies of Smallholder Farmers to Climate Change and Variability: Evidence from Northern Ghana, *information management and business review journal*, 5(5), 233-239.
- Lipper, L., Thornton, K.P. & Campbell, P. (2014). Climate smart agriculture for food security. *Nature climate change*, 4(1), 1068-1072. Doi:10.1038/nclimate2437.
- Midega, A.O., Bruce, J.A., Pickett, J., Pittchar, J., Murage, A. & Khan, Z. R. (2015). Climate-adapted companion cropping increases agricultural productivity in East Africa, *Field crop research journal*, 180(1), 118-125.
- Mohammed, U. A., Ibrahim, S., Hayatu, M., & Mohammed, F. A. (2019). Rice (*Oryza sativa* L.) production in Nigeria: challenges and prospects. *Dutse Journal of Pure and Applied Sciences*, 5(2), 29-37.
- Molua, L.E., Sonia, D., Bele, Y., Foahom, B., Mweru, J., Wa Bassa, S., Gapia, M., Ngana, F., Joe, A. & Massumboku, E.M. (2023). Climate-smart conservation Agriculture, farm values and tenure security: Implications for climate change adaptation and mitigation in the Congo basin. *Tropical conservation science*, 16(1), 1-21.
- Musa, I. (2014). Stock market development, foreign direct investment and macroeconomic stability: Evidence from Nigeria. *Research Journal of Finance and Accounting*, 5(18), 2222-2847.
- Newell, P. & Taylor, O. (2018). Contested landscapes: The global political economy of climate-smart agriculture. *Journal of Peasant Studies*, 45(1), 108–129.
- Nicholas, E. & Patrick, D. (2015). Impact of poverty on housing condition in gwagwalada urban area of federal capital territory (FCT) of Abuja. *International Journal of Social Science Studies*, 3(10), 10-11.
- Ologeh, I. O., Akarakiri, J. B., & Adesina, F. A. (2016). Promoting climate smart agriculture through space technology in Nigeria. *Innovation in Climate Change Adaptation*, 99-112.
- Olorunsanya, E.O. (2015). A gender based economic analysis of rice production among resource poor farm households in Kwara state, Nigeria. *Agricultural tropical et subtropical*, 48(1-2), 5-10.
- Osai Azubuike, V., Nwogwugwu, U., & Nwokoye, E. (2023). The Role of Agriculture in Economic Development: in Nigeria. *Journal of International Economic Relations and Development Economics*, 3(2), 103-111.
- Prasanth & Sivanantha (2022). The role of agriculture in the economy. *Research Insights of life science student*. 3, 119-1121.

- Saito, K., Senthilkumar, K., Dossou-Yovo, E. R., Ali, I., Johnson, J. M., Mujawamariya, G., & Rodenburg, J. (2023). Status quo and challenges of rice production in sub-Saharan Africa. *Plant Production Science*, 26(3), 320-333.
- Sanni, U.A., Offiong, U.A.E & Airede, K. (2021). School health instructions in primary schools: a study of gwagwalada area council, federal capital territory nigeria. *West African journal of medicine*. 38(1), 359-365.
- Sasu, D. D. (2025). Production of milled rice in Nigeria from 2010 to 2023. *Stastista*.
- Shehadeh, Esam & Alitani, S. (2021). Firms and governance factors affecting the adoption of web-based corporate reporting: Evidence from the USA. *Journal of Accounting*, 7(1), 1017-1024.
- Shukla, P.R., Skeg, J., Calvo, E., Emily. H., Portner, H., Vyas, P., and Zhai, P., ... Luz, S. (2019). Climate change and land: an Ipcc special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. In Malley, J (Ed.), 10(1), 2-3.
- Simon, Yerima & Samuel, Ademu. (2021) Analysis of land-use conflict between farmers and pastoralists in Gwagwalada area council of Abuja, Nigeria. *Global Journal of Science Frontier Research: Enviroment & Earth Science*, 21(3), 2249-4626.
- Touch, V., Tan, D. K., Cook, B. R., Li Liu, D., Cross, R., Tran, T. A., ... & Cowie, A. (2024). Smallholder farmers' challenges and opportunities: Implications for agricultural production, environment and food security. *Journal of Environmental Management*, 370, 122536.
- Vermeulen, Sonja., Campbell, B. M. & Ingram, S. (2012) Climate change and food systems. *Annual Review of Environment and Resources*, 37(1), 195-222.
- World Bank. (2023). World Bank Group Climate Change Action Plan 2021–2025. *Openknowledge.worldbank.org*. <https://openknowledge.worldbank.org/entities/publication/ee8a5cd7-ed72-542d-918b-d72e07f96c79>
- World Bank. (2024). *Agriculture and Food*. World Bank. <https://www.worldbank.org/en/topic/agriculture>
- Yamane, T. (1967). *Statistics: An Introductory Analysis*, 2nd Edition., New York: Harper and Row. Pp.33-50.
- Yellapu, V. (2018). Descriptive statistics. *International Journal of Academic Medicine*, 4(1), 60-77.