



**ECONOMIC OF UTILISATION OF CLIMATE SMART AGRICULTURAL PRACTICES
AMONG RICE FARMERS IN DASS LOCAL GOVERNMENT AREA,
BAUCHI STATE, NIGERIA**

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ABSTRACT

The study analysed the economic utilisation of Climate Smart Agricultural Practices (CSA) among rice farmers in Dass Local Government Area of Bauchi State, Nigeria. A multi-stage sampling technique was used to select 120 rice farmers randomly. Primary data were collected using structured questionnaires and analysed using descriptive statistics, net farm Income, and a logit regression model. The results revealed that rice farming was male-dominated (62.5%), with moderate access to extension (54.2%) and credit services (77.5%). The results revealed that majority (66.7%) of the farmers utilised CSA practices. Early maturing varieties (57.5%), zero tillage (52.5%), and good market strategies (51.7%) were the most utilized CSA practices. The total cost, gross income and net farm income were ₦532,954.76, ₦862,755.75 and ₦329,800.99 per hectare, respectively. The results on factors influencing utilisation of CSA practices, revealed that education was positive and highly significant ($P < 0.01$). Similarly, marital status, occupation, access to extension services and years of farming experience were significant at $P < 0.05$. The constraints affecting the farmers were inadequate capital ($\bar{X} = 4.1$), high cost of inputs ($\bar{X} = 3.8$) and inadequate enlightenment ($\bar{X} = 3.7$) on CSA practices, among others. The study recommended that financial institutions should promote farmer-friendly credit facilities. Also, provision of subsidised inputs to the rice farmers in order to promote utilisation of CSA practices on rice production in the study area.

Keywords: Agriculture, Climate, Practices, Smart, Utilisation

INTRODUCTION

The agricultural sector plays a pivotal role in the economic development and social stability of many countries, particularly in developing regions and serves as a primary source of livelihood, employment, food security, and income generation (Totin *et al.*, 2018). Globally, agriculture contributes approximately 4% of the global gross domestic product (GDP), but in low-income countries, this contribution can exceed 25%, reflecting its foundational role in sustaining rural livelihoods (World Bank, 2023). Specifically, in countries heavily reliant on agrarian economies, agriculture is not only a source of food but also a major contributor to export revenues, rural development, and poverty alleviation (FAO, 2023). In sub-Saharan Africa and parts of Asia, smallholder farmers dominate the agricultural landscape, and rice is one of the most significant staple crops. Rice farming contributes significantly to household income, national food baskets, and employment creation, especially for women and rural youth (IRRI, 2019). The sector supports value chains, including processing, marketing, and input supply, thus creating ripple economic effects beyond farm-level activities (FAO, 2023).

Agriculture is impacted by climate change, notably because it results in lower precipitation and higher temperatures, both of which have a detrimental impact on agricultural productivity (Kolleh and Jones, 2018). Crop productivity and the kinds of crops that can be cultivated in particular locations can be affected by the influence of climate change on agricultural inputs including the quantity of plant's exposure to solar radiation for development, how often pests are present and for irrigation (Onyeneke, 2021). Rice is a significant food crop in Sub-Saharan Africa because it serves as an important source of calories in meals for the region's occupants. External forces, including temperature and precipitation, influence agricultural output and have a substantial influence on the production of rice. As rice is extremely susceptible to soil, environmental, and climatic factors, rice production is expected to plummet from 2020 to 2080 due to the anticipated rise in temperature and fall in precipitation, as

predicted by Kolleh and Jones (2018). The severity of weather conditions will determine the output of rice production (Onyeneke, 2021). Climate-smart agricultural practice has emerged as a promising way to ensure adequate food supplies for the growing population and to meet the challenges of climate change (Totin *et al.*, 2018).

Several studies have been carried out on climate and agriculture in Nigeria. Some of them focused on impact of climate change on rice production where adoption rate of CSA practices in guinea savannah region is generally very low (Chandio *et al.*, 2020). The low utilisation rate can be ascribed to the knowledge of human as well as their flexibility to respond to the negative consequences of climate change. Despite various governmental and non-governmental efforts aimed at promoting CSA utilisation, little empirical research has been conducted to assess how these practices are utilised by rice farmers in the study area. The study will provide valuable information for rice value chain actors, policy makers, agricultural extension agents, and development organizations working to promote sustainable rice production in the face of climate change.

The specific objectives were to:

- i. describe the socio-economic characteristics of rice farmers in the study area;
- ii. evaluate the costs and return of the rice production;
- iii. determine the factors that influence utilisation of climate smart agricultural practices in rice production; and
- iv. identify the constraints affecting utilisation of climate smart agricultural practices by the rice farmers in the study area.

METHODOLOGY

The Study Area

This study was conducted in Dass LGA of Bauchi. The area is located within the geographical coordinates of 10° 10' North latitude and longitude 9° 40' East. The area is characterized by a semi-arid climate with distinct wet and dry seasons. The region experiences moderate to high temperatures throughout the year, with average annual temperatures ranging from 25°C to 35°C and rainfall of approximately 800 – 1,200 mm. This period is crucial for crop production, especially for rain-fed crops such as rice, maize, and sorghum (Tambo *et al.*, 2018). The LGA covers a total area of approximately 3,100 square kilometers with flat plains, hills, and valleys that are conducive for diverse farming activities (Bauchi State Government, 2021). The land is primarily used for both crop and livestock farming, with rice being one of the dominant crops in the region. The 2006 population census of Dass LGA is 89,943 persons. The estimated population at 3.7% growth rate is 161,960 persons as of 2024. The population is predominantly rural, with farming being the primary economic activity for most residents (Bauchi State Government, 2021).

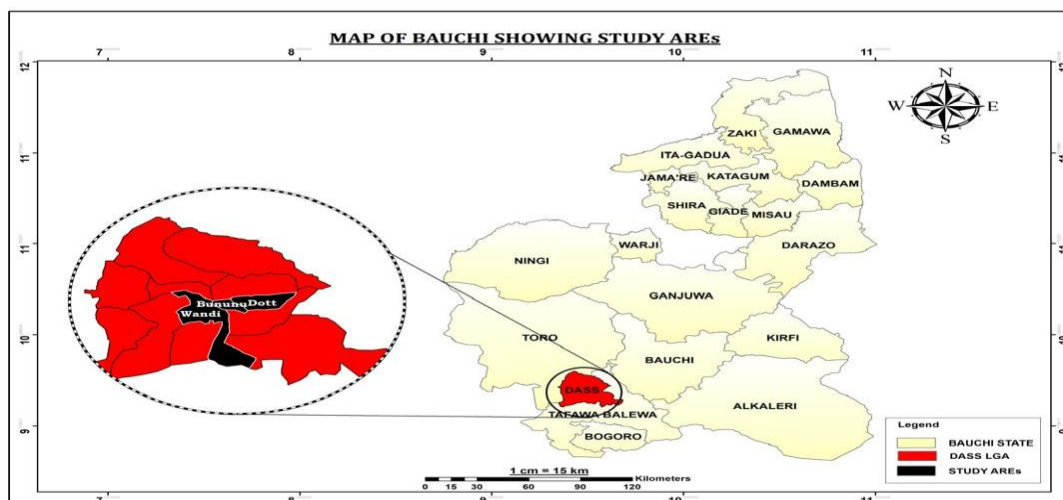


Figure 1: Map of the Study Area



Sampling Technique and Sample Size

A multi- stage sampling technique was used to select the respondents for this study. The first stage involved the purposive selection of three (3) wards (Wandi, Dott, Bununu) from the Local Government Area due to huge volume of rice production. In the second stage, two (2) communities from each ward were purposively selected making a total of 6 communities. In final stage, 10% of the rice farmers in each of the communities were selected randomly from sampling frame. This gave a total sample size of 120 farmers. The sampling technique and sample size is presented in Table 1

Table 1: Sampling Technique and Sample Size

LGA	Wards	Communities	Sampling Frame	Sample size (10%)
Dass	Wandi	Gamki	250	25
		Goltukurwa	210	21
	Dott	Kuletu	170	17
		Bondi	180	18
	Bununu	Tudun Wus	190	19
		Garam	200	20
Total			750	120

Source: BSADP, 2024 and Author’s Computation

Method of Data Collection

Data for the study were collected through a structured questionnaire which was used to obtain information from the farmers. The information collected include, socio-economic characteristics of the rice farmers, information on profitability of rice production under CSA, factors influencing adoption of CSA and constraints affecting utilisation of CSA practices.

Method of Data Analysis

Data were analyzed using both descriptive, budgeting model and inferential statistics. Descriptive statistics such as mean percentage and frequency distribution were used to achieve objectives i and iv. The iii objective was achieved using logit regression model. While farm budget analysis was used to analyse objective iii. Mean score was used to measure constraints affecting rice farmers under CSA practices.

Net Farm Income

Net farm income is the difference between gross Income and total costs. It is calculated as:

$$NFI = GI - TC \quad \dots (1)$$

Where;

NFI=Net farm income (₦)

GI = Gross Income (₦)

TC = Total cost (TVC + TFC)

TVC = Total variable cost (₦)

TFC= Total fixed cost (₦)

Return per naira invested is the turnover on each naira invested in rice production. It is estimated as:

$$RNI = \frac{NI}{TC} \quad \dots (2)$$

Where;

ROI = Return per naira Investments on rice production

NI = Net Income on rice production

TC = Total Cost on rice production

The gross ratio measures the ultimate solvency of the farm business. Gross ratio is calculated as:

$$GR = \frac{TC}{GI} \quad \dots (3)$$



Where;

GR = Gross Ratio

TC = Total cost for rice production

GI = Gross Income for rice production

The operating ratio measures the variable resource inputs involved in the farm business at a point in time. Operating ratio is computed as:

$$OR = \frac{TOC}{GI} \quad \dots (4)$$

Where;

OR = Operating Ratio

TOC = Total Operating cost for rice production

GI = Gross Income for rice production

The fixed ratio is an indication of the percentage of the gross income accruing to fixed resources. It is calculated as:

$$FR = \frac{TFC}{GI} \quad \dots (5)$$

Where;

FR = Fixed Ratio

TFC = Total Fixed Cost for rice production

GI = Gross Income for rice production

Logit Regression

Logit regression was used to analyze the factors influencing the utilisation of climate smart agricultural practices. In the model, the dependent variable is the utilised climate smart agricultural practices and coded as 1, and 0 not utilised. The model is specified implicitly as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11} + e) \quad \dots (6)$$

The explicit form of the model is specified as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + e \quad \dots (7)$$

Where;

Y = Utilised climate smart agricultural practice (utilized = 1, otherwise = 0)

X₁ = Age of Household head (years)

X₂ = Sex (1 = male 2 = female)

X₃ = Marital Status (married = 1, single = 2, divorce = 3, widowed = 4)

X₄ = Household size (numbers)

X₅ = Major occupation (livestock rearing = 1, civil servant = 2, trading = 3, student = 4, others = 5)

X₆ = Educational of status household (not educated = 1, Qur'anic education = 2, Adult education = 3, primary education = 4, secondary education = 5, tertiary education = 6)

X₇ = Participation in CSA training (participate = 1, not participate = 0)

X₈ = Source of capital (personal savings = 1, loan = 2, salary = 3, relatives = 4, others = 5)

X₉ = Source of information (family = 1, friends = 2, mass media = 3, extension agents = 4, others = 5)

X₁₀ = Access to extension service (yes = 1, no = 0)

X₁₁ = Years of Farming experience (years)

b₁-b₁₁ = Coefficient of the regression model

v = Error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Table 2 presents the socioeconomic characteristics of the rice farmers in the study area. The finding shows that the majority (62.5%) of the respondents were male, while 37.5% were female. This implies that rice farming is male-dominated, although a substantial proportion of women also



participate. This finding agrees with the report of Abubakar *et al.* (2022), who observed male dominance in smallholder rice production in Bauchi State. Similarly, Ayanlade and Radeney (2020) found that male farmers often have more access to agricultural information and extension services, which enhances their adoption of climate-smart technologies. The findings also show that majority (61.7%) of respondents were married, 13.3% were single, 13.3% divorced, and 11.7% widowed. This suggests that most rice farmers are married individuals who likely have family responsibilities and dependents. This finding is consistent with Bashir *et al.* (2021), who reported that marital status enhances farmers' social and economic responsibilities, influencing their motivation to engage in productivity-enhancing practices.

The result also indicated that a good proportion 37.5% of respondents were primarily engaged in farming, 17.5% in livestock rearing, 18.3% were civil servants, 17.5% traders, and 9.2% students. This finding implies that farming is the predominant occupation in the study area, reflecting the agrarian nature of the community. This agrees with Aliyu *et al.* (2020), who reported that livelihood diversification enhances the utilisation of Climate Smart Agricultural Practice (CSAPs) by reducing financial vulnerability and improving farmers' adaptive capacity.

Table 2: Distribution of the Respondents based on the Qualitative Socioeconomic Characteristics (n=120)

Variables	Frequency	Percentage
Sex		
Male	75	62.5
Female	45	37.5
Marital status		
Married	74	61.7
Single	16	13.3
Divorce	16	13.3
Widowed	14	11.7
Occupation		
Farming	45	37.5
Livestock rearing	21	17.5
Civil servant	22	18.3
Trading	21	17.5
Students	11	9.2
Educational level		
Non-formal	13	10.8
Qur'anic education	11	9.2
Adult education	7	5.8
Primary education	17	14.2
Secondary education	43	35.8
Tertiary education	29	24.2
Participation in CSA		
Yes	80	66.7
No	40	33.3
Source of capital		
Personal savings	54	45.0
Loan	29	24.2
Salary	16	13.3
Relatives	21	17.5
Access to extension services		
Yes	65	54.2
No	55	45.8
Access to credit		
Yes	93	77.5
No	27	22.5

Source: Field Survey, 2025



The result further revealed that a good proportion 35.8% of the respondents attained secondary education, 24.2% tertiary education. This distribution suggests a relatively high literacy level among rice farmers in the study area, which is a positive indicator for technology adoption and effective utilization of CSAPs. The finding aligns with Nkwi *et al.* (2022), who asserted that education improves farmers' capacity to access and utilize agricultural innovations. The finding showed that majority (66.7%) of the respondents participated in CSAPs, while only few 33.3% had not yet utilised the practices. This level of participation suggests that awareness and utilisation of CSAPs are still limited among rice farmers in the study area. This finding aligns with Bashir *et al.* (2023), who reported low adoption rates of CSAPs among Nigerian smallholders due to insufficient institutional support and lack of access to training.

The results also show that a large proportion 45% of respondents financed their farming through personal savings, 24.2% through loans, 17.5% from relatives, and 13.3% from salaries. This suggests that most farmers rely on self-financing, which limits their ability to invest in improved technologies and CSAPs. According to Ozor *et al.* (2022) lack of formal credit access constrains smallholder farmers' capacity to implement adaptive measures such as irrigation, soil fertility improvement, and the use of improved seed varieties. The result further reveals that 54.2% of the respondents had access to extension services. Similarly, majority (77.5%) had access to credit. This finding indicates moderate access to institutional support in the study area, suggesting that extension agents play a crucial role in disseminating information on CSAPs and climate adaptation. This is consistent with Myeni *et al.* (2020) and Eze *et al.* (2021), who emphasized that access to extension and credit services positively influences the adoption of CSAPs and resilience strategies.

Types of Climate Smart Agricultural Practices Utilised by Rice Farmers

Table 3 presents the distribution of respondents according to the types CSAPs adopted in the study area. The finding shows that the most commonly utilized CSA practices were early maturity varieties (57.5%), zero tillage (52.5%), and good market strategies (51.7%), ranked first, second, and third, respectively.

Table 3: Distribution of the Respondents based on the Types of Climate Smart Agricultural Practices Utilised

Variables	Frequency*	Percentage	Rank
Early maturity varieties	69	57.5	1 st
Zero tillage	63	52.5	2 nd
Good market strategies	62	51.7	3 rd
Use of cover crops	50	41.7	4 th
Use of organic fertilizers	48	40.0	5 th
Agro-forestry practices	41	34.2	6 th
Use of drought tolerant varieties	40	33.3	7 th
Post-harvest management	39	32.5	8 th
IPM	27	22.5	9 th
Use of pest and disease resistant varieties	27	22.5	9 th
Efficient irrigation methods	10	8.3	11 th

Source: Field Survey, 2025 *Multiple response

The high utilisation of early maturing varieties indicates farmers' awareness of the need to adapt to shorter and less predictable growing seasons, which have become more frequent due to climate variability. Similar findings were reported by Aliyu *et al.* (2020) and Ayanlade and Radeny (2020), who observed that early-maturing rice varieties were increasingly adopted across northern Nigeria as a coping mechanism for erratic rainfall and delayed onset of the rainy season. Zero tillage the second-ranked practice, enhances soil structure, improves moisture retention, and reduces erosion. Its significant utilization suggests that farmers are gradually shifting from conventional ploughing to conservation-based systems that sustain soil health. According to Eze *et al.* (2021), zero tillage contributes to long-term soil fertility conservation and cost reduction, making it an economically viable CSA option for resource-poor farmers. The adoption of good market strategies highlights the economic



dimension of CSA, reflecting farmers' recognition that resilience extends beyond production to marketing. By improving access to profitable markets, farmers can better cope with post-harvest losses and price fluctuations. Nkwi *et al.* (2022) similarly reported that market-oriented resilience strategies enhance income stability among smallholder rice producers.

Other practices included use of cover crops (41.7%), organic fertilizers (40.0%), agroforestry (34.2%), drought-tolerant varieties (33.3%), and post-harvest management (32.5%). These mid-level adoption rates suggest that most farmers employ multiple complementary strategies to maintain productivity under changing climatic conditions. The relatively moderate adoption of agroforestry indicates potential for expansion, especially given its ecological benefits such as carbon sequestration and microclimate regulation (Myeni *et al.*, 2020). Less commonly adopted practices were integrated pest management (IPM) and use of pest and disease-resistant varieties (22.5%), while efficient irrigation methods (8.3%) recorded the lowest adoption rate. The low uptake of irrigation-related CSA techniques may be linked to inadequate water infrastructure, high costs, and limited technical know-how. This aligns with Bashir *et al.* (2021), who found that the adoption of irrigation-based CSA technologies in northern Nigeria remains low due to infrastructural and financial barriers.

Profitability Analysis of Rice Production under CSA Practices

Table 4 presents the cost and returns analysis of rice production under CSA practices in the study area. Profitability analysis is crucial to assess the economic feasibility and sustainability of climate-smart farming systems. The total variable cost (TVC) accounted for the majority of production expense was ₦497,371.53. Among the TVC components, fertilizer constituted about 44.56% of the total cost with was the highest, reflecting heavy input dependence even under CSA systems. This may be attributed to the combined use of organic and inorganic fertilizers, a common practice among smallholders to ensure adequate nutrient supply. This was followed by cost of harvesting, ridging and transportation with constituted 13.17%, 9.56% and 8.58%, respectively of the total cost of production. These findings are consistent with Eze *et al.* (2021), who identified fertilizer and labor as major cost drivers in climate-smart rice production in Nigeria.

Table 4: Average Cost and Returns on Rice Production among Respondents Utilising CSA in the Study Area

Variables	Amount (₦)	Percentage
Variable cost		
Seeds/seedlings	5,850.00	1.10
Fertilizer/Organic manure	237,500.50	44.56
Pesticides/insecticides	8,300.00	1.56
Herbicides	25,580.50	4.79
Land clearing	3,205.40	0.60
Ridging	50,950.25	9.56
Sowing	4,255.50	0.80
Fertilizer application	5,800.00	1.09
Spraying	2,500.00	0.47
Weeding	37,527.50	6.99
Harvesting	70,175.40	13.17
Transportation	45,726.33	8.58
TVC	497,371.53	
Fixed cost		
Depreciation fixed on assets	35,583.23	6.67
TFC	35,583.23	
TC	532,954.76	100.00
Revenue		
Sales of paddy (32.5 bags/75kg @ #25,000 per bag)	812,500.00	
Rice straw	50,255.75	
Gross Income (Total Revenue)	862,755.75	
Net Farm Income	329,800.99	
Return per Naira Invested	0.62	
Operating ratio	0.58	
Fixed ratio	0.04	
Gross ratio	0.62	

Source: Field Survey, 2025

The total fixed costs (TFC) was ₦35,583.23 including depreciation amount of farm tools and equipment representing a minimal proportion of 6.67% of the total cost (₦532,954.76). The returns on sales of paddy rice and rice straw were ₦812,500.00 and ₦50,255.75, resulting in a gross income of ₦862,755.75. The net farm income (NFI) and Return per Naira Invested (RNI) were ₦329,800.99 and 0.62, respectively. This implies that for every naira invested, farmers obtained a return of ₦0.62. This substantial NFI and RNI indicates strong profitability and economic viability of CSA-based rice farming in the study area. The result further revealed that financial ratios were 0.58, 0.04 and 0.62 for operating, fixed and gross ratios, respectively. This indicates that all the ratios were of less than one (1) implying that the gross income of the farm is able to offset the cost of variable and fixed inputs used in the rice production. This finding aligns with Nkwi *et al.* (2022) and Bashir *et al.* (2021), who reported that CSA adopters achieved significantly higher returns on investment due to reduced input costs and improved yield stability compared to non-adopters. Similarly, Ozor *et al.* (2022) emphasized that CSA promotes resource efficiency, resulting in higher productivity per unit cost of input.

Factors Influencing Utilisation of CSA among Respondents

The logistic regression results in Table 5 revealed the factors influencing the utilisation of climate-smart agriculture (CSA) among rice farmers in Dass. The result shows that educational level (3.24) was positive and highly significant ($P < 0.01$) influence on CSA utilization. This finding implies that educated farmers are more likely to engage in CSA compared to their less educated counterparts. This agrees with global evidence that education enhances farmers' ability to interpret climate information, understand risks, and adopt innovative technologies (Makate, 2020). The result further shows that marital status (-2.52) has a statistically significant ($P < 0.05$) and negative influence on CSA



utilization. This finding implies that married farmers are less likely to adopt CSA practices compared to unmarried farmers. This finding aligns with the argument that married farmers often have higher household financial burdens, making them more risk-averse to new or uncertain technologies Mango *et al.* (2018).

Table 5: Factors Influencing Utilization of Climate Smart-Agriculture among Respondents

Variables	Odds Ratio	Std. Error	Z	P z
Age	1.010357 ^{NS}	.0242195	0.43	0.667
Sex	2.39312 ^{NS}	1.28079	1.63	0.103
Marital status	.5576573 ^{***}	.1292155	-2.52	0.012
Household size	.9935717 ^{NS}	.0877585	-0.07	0.942
Occupation	.7407842 ^{**}	.1493057	1.49	0.037
Educational level	1.697414 ^{***}	.2774228	3.24	0.001
Participation in CSA	.4586354 ^{NS}	.3049131	-1.17	0.241
Source of capital	.7383367 ^{NS}	.1774718	-1.26	0.207
Source of information	.521691 ^{NS}	.2861908	-1.19	0.236
Access to extension services	.9080769 ^{**}	.4905525	-0.18	0.048
Years of farming experience	.9398928 ^{**}	.0630088	-0.92	0.025
Constant	11.70522	36.28638	0.79	0.427
Log likelihood	-59.287192			
Pseudo R ²	0.5838			

Source: Field Survey, 2025 *** = P<0.001 ** = P<0.005

On the other hand, major occupation is positive and significant (P<0.05) although full-time farmers might be expected to adopt CSA more readily, this result suggests that occupational diversification significantly influence adoption. This aligns with findings from Asfaw *et al.* (2019), which show that rural households often combine farming with non-farm income, reducing reliance on agriculture and limiting incentives for CSA investment.

Constraints Affecting Respondents in Utilisation of CSA Practices

Table 6 outlines the constraints that hinder effective utilization of CSA among rice farmers in the study area. The finding shows that the most severe constraint was inadequate capital with a mean score of 4.1 highlighting a financial limitation as the foremost challenge to CSA utilisation. This result aligns with Ayanlade and Radeny (2020) and Ozor *et al.* (2022), who emphasized that insufficient funding and poor access to agricultural credit prevent smallholders from acquiring technologies and inputs required for CSA implementation. Other severe challenges include inadequate extension workers (3.9), high cost of inputs (3.8), and technical know-how limitations (3.7). The shortage of trained extension personnel limits the dissemination of CSA knowledge, resulting in improper application or non-adoption of technologies. Similarly, escalating costs of inputs such as fertilizer and irrigation equipment discourage continuous utilization of CSA practices. Eze *et al.* (2021) and Nkwi *et al.* (2022) both reported that technical and input-related constraints critically undermine climate adaptation initiatives.

Table 6: Constraints Affecting Respondents in Utilisation of CSA Practices

Variables	Very severe	Severe	Moderately severe	Not severe	Neutral	Mean	Remark
Inadequate capital	46(38.3) *	49(40.8)	25(20.8)	-	-	4.1	Severe
Technical know-how	35(29.2)	31(25.8)	45(37.5)	1(0.8)	8(6.7)	3.7	Severe
High cost of inputs	23(19.2)	69(57.5)	23(19.2)	2(1.7)	3(2.5)	3.8	Severe
Pest and disease infection	13(10.8)	49(40.8)	50(41.7)	5(4.2)	3(2.5)	3.5	Severe
Poor infrastructures	28(23.3)	46(38.3)	30(25.0)	8(6.7)	8(6.7)	3.6	Severe
Community resistance	20(16.7)	29(24.2)	62(51.7)	5(4.2)	4(3.3)	3.4	Severe
Inadequate extension workers	32(26.7)	59(49.2)	22(18.3)	6(5.0)	1(0.8)	3.9	Severe
High cost of labour	39(32.5)	25(20.8)	46(38.3)	10(8.3)	-	3.7	Severe
Inadequate enlightenment on CSA practice	33(27.5)	31(25.8)	49(40.8)	4(3.3)	3(2.5)	3.7	Severe

Mean score threshold <3.0= Not severe ≥3.0= severe *Figures in parentheses are percentage

Additionally, high cost of labor and inadequate enlightenment on CSA practices with a mean score of 3.7each were perceived as severe barriers. Many farmers still rely on manual labor for rice production, which increases operational costs. Moreover, limited awareness campaigns have slowed CSA utilisation among the farmers. This result is in conformity with findings of Bwala *et al.* (2021). Other constraints include poor infrastructure (3.6), pest and disease infestations (3.5), and community resistance (3.4). Poor infrastructure limits market access and timely acquisition of inputs, while pest outbreaks reduce crop yield despite CSA utilisation.

CONCLUSION AND RECOMMENDATIONS

The study concluded that climate smart agricultural practices are economically viable and environmentally friendly. CSA presents a viable pathway for enhancing rice productivity, income generation, and climate resilience in the study area. Based on the findings, the following recommendations were made:

- i. Government and developmental agencies should recruit and train more extension personnel to enhance farmer awareness and technical support on CSA practices.
- ii. Financial institutions should design low-interest agricultural credit schemes tailored to smallholder rice farmers to address capital constraints.
- iii. Government should subsidise inputs such as improved seed varieties, agrochemicals and fertilizers,

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