



## UTILIZATION OF CLIMATE-SMART RICE PRODUCTION TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN ABAKALIKI LOCAL GOVERNMENT AREA OF EBONYI STATE, NIGERIA

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### ABSTRACT

The study was carried out in Abakaliki Local Government Area of Ebonyi state. The broad objective of the study was to assess utilization of climate-smart rice production technologies among smallholder rice farmers. The specific objectives were to: assess the utilization of climate smart rice production technologies and determine the factors influencing the utilization of climate-smart rice production technologies. Multistage sampling procedure was used to select 85 rice smallholder rice farmers. Questionnaire was used for data collection while frequency, percentage, mean and binary logistics were used for data analysis. The study found that 56.5% of the rice farmers were males, 42.4% were married, 38.8% had secondary education. More so, the findings revealed that 96.5% of the rice farmers utilized crop rotation, 94.1% used disease-resistant varieties, 91.8% used agroforestry, 90.6% made use of efficient fertilizer application and 90.6% efficient use of herbicides. The results also showed that source of credit was a factor influencing the utilization of climate-smart rice production technologies. Financial institutions should prioritize providing credit to farmers for investment in climate-smart rice production technologies that will boost yields and income.

**Keywords:** Utilization, Technologies, Climate-smart, Production, Rice

### INTRODUCTION

Rice (*Oryza sativa*) is one of the most staple crops on earth and supply food for over half the world's population and the most important among all the cereal crops. In 2020, more than 100 countries cultivated rice from 16 hectares of rice area (FAO, 2022). Also, more than 5.3 billion world population depend on rice for obtaining 20% of their daily calorie intake (Fahad, *et al.*, 2019). According to Shahbandeh (2023), in 2021/2022 crop year, China produced over 148 million metric tons of milled rice than any other country in the world with 30 million hectares of area harvested, followed by India with 129 million tons with 46 million hectares of area of land harvested. In 2021, rice production in Nigeria amounted to about 8.3 million metric tons, making the country the leading rice producer in Africa (Sasu, 2023). Nigeria is the 11<sup>th</sup> largest consumer of rice worldwide and the lowest annual consumption per capital of the top 11 consuming countries, with a value of 35kg/year (Sasu, 2023). Nigeria is the largest rice producing country in West African sub-region and second in Africa after Egypt with 6.5% over the past decades, reaching 3.8 million metric tons in 2018. Rice is one of the most extensively grown crops in Ebonyi state which is also the main staple meal that is eaten by many households throughout the local government areas (Onyeneke *et al.* 2021). Rice production is threatened by climate change which reduces yield, worsening the food insecurity situation of farming households. Climate change is referred to as change in climate that is attributable directly or indirectly to human activities that alter the atmospheric composition of the earth which leads to global warming, flood, drought, pests and infestation among others (Abbas *et al.*, 2022). Flooding, heavy rainfall, heat stress, and insect and disease infestation are the most significant impacts of climate change on rice production (Pendergrass and Knutt, 2018). Farmers have suffered both financial and yield losses, which has had a significant effect on their yield and well-being. In this case, rice farmers must utilize climate-smart rice production technologies that can mitigate the negative effects of climate change to increase their yield, income food security (Yakubu *et al.*, 2019).



These farming technologies recognize the necessity of promoting yield to sustain a growing populace, concurrently curbing greenhouse gas emissions, and heightening resilience against climate change impacts (Ayorinde *et al.* 2022). Climate-smart rice production technologies include disease resistant varieties, crop rotation, agroforestry (Nchanji *et al.* 2022). Furthermore, rice farmers utilize improved rice varieties to reduce negative effects of climate-smart on their livelihoods like FARO 44 and FARO 52 among other improved varieties of rice (Izuogu *et al.*, 2024). The utilization of climate-smart agriculture practices increases agricultural productivity, build resilience and reduce greenhouse gas emission (Shahbaz *et al.* 2022). However, rice farmers face constraints in utilizing climate-smart rice production technologies like complexity and difficulty in the technologies and unexpected outcomes, lack of capital, low level of motivation, farmer's attitude towards risk and change, lack of fertilizer, infestation by weeds, pests and disease, poor access to information and extension services, land tenure system, cultural beliefs among others. Therefore, based on the above constraints the study is aimed at assessing the utilization of climate-smart rice production technologies among small-scale rice farmers in Abakaliki Local Area of Ebonyi state, Nigeria. The specific objectives of the study were to assess the utilization of climate smart rice production technologies and determine the factors influencing the utilization of climate-smart rice production technologies by smallholder rice farmers.

## **METHODOLOGY**

The study was carried out in Abakaliki Local Government Area of Ebonyi State, Nigeria. Ebonyi State is situated in the southeastern region of Nigeria. The state shares borders with Enugu State to the west, Benue State to the north, Cross River State to the south, and Abia State to the south-west. The state is located between Latitude 6.32<sup>0</sup> North and Longitude 8.12<sup>0</sup> East.. The state's topography is characterized by both lowland and upland areas, with fertile soil suitable for agriculture. The state is known for producing various crops, including rice, yam, cassava, maize, and vegetables. The population of the study involved all smallholder rice farmers in Abakaliki, Ebonyi State. Multi-stage sampling procedure was employed for selection of 85 rice farmers. In the first stage, purposive sampling was used to select Abakaliki Local Government because of its prominence in rice production, from which five council wards were selected at random including Izzi Unuhu ward, Abakpa ward, Amagu ward, Ndiagu ward and amachi ward. At the second stage, one community from each of the selected council ward was selected based on their massive involvement in rice production, giving a total of five communities for the study. At the last stage, purposive sampling was used to select 17 smallholder rice farmers who were selected from each of the selected communities, giving a total of 85 smallholder rice farmers for the study. Structured questionnaire was used for data collection. Frequency, percentage and multiple linear regression were used for data analysis.

## **RESULTS AND DISCUSSION**

### **Socioeconomic Characteristics of Rice Farmers**

Table 1 reveals that 56.5% of the rice farmers were males while 43.5% were females, 31.8% of the respondents were within the age of 41 and 50. The average age of the respondents was found to be 45.98 years, 42.4% of smallholder rice farmers were married. The study found that 38.8% of the respondents obtained secondary education. This implies that the respondents had a reasonable level of education that could help them to understand difficult concepts (Ahsan *et al.*, 2020). More so, the average household size was 7 people. Onyeneke *et al.* (2021) found that the household size of rice farming household in Ebonyi state was approximately 7 persons. The majority (76.8%) of the respondents had farm sizes between 1 and 4, and the average farm size was 5.526 hectares. Also, 69.4% % of the respondents had an annual income of above 600,001 naira, with an average annual income of ₦1,590,071.765. This implies that the respondents made a reasonable amount of money from rice production, and this could probably be due to utilization of climate-smart rice production technologies. More so, 34.1% of respondents had spent more than 13 years on rice production, 23.5% had spent 1-4 and 5-12 years, respectively, while 17.7% had spent between 9 and 12 years. The average age spent on rice production was found to be 15.18 years. This implies that the respondents had spent a reasonable number of years on rice production.



**Table 1: Socio-economic Characteristics of Smallholder Rice Farmers (n=85)**

Socio-economic Characteristics	Frequency	Percentage	Mean
<b>Sex</b>			
Male	48	56.5	
Female	37	43.5	
<b>Age</b>			
20-30	24	28.2	
31-40	14	16.5	
41-50	27	31.8	46
51 and above	20	23.5	
<b>Educational levels</b>			
No formal education	15	17.6	
Primary education	15	17.6	
Secondary education	33	38.8	
Tertiary education	22	25.9	
<b>Household size in number</b>			
1-4	15	17.7	
5-8	36	42.4	7
9 and above	28	33.0	
<b>Farm size in hectares</b>			
1-3	65	76.8	
4-6	12	14.1	5
7-10	4	4.7	
11 and above	4	4.7	
<b>Annual income in naira</b>			
1-200,000	11	12.9	
200,001-400,000	8	9.4	
400,001-600,000	7	8.2	
600,001 and above	59	69.4	₦1,590,071.765
<b>Rice production experience in years</b>			
1-4	20	23.5	
5-8	20	23.5	
9-12	16	17.7	
13 and above	29	34.1	15
<b>Sources of credit facilities</b>			
Commercial banks	13	15.3	
Microfinance bank	2	2.4	
Isusu	11	12.9	
Friends	8	9.4	
Relatives	33	38.8	
personal savings	18	21.2	
<b>Sources of seeds</b>			
Local Market	41	48.2	
Seed suppliers	8	9.4	
Government agency	5	5.9	
Personal source	31	36.5	

**Source:** Field Survey, 2024

Furthermore, 74.1% belonged to social organization while 25.9% did not: 45.9% belonged to rice farmers' association, 34.1% were in village cultural association while 17.6% were in political group and 2.4% belonged to others. This implies that majority of the respondents were members of social organization and this could be because of the benefits associated as reported by Liverpool-Tasie and Parkhi, (2020). Also, 52.9% did not have extension visits for the last one year while 47.1% had extension visits in the last one year. This indicates that there was poor extension activity, and this contradicts the findings of Onyeneke *et al.* (2021) found that majority of rice farmers in Ebonyi state have accessed extension services. Majority (65.9%) got their farmland from inheritance.



### **Utilization of Climate-smart Rice Technologies by Rice Farmers**

Table 3 reveals that crop rotation, use of resistant varieties, agroforestry, efficient fertilizer application, efficient use of herbicides, organic manure, pest and disease management bush fallowing, changing planting dates, drought resistant seed varieties and effective irrigation practices (96.6%, 94.1%, 91.8%, 90.6%, 89.4%, 87.1%, 88.2%, 85.9%) were the climate-smart rice production technologies utilized by the respondents. Utilization of crop rotation helps improve soil health, enhances water management and reduces green-house gas emissions. Yu *et al.*, (2022) reported that crop rotation can improve soil structure, increase water retention and prevent erosion, leading to a more sustainable and climate-resilience agricultural system. More so, smallholder rice farmers utilized resistance rice varieties as a climate-smart rice production technology in their rice production and this could probably be because using resistant rice varieties is a key as it helps farmers adapt to climate change impacts and enhance food security. The rice resistant variety is bred to withstand various stressors such as drought, floods and pests, ensuring stable yields under any climatic conditions. Reported that rice farmers in Nigeria made use of improved varieties such as FARO 44, FARO 52 and FARO 59 as climate-smart rice varieties. This could be because rice varieties mature earlier than conventional varieties, grow shorter than conventional varieties, yield more, and are resistant to climate risks and lodging (Onyenee *et al.*, 2021). Agroforestry was another climate-smart technology used by the respondents in rice production and this might be because agroforestry integrates trees into agriculture which helps to enhance soil health and biodiversity conservation, leading to more sustainable and climate-resilient farming as reported by Ntawuruhunga *et al.*, (2023). Furthermore, the finding implies that the respondents observed efficient fertilizer application as a climate-smart technologies to reduce the effect of climate change on their farms. This might be because effective fertilizer application in rice production is essential for crop yields and maintaining healthy soil. It ensures plants receive the necessary nutrients leading to higher quality harvests and improved soil fertility over time (Alnaass *et al.*, 2021). More so, the finding indicates that the respondents applied efficient use of herbicides in their rice production that helps control weeds and provide flexibility to crop growers. The finding further implies that the respondents utilized pest and disease management strategy as climate-smart rice production technology in their rice production and this might be because there will be an increase in farm yield when pests are properly controlled and disease well managed. The study found that smallholder rice farmers adopted organic manure as a climate-smart rice production technology as organic manure enhances soil health, reduces reliance on synthetic fertilizers and promote sustainable agriculture (Bongole *et al.*, 2022).

Rice pest and disease management, efficient and effective use of pesticides was necessary to drive efficient growth processes and plant development without stress (Onyekwere, *et al.* 2020). Furthermore, adjusting planting and harvesting dates is seen as an effective crop and land management practice that enables rice farmers to adjust their planting and harvesting calendars to suit any prevailing climate change which, if not adhered to, might cause havoc on planted rice crops (Onyeneke, 2021). Also, the respondents utilized changing planting dates as a climate-smart agriculture practice. This is because adjusting the timing of planting to align with changing climatic conditions, such as shifting rainfall patterns or longer/shorter growing seasons improve crop yields and resilience. Bush fallowing and effective irrigation were among climate-smart rice production technologies practiced by smallholder rice farmers in the study area. Okoronkwo *et al.*, (2024) reported that farmers in sub-Saharan Africa adopted Bush fallowing and irrigation practices as climate-smart strategies to climate change.



**Table 2:** Utilization of Climate-smart Rice Technologies by Rice Farmers (n=85)

Climate-smart Rice production technologies	Percentage
Crop rotation	96.5
Disease resistant varieties	94.1
Agroforestry	91.8
Efficient fertilizer application	90.6
Efficient use of herbicides	90.6
Organic manure	90.6
Pest and disease management	89.4
Changing planting dates	88.2
Drought resistant seed varieties	88.2
Bush fallowing	87.1
Effective irrigation practices	85.9

**Source:** Field Survey, 2024

### Factors Influencing Utilization of Climate-smart Rice Production Technologies by Rice Farmers

Table 6 shows the influence of socioeconomic characteristics on the utilization of climate-smart rice production technologies. This was determined by the multiple linear regression, taking into cognizance its significant variables, the highest F-value and  $R^2$ . The F-value of 1.199 indicated that the model was fit, which implies that socioeconomic characteristics influenced utilization of climate-smart rice production technologies. The  $R^2$  value of 0.220, implying that 22% of the total variation in the endogenous variables were fully explained by the climate-smart technologies. The Table shows that source of credits was significant and positive at 1% level in influencing the utilization of climate-smart rice production technologies. This implies that a unit increase in the source of source credits for the smallholder farmers influences their utilization of climate-smart rice production technologies. This could be because access to credit enhances the utilization of climate-smart agriculture by allowing farmers, particularly smallholders, to afford the upfront costs of adopting new CSA technologies and practices which can be financially challenging without readily available loans, ultimately enabling them to invest in more sustainable and resilient farming methods that better adapt to climate change. Kalu and Mbanasor (2023) found that access to credit significant influence on the utilization of climate-smart agriculture technologies among crop root farming households in Nigeria.

**Table 3:** Influence of Socioeconomic Characteristics on the Utilization of Rice Climate-smart Production Technologies by Rice Farmers

Independent variables	B	Std. Error	Beta	T	Sig.
(Constant)	.394		.434	.909	.367
Sex	-.150		.132	-1.139	.259
Age	-.004		.006	-.757	.452
Educational level	.038		.077	.500	.618
Household size	-.003		.024	-.110	.913
Farm size	-.002		.005	-.437	.663
Annual income	2.852E-8		.000	.810	.421
Farm experience	.001		.007	.102	.919
Access to credits	.051		.155	.330	.742
Source of credits	.095		.039	2.438	.077*
Social organization	-.014		.169	-.081	.936
Different social orgs	.042		.071	.602	.549
Extension visits	.160		.123	1.303	.197
Sources of seeds	-.038		.046	-.825	.412

**Dependent Variable:** Utilization of rice production technologies \*Significant at 10%

$R = 0.469$ ,  $R^2 = 0.220$ , Adjusted  $R^2 = 0.037$ ,  $P\text{-value} = 0.291$ ,  $F\text{-value} = 1.199$





## CONCLUSION AND RECOMMENDATION

Utilization of climate-smart rice production technologies is beneficial to the rice farmers in many areas such as increased yield, enhanced sustainability of farming practice, improved efficient use of water, ensured better pest and disease control and reduction of production cost among others. However, smallholder farmers encountered constraints in the utilization of climate-smart rice production technologies such as poor extension services, low income from farming and limited availability of farm inputs among others. Federal and state governments should provide different sources of credit for the respondents for investment in climate-smart agriculture.

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