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FARMERS' UTILIZATION OF IMPROVED RICE PRODUCTION TECHNOLOGIES IN EBONYI STATE, NIGERIA

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ABSTRACT

The study assessed farmers' utilization of improved rice production technologies in Ebonyi State, Nigeria. Both random and purposive sampling techniques were used in the selection of 140 respondents for the study who were administered with a structured questionnaire. Data were analyzed using descriptive statistics such as frequency, mean scores, and inferential statistics of principal factor analysis. The study shows that farmers are highly aware of existing improved rice production technologies. The most utilized rice production technologies by farmers in the area include use of improved rice varieties ($\bar{X} = 2.9$), fertilizer application ($\bar{X} = 2.8$), use of agrochemicals ($\bar{X} = 2.6$), modern rice milling equipment ($\bar{X} = 2.6$) and timely transplanting and use of standard depths and spaces ($\bar{X} = 2.5$). The major constraints to farmers' utilization of improved rice production technologies in the study area are administrative, individual, environmental, financial and technical constraints. The study recommends that extension organisations should rejig their extension delivery system to ensure timely dissemination of information on improved rice production technologies to farmers; and farmers should organize themselves into cooperative organization to enhance their access to credit for procurement of modern rice storage and processing facilities.

KEYWORDS: Utilization, improved rice technologies, institutional constraints, environmental constraints, financial constraints, technical constraints

INTRODUCTION

Agriculture remains a fundamental component of Nigerian economy, employing about two-thirds of the nation's workforce. The National Bureau of Statistics (NBS) reported that agricultural sector contributed N41 trillion representing 23.7 percent of the total nominal Gross Domestic Product (GDP) to Nigeria's economy in 2021 (Ripples Nigeria, 2022). Over 70 percent of Nigerians engage in the agriculture sector mainly at a subsistence level (Food and Agriculture Organization (FAO), 2022). The country is rich with abundant human and natural resources, quality soil and favourable climatic conditions for agricultural activities. Nigeria with a population of over 200 million people and a landmass of 923,768 square kilometres has a total of over 79 million hectares of cultivable land (FAO, 2022). A breakdown of the arable land reveals that about 4.6 million hectares are suitable for rice cultivation, of which 1.8 million hectares (39%) is currently utilized for rice production (Demont, 2013). Rice (*Oryza sativa*) is a staple food for more than 60 percent of the world population (Chikezie, Benchendo, Ibeagwa, *et al*., 2020). In terms of production, rice is ranked third after wheat and maize at the global level (Akinbile, 2010). It is a leading cereal crop in South East, Asia where it originated and among the widely cultivated food crops (FAO, 2013).

In Nigeria, rice constitutes one of the major crops cultivated with other cereals, root and tubers such as sorghum, millet, cowpea, cassava and yam (Akinbile, 2010). It is a major staple food in the country, and its domestic production has not been able to meet local demand. While land cultivation and production of rice are growing at arithmetic progression, consumption is increasing at geometric progression (Olaolu, Akinnagbe and Agber, 2013). Corroborating this assertion, FAO (2013) observed that the demand and supply gap in rice production is widening annually, thereby resulting in huge import bill for the nation. According to Ammani (2013), Nigeria is the second highest importer of rice and spent over 356 billion naira on the importation of the commodity annually. Nigeria food importation is growing at an alarming and unsustainable rate of 11% yearly, and it has continued to fuel domestic inflation resulting from the use of scarce foreign currency to import rice. Uduma, Adeoye and Agbonlahor (2016) noted that the inability of local supply to meet up with consumers' demand (consumption) has given rise to the high importation of rice in Nigeria. Uduma *et al*. further opined that there has been a phenomenal rise in rice importation in Nigeria, estimated at 300 thousand tons annually in recent times which on the average is valued at 300 million naira per annum. They stressed that aside from the huge cost to the Nigerian economy, rice imports expose the country to international market

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shocks with its associated risk implications on food security. This growing dependence on rice imports is a major concern of Nigeria's government, and since the early 1980s numerous programmes have been implemented to encourage domestic rice production and achieve rice self-sufficiency (or at least to reduce the growth in imports). In particular, the current government of President Buhari initiated the Anchor Borrowers' Programme on November 17, 2015 (Central Bank of Nigeria (CBN), 2021). The core mandate of this programme is to provide loans (in kind and cash) to smallholder farmers to boost agricultural production, create jobs and reduce food import bill for conservation of foreign reserve. As at the end of December 2021, 4,489,786 farmers who cultivated 5,300,411 hectares across 21 commodities through 23 Participating Financial Institutions in the 36 States including Abuja have been financed (CBN, 2022). This intervention has impacted significantly on Nigerian rice output and decrease import bill on rice. For instance, in 2014, rice imported from Thailand to Nigeria which stood at 1.3 million metric tons dropped to 58,000 million metric tons in 2016 and further dropped to 2,160 metric tons by the end of 2021 (CBN, 2022); thereby saving the country foreign exchange and helping preserve jobs in Nigeria.

Despite this remarkably progress, comparatively, Nigeria's rice statistics suggest there is an enormous potential to raise productivity and increase production. Yields have remained at 2 tons per hectare, which is about half of the average achieved in Asian countries and just a quarter of the average yield in USA (PWC, 2017). In addition, as population increases, along with rural to urban migration, ensuring food security in key staples becomes critical. However, food security cannot be achieved by a system that depends almost entirely on human muscle power and obsolete technologies.

Technology adoption by rice farmers such as improved varieties, improved spacing, accurate planting depth, zero tillage, use of fertilizer, use of herbicides, modern mechanical equipment and machineries among others is an essential pre-requisite for reversing the downturn in rice upstream value-chain and stimulates economic prosperity in Nigeria. In many developing nations, a huge number of resources have been devoted to extension service in order to educate farmers on new agricultural practices (source). In Nigeria, such initiatives have been undertaken through the Agricultural Development Programme (ADP) (Donye, Ja'afar-Furo and Obinne, 2013). The effectiveness of these programmes in terms of delivery results depends on the factors that influence technology adoption. These factors are critical to policy makers and extension practitioners to understanding how they affect technology adoption to target users and for designing a more effective technology adoption programmes. The use of high yielding crop varieties facilitates and stimulates the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (Mwangi and Kariuki, 2015). The overall objective of technology adoption is to improve its' utilization by farmers for enhancing income generation from increase productivity. Asfaw, Shiferaw, Simtowe and Lipper (2012) supported this view by stating that developing and promoting the adoption of high yielding crop varieties in a sustainable manner will help to improve the livelihood of rural farmers.

The low rice productivity by farmers occasioned by the continuous use of obsolete technology, which does not support large scale production, is responsible for the widening supply – demand gap. For instance, Fasoyiro and Taiwo (2012) observed that in Nigeria, rice is mainly produced by small-scale farmers whose production are characterized by low output resulting from production inefficiency, aging farming population and low rice technological adoption. Okonji and Awolu (2020) asserted that there are several factors constraining farmers' adoption and utilization of improved rice technologies and innovations. These include the extent to which the farmer finds the new technology to be complex and difficult to comprehend, how readily observable the outcomes, its financial cost, the farmers level of motivation as well as his beliefs and opinions towards the technology. Other factors of interest as noted by Awotide *et al*. (2010) are the farmer's attitude towards risk and change, lack of fertilizer, infestation by weeds, pests and disease.

According to FAO (2013), the main barriers to agricultural technology adoption appears to be large investment costs, the perceived risk of a technology, long gestation period for the perceived benefits of the technology to materialize, poor access to information and extension services, land tenure system, cultural and recent outcomes of the technology. Likewise, socio-economic status such as family income, educational level, parental occupation and social status all affect the extent of utilization of improved rice technologies (Tiku, Sanusi, Adedeji and Ebira, 2017).

Studies have shown that several improved rice production technologies abound (Awotide et al., 2010; Mwangi and Kariuki, 2015; Okonji and Awolu, 2020). These include seed selection techniques, planting depth, plant spacing, pesticide application, high-yielding seed species, improved land preparation, herbicide application, fertilizer application, the use of combined harvester, high-table well, modern storage system, water management and irrigation system in addition to government intervention programmes like Anchor Borrowers' programme (CBN, 2021; CBN, 2022). Despite the foregoing, it seems farmers' adoption of improved rice production technologies is still low, which has given rise to the shortfall in the average yield per hectare of rice farming in Nigeria. A better understanding of farmers' utilization of improved rice production technologies is needed to develop appropriate agricultural policies and programmes for enhancing adoption of improved rice production technologies. It is against this backdrop that this study was carried out to assess farmers' utilization of improved rice production technologies in Ebonyi State, Nigeria. Specifically, the study set out to (i) find out farmers' awareness of existing improved rice production technologies; (ii) analyze the level of utilization of improved rice production technologies in the study area; and (iii) analyze the constraints to utilization of improved rice production technologies in the study area.

METHODOLOGY

Study area

This study was carried out in Ebonyi State, Nigeria. Ebonyi State has thirteen (13) Local Government Areas (LGAs), namely: Abakaliki, Afikpo North, Afikpo South, Ebonyi, Ezza North, Ezza South, Ikwo, Ishielu, Ivo, Izzi, Ohaukwu, Ohaozara and Onicha. The State comprises three (3) agricultural zones, namely: Ebonyi North, Ebonyi Central and Ebonyi South. The State lies on latitude $6^0 31^1$N and longitude $8^0 15^1$E (Ezeh, Eze and Eze, 2021), with a population of 2,173,501 peoples (NPC, 2006). The mean temperature, range between 20^0C and 28^0C, while the topography and soil types of Ebonyi State are very favourable to agricultural activities. Thus, farming remains the major economic activities of the people of Ebonyi State, with rice being one of the major crops farmed in the State.

Sampling Technique

A multi-stage sampling procedure involving both random and purposive sampling techniques were used for the selection of respondents. Stage 1 involved the purposive selection of two (2) Local Government Areas (LGAs) from each of the three agricultural zones of the State to give a total of 6 LGAs. This is to ensure that only LGAs with high intensity of rice farming activity were selected. Based on this, the following LGAs were selected; Ikwo and Ezza North LGAs from Ebonyi Central, Ivo and Ohaozara from Ebonyi South and Abakaliki and Izzi LGAs from Ebonyi North. Stage II involved the random selection of two (2) communities out of the 6 LGAs already chosen to make a total of 12 communities. In stage III, a random sample of two (2) villages were selected from the 12 communities already chosen to make a total of 24 villages. In stage IV, five (5) farmers were randomly selected from each of the 24 villages already selected to make a total of 120 respondents that were used for the study.

Data collection and analysis

Primary data were used for the study. The data were collected through the use of structured questionnaire administered as interview schedule. Analytical techniques such as descriptive and inferential statistics were used to analyze the objectives of the study. Descriptive statistics such as frequency, mean score and percentage were used to analyze objectives (i) and (ii) while objective (iii) was analyzed using inferential statistics such as factor analysis.

Mean Score formular

$\bar{X} = \sum \frac{x}{N}$

Where;

$\bar{X}$ = mean score

$\sum$ = summation

X = likert value

N = number of respondents.

Decision point for the four-point likert scale;

4= strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree.

$X = \frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$

This implies that using 2.5 as decision point, any item that has mean score less than 2.5 was rejected while those with mean score of 2.5 and above were accepted.

Model Specification

Factor Analysis Model

In order to obtain the factor loadings of each of the variables necessary for achieving aspects of objective v, factor analysis presented below was used.

$X_{ij} = \varphi_{i1}F_{i1} + \varphi_{i2}F_{i2} + \varphi_{i3}F_{i3} + \cdots \varphi jmF_iK + e_ij$

Where;

Xij = Observation on variable X_j for the ith sample number

F_ik = Score on factor Fk (k = 1,2,3,…….,m)

F1-Fm = Common factors

e_ij = The value on the residual variable Ej for the ith sample member

$\varphi ji \ldots\ldots\ldots \varphi jm$ = Factor loadings (regression weights)

The associated assumptions were applied accordingly while the suitable number of factors was subjectively selected based on varimax rotated factor matrix to be obtained using SPSS version 21 analytical software.

RESULTS AND DISCUSSION

Farmers' Awareness of Existing Improved Rice Production Technologies

The result of the analysis in Table 1 shows that there are a number of improved rice production technologies which farmers are aware of. Notable among these are: improved rice varieties (94.3%), fertilizer application (91.4%), use of agro-chemicals (85.7%) and timely transplanting (80.0%). Others are modern rice milling (68.6%), improved nursery techniques (57.1%) and use of standard planting depth (54.3%) while mechanized harvesting received least (8.6%) awareness in the area. The finding is tandem with that of Donkoh, Azumah and Awuni (2019) who reported that farmers in Ghana are aware of the improved rice technologies such as nursery practice, proper spacing of rice plants, line planting and bunding. Overall, the average response of the farmers showed that majority (62.9%) were aware of the existing rice production technology in the area while few (37.1%) were not aware. This implies that the farmers have appreciable awareness level of the existing rice production technologies in the study area, which may be attributed to awareness creation through multiple

sources such as print media, electronic media, fellow farmers, extension agents, among others. This is also in line with Mustapha, Undiandeye, Sanusi and Bakari (2012) who found that most rice farmers were aware of the rice production technologies in Jeer LGA in Borno State, Nigeria. However, this level of awareness has not translated into full adoption of improved rice production technologies as evidently seen in the average yield per hectare still hovering around 2 tons (PWC, 2017). It is therefore imperative that factors that hamper adoption of improved rice technologies be investigated.

Table 1: Farmers' Awareness of Existing improved rice Production technologies

Technologies	Frequency (N = 140)	
	Aware	Not Aware
Improved rice varieties	132 (94.3)	08 (5.7)
Use of line spacing	51 (36.4)	89 (63.6)
Use of standard planting depth	76 (54.3)	64 (45.7)
Use of agrochemicals	120 (85.7)	20 (14.3)
Fertilizer application	128 (91.4)	12 (8.6)
Mechanized harvesting	12 (8.6)	128 (91.4)
Improved nursery techniques	80 (57.1)	60 (42.9)
Timely transplanting	112 (80.0)	28 (20.0)
Optimum seed rate	70 (50.0)	70 (50.0)
Modern rice milling	96 (68.6)	44 (31.4)
Average Response	**88 (62.9)**	**52 (37.1)**

Source: Field Survey, 2021

***MULTIPLE RESPONSES RECORDED**

Extent of Utilization of Improved Rice Production Technologies in the Study Area

The extent of utilization of improved rice production technologies is presented in Table 2. The result shows that use of improved rice varieties ($\bar{X} = 2.9$), fertilizer application ($\bar{X} = 2.8$), use of agrochemicals ($\bar{X} = 2.6$), modern rice milling ($\bar{X} = 2.6$) and use of timely transplanting ($\bar{X} = 2.5$) were among the rice production technologies extensively utilized by the farmers in the study area. So far, the finding shows that apart from modern rice milling technology, all other improved rice production technologies utilized by the farmers revolve around improved agronomic practices while mechanical technologies have not received extensive utilization among farmers. Similar finding has been credited to Mustapha *et al*. (2012) who found rice production technologies adopted by farmers in Jeer LGA of Borno State to include high yielding varieties, disease resistant varieties, early maturing varieties, use of weedicides, broadcasting method, manual harvesting and bagging method of storage. Similarly, Adeleye (2016) found the level of farmers' adoption of improved rice production technologies were mainly limited to use of tractor for land preparation, planting of improved rice variety, seed dressing with agrochemical, use of herbicide for land clearing, use of herbicide for weed control in rice fields, basal NPK fertiliser application and top dressing with urea.

Furthermore, utilization of improved nursery ($\bar{X} = 2.4$), standard planting depth ($\bar{X} = 2.2$), mechanized harvesting ($\bar{X} = 2.1$) and optimum seed rate ($\bar{X} = 2.0$) were below the cut-off point of 2.5, indicating low utilization. The low utilization of these technologies is probably due to technicality related to adoption of improved nursery practice and standard planting depth as well as heavy cost associated the use of mechanized equipment. Adeleye (2016) in his study reported that the use of mechanical technologies such as sorting of rice seeds for planting, rice-legume rotation, use of mechanical thresher and use of mechanical winnower were lowly adopted. Overall, the average score of $\bar{X} =$ 2.5 signifies that most of the improved rice production technologies in the area were moderately utilized by the rice farmers.

Table 2: Extent of Utilization of Improved Rice Production Technologies in the Study Area

Rice Technologies	Mean ($\bar{X}$)	Decision Rule $\bar{X}$ = 2.5
Improved rice varieties	2.9	Accepted
Use of line spacing	2.6	Accepted
Use of standard planting depth	2.2	Rejected
Use of agrochemicals	2.7	Accepted
Fertilizer application	2.8	Accepted
Mechanized harvesting	2.1	Rejected
Improved nursery	2.4	Rejected
Timely transplanting	2.5	Accepted
Optimum seed rate	2.0	Rejected
Modern rice milling	2.6	Accepted
Average Mean	**2.5**	**Accepted**

Source: Field Survey, 2021

Constraints to Farmers' Utilization of Improved Rice Production Technologies

The result in Table 3 shows varimax rotated matrix on constraints to farmers' utilization of improved rice production technologies in Ebonyi State. Based on items that clustered and loaded high (Ezeh, Nwibo, Umeh and Eze, 2018), five (5) factors were identified and extracted, namely; institutional (Factor I), individual (Factor II), environmental (Factor III), financial (Factor IV) and technical (Factor V). These five represent the principal factors and constraints to farmers' utilization of improved rice production technologies in Ebonyi State, Nigeria. The finding aligns with that of Chukwu, Eze and Osuafor (2016) who classified constraints limiting the adoption of improved rice production technologies into four, namely: institutional, technical and financial factors. From the result, institutional factors which arose out of poor government's policy framework for catalyzing farmers' utilization of improved rice production technologies were: land scarcity (0.451), untimely dissemination of technologies (0.829), inadequate irrigation (0.846), inadequate extension agent contact (0.782), poor access to institutional credits (0.727), bad rural road network (0.663), inadequacy of modern storage and processing facilities (0.658) and irregular technologies (0.730).

Individual-related factors that affect farmers' utilization of improved rice production technologies were: poor understanding of technology (0.551), poor health status of rural farmers (0.706), lack of nutritional knowledge of the improved rice variety (0.883), poor income realized from the variety (0.764), no change in yield (0.706) and technologies incompatibility with prevalent practices (0.664). This is in tandem with the finding of Umeh (2009) who identified complexity of technology as a constraint to adoption of agro forestry recommendations among farmers in Ebonyi State Nigeria. Environmental factors arising from climate change and land overuse hindering farmers' utilization of improved rice production technologies include poor soil fertility (0.518), drought factors such as rain fall, temperature and solar radiation (0.863) and disease and pest infestation on cultivated rice crop (0.843). Finding agree with that of Ezeh and Eze (2016) who identified unpredictable weather regime, lack of climate change related information and declining soil fertility, among others, as the environmental factors arising from climate change that affect farmers and farming activities in Ebonyi State. Financial factors impeding farmers' utilization of improved rice production technologies include: scarcity and high cost of inputs (0.871) and high cost of information (0.801). Finally, specific technical factors hindering farmers' utilization of improved rice production technologies are: technicalities of innovation (lack of technical know-how) (0.733) and short life cycle of the variety (0.767). Chukwu, Eze and Osuafor (2016) identified funds as a major constraint to continuous adoption of technologies. They further contended that agricultural technologies that are at exorbitant prices are not easily adopted.

Table 3: Varimax Rotated Component Matrix on Constraints to Farmers' Utilization of Improved Rice Production Technologies in Ebonyi State

Constraints	A	B	C	D	E
Land scarcity	**0.451**	0.222	0.368	0.381	0.334
Scarcity and high cost of inputs	0.253	0.146	-0.739	**0.871**	0.067
Untimely dissemination of technologies	**0.829**	0.334	0.185	0.345	0.276
Poor understanding of technology	0.166	**0.551**	0.083	0.359	0.087
Inadequate irrigation	**0.846**	0.268	0.166	0.337	0.340
Inadequate extension agent contact	**0.782**	-0.429	0.046	0.055	-0.861
Poor access to institutional credits	**0.727**	0.017	-0.411	0.074	0.289
Bad rural road network	**0.663**	-0.554	-0.668	0.061	0.253
Technicalities of innovation (lack of technical know-how)	0.382	0.073	0.282	0.348	**0.733**
Inadequacy of modern storage and processing facilities	**0.658**	-0.302	0.303	0.340	0.065
Poor health status of rural farmers	0.041	**0.706**	0.093	0.322	0.067
High cost of information	0.339	0.301	-0.781	**0.801**	0.233
Lack of nutritional knowledge of the improved rice variety	0.065	**0.883**	0.344	0.061	0.218
Poor income realized from the variety	0.356	**0.764**	0.345	0.087	0.342
Poor soil fertility	0.074	0.061	**0.518**	-0.431	0.231
Drought factors such as rain fall, temperature and solar radiation	0.067	0.054	**0.863**	0.331	0.267
Short life cycle of the variety	0.088	0.078	0.068	0.233	**0.767**
Irregular technology	**0.730**	0.087	0.351	0.056	-0.721
No change in yield	0.088	**0.706**	0.367	0.060	0.385
Technologies incompatibility with prevalent practices	0.271	**0.664**	0.302	0.221	0.068
Disease and pest infestation on cultivated rice crop	0.321	0.051	**0.843**	0.089	0.046

KEY: A, B, C, D and E = Institutional, individual, environmental, financial and technical constraints respectively.

CONCLUSION AND RECOMMENDATIONS

The study established that most of the farmers have appreciable awareness of the existing improved rice production technologies in Ebonyi State. This suggests that there are probably existing diverse channels for dissemination of information on improved rice production technologies and this may have been responsible for the high awareness level. However, the study established that the existing improved rice production technologies were moderately utilized. It is concluded that besides modern rice milling technology, all other improved rice production technologies utilized by the farmers were mainly improved agronomic practices while mechanical technologies have not received extensive utilization among farmers.

Based on items that clustered and loaded high, the study identified five (5) principal factors and constraints to farmers' utilization of improved rice production technologies in Ebonyi State. These include; institutional, individual, environmental, financial and technical factors. Addressing these constraints is pivotal to enhancing farmers' utilization of improved rice production technologies. Based on the findings, the following recommendations were put forward:

(i) Research institutions that develop improved rice production technologies should in addition, design technical manual for extending these technologies to end users. This will help to limit technical problems arising from incompatibility of the technologies with prevailing know-how and improve its utilization.

(ii) Extension organisations should rejig their extension delivery system to ensure timely dissemination of information on improved rice production technologies to farmers.

(iii) Rice farmers should organize themselves into cooperative organizations to enable them pool resources together to procure modern rice storage and processing facilities.

(iv) Government and private extension organisations should come up with a more robust and inclusive extension programme that will cover every individual farmer related factor like healthy lifestyle as well as recommended farming practices.

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