

Determinants of Extent and Intensity of Improved Rice Variety Utilization Among Small-Holder Farmers in Ebonyi State, Nigeria

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Abstract: This study investigated the determinants of extent and intensity of improved rice variety (IRV) utilization among small-holder farmers in Ebonyi State, Nigeria, a significant rice-producing region in the South-East. Recognizing the crucial role of IRVs in enhancing agricultural productivity, the study aimed to determine the current utilization patterns and identify factors influencing the intensity of IRV utilization. A multi-stage and purposive sampling technique was used to select 120 small-scale rice farmers (cultivating < 3 ha). Data were analyzed using descriptive statistics and the Intensity of Improved Rice Variety Utilization (IIRVU) Index. Farmers' perceptions of influencing factors were assessed using a 3-point Likert scale and mean score analysis. Results indicate a high extent of IRV utilization, with FARO 44 (86.67%), ITA 306 (73.33%), MAS 11 (68.33%), and NERICA 8 (60.33%) being the most extensively adopted and utilized varieties. FARO 44, in particular, demonstrated significant post-adoption utilization, consistent with prior research attributing its preference to early maturity and high yield potential. The average rice land area sown with IRVs was 0.78 hectares, representing 60.94% of the total rice cultivated land. This indicates a moderate intensity of IRV utilization, suggesting a substantial integration of modern rice cultivation practices, yet also highlighting continued reliance on traditional varieties. Key factors significantly influencing the intensity of IRV utilization included availability of improved seeds (mean = 2.60), farm location (mean = 2.63), quality of rice (mean = 2.48), cost of improved seeds (mean = 2.40), access to credit (mean = 2.38), and land type (mean = 2.40). The physical accessibility of seeds emerged as the most critical determinant. These findings underscore that economic and logistical challenges, rather than solely awareness, are primary impediments to increased IRV utilization. Therefore, to further enhance rice productivity and food security in Ebonyi State, interventions should focus on improving the accessibility and affordability of quality improved seeds, addressing farm-specific logistical constraints, and strengthening credit access for small-scale farmers.

Keywords: Improved Rice Varieties (IRVs), Intensity of IRV Utilization, Rice, Ebonyi State.

INTRODUCTION

Rice is one of the most important staple food crops (Checco *et al.*, 2023), providing food and essential calories for over half of the world's population (Sanusi *et al.*, 2025; Wu *et al.*, 2023), and serving as a major source of income for farmers, particularly in Africa (Hussain *et al.*, 2020). In Nigeria, rice is primarily cultivated in the North-Central (31%), North-West (30%), North-East (24%), and South-East (8%) of the country (United States Department of Agriculture, USDA, 2022). Unfortunately, despite the contributions from these regions, the production levels cannot meet the growing national demand for rice. The demand for rice in Africa has been growing rapidly due to population

growth (Arouna *et al.*, 2021), and to meet this increasing demand, the expansion of rice cultivation land area is required. In the past three decades, the cultivated land area in Africa has expanded by approximately, 400,000 hectares per year (Jiang *et al.*, 2025; Yuan *et al.*, 2024). Even at this rate of expansion, Africa's cultivated land area is not commensurate with the growing demand for rice, leading to food security issues, especially in Nigeria.

Addressing this critical challenge and ensuring long-term food security necessitates a fundamental shift in Africa's farming systems. This involves moving from the predominant use of local rice varieties to more improved rice varieties (IRVs), and concurrently,

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increasing the land area sown with these IRVs. This transition is key to ensuring the widespread and intensified utilization of improved rice varieties. These varieties offer higher yields, greater resilience to pests, diseases, and climate change, and better nutrient use efficiency, making them superior to many traditional local varieties in terms of productivity and stability (Ndip and Sakurai, 2025; Islam *et al.*, 2024; Addison *et al.*, 2023; IRRI, 2020). Improved rice varieties commonly cultivated in Nigeria include FARO 44, FARO 61, FARO 60, FARO 52, MAS 11, and NERICA 8. FARO 44 is preferred due to its early maturity and increased yield potential, while MAS 11 is favored for its taste, long grain size, and yield (Adeleke *et al.*, 2022; Mba *et al.*, 2021).

Regrettably, many small-scale farmers, especially in Africa, still rely on conventional rice varieties (Abebrese and Yeboah, 2020), and area of land sown with improved seeds remains very low (Kassa *et al.*, 2021). This limited IRV utilization indicates that farmers are often unwilling to commit a larger proportion of their land to IRVs even after initial adoption (Checco *et al.*, 2023). The reasons for this reluctance primarily stem from the lack of availability, accessibility and affordability of improved rice seeds (Assaye *et al.*, 2022; Zeleke *et al.*, 2021). Other contributing factors include the high cost of improved seeds (Addison *et al.*, 2023), limited access to credit (Thanh and Duong, 2021; Rahaman *et al.*, 2020), farm size, yield potentials and taste preferences (Islam *et al.*, 2024; Ruzzante *et al.*, 2021; Jones-Garcia and Krishna, 2021), poor access to extension services (Akinagbe and Akinbobola, 2022; Mektel and Mohammed, 2021; Feyisa, 2020), land type (Wang *et al.*, 2020), and farmer's level of education (Bancin *et al.*, 2024). These myriad factors collectively influence the extent and intensity of improved rice variety utilization among small-scale farmers. Addressing these challenges to foster continued and consistent use of IRVs is crucial for bridging the demand-supply gap and building a more food-secure future for Nigeria. Considering these critical issues, and recognizing that the study area is one of the major rice producers in the South-East region of the country, this study therefore examines the extent and intensity of improved rice variety utilization among small-scale farmers in Ebonyi State, Nigeria. The specific objectives are to;

- i. Determine the extent and intensity of improved rice variety utilization among small-scale farmers in the study area, and
- ii. Ascertain farmer's perception of the factors influencing the intensity of improved rice variety utilization in the area.

METHODOLOGY

The Study was conducted in Ebonyi State, Nigeria. Ebonyi State is one of the thirty-six states of Nigeria, with Abakaliki as its capital. Located in the South-East geo-political zone, and occupies a land area

of about 5,935 square kilometers, divided into thirteen Local Government Areas. The State is bounded in the North by Benue State, in the South by Abia State, in the East by Cross River State and in the West by Enugu State (Global Data Lab, 2018). Ebonyi State has an estimated population of about 2.9 million people and projected to increase to 3.2 million people by 2022 (National Population Commission of Nigeria, 2018), and the major occupation in the area is farming [(National Bureau of Statistics (NBS), 2007)]. The State has a mean temperature of 30°C during the hottest period of the year (February to April) and a mean temperature of 21°C during the coldest period (December to January), with mean annual rainfall ranging from 1,500mm and 1,800mm (Nigerian Meteorological Agency (NiMET), 2020). Ebonyi State is endowed with vast area of swampland and is popular for the cultivation of swamp rice. Ebonyi State produces more than 50% of the total Nigerian output of rice. Rice is commonly produced in lowland/swamp lands (Ebonyi State Ministry of Land Survey and Urban Planning, 2015).

Well-structured questionnaires were administered to small-scale rice farmers in the study area. Multi-stage and purposive sampling techniques were employed, and one hundred and twenty (120) small-scale farmers (with < 3 ha) were randomly selected for the study. Data collected were analyzed using descriptive statistics and the Intensity of Improved Rice Variety Utilization Index (IIRVU). Objective (i) was analyzed using both descriptive statistics and the IIRVU index. Descriptive statistics determined the extent of utilization, while the IIRVU index measured the intensity of utilization of improved rice varieties. The IIRVU index measures the proportion of a farmer's rice land area sown with improved rice seeds/seedlings in a given season or year. In this study, only land areas sown with rice seeds/seedlings were considered. The focus was not on expanding rice land area but rather on the intensity of improved rice variety utilization on existing rice land areas. Following Hou *et al.*, (2022), Rajbhandari (2011), and modifying to align with the scope of this study, the IIRVU is stated as:

$$IIRVU_i = \sum_{k=1}^n \frac{LSI_{ik}}{LCI_{ik}} \quad (1)$$

In this case, if:

- a) $0 \leq \mu \leq 25 \rightarrow \text{Low utilization} = 1$
- b) $26 \leq \mu \leq 75 \rightarrow \text{Medium utilization} = 2$
- c) $76 \leq \mu \leq 100 \rightarrow \text{High utilization} = 3$

Where,

LSI_{ik} = Rice land area of the i^{th} farmer sown with improved seeds/seedlings in the k^{th} fragment (hectares)
 LCI_{ik} = Total rice cultivated area of the i^{th} farmer for the k^{th} fragment (hectares).

n = Number of rice land fragments (number)

μ = Level of utilization (percent)

Objective (ii) was analyzed using a mean score analysis. A 3-point Likert type scale of Major factor (3), Minor factor (2), and Not a factor (1) was used to weigh farmers' responses, with a cut-off point (mean value) of 2.0, to ascertain farmer's perception of the factors influencing the intensity of improved rice variety utilization among farmers in the study area.

RESULTS AND DISCUSSION

Extent and Intensity of Improved Rice Variety Utilization among Small-scale farmers

Extent of Improved Rice Variety Utilization among Small-scale farmers

Table 1 shows the multiple response and percentage distribution of small-scale farmers based on the improved rice varieties utilized in the last production season in the study area. Results showed that FARO 44 (86.67%), ITA 306 (73.33%), MAS 11 (68.33%), and NERICA 8 (60.33%). Conversely, other improved varieties, including FARO 46, FARO 52, FARO 55, and FARO 57, shows considerably lower utilization. FARO 46 was utilized by only 17.50% of farmers, while FARO 57, FARO 55, and FARO 52 were utilized by 14.17%, 8.33%, and 5.83% of farmers, respectively. The limited uptake of these varieties could be attributed to various factors such as insufficient farmer awareness, perceived lower performance compared to the major varieties, restricted availability, or specific agronomic requirements that may not align with the predominant farming practices or preferences of small-scale farmers in the study area. The findings indicate a clear preference for specific varieties, with FARO 44, ITA 306, MAS 11, and NERICA 8 identified as the most extensively utilized in the study area. The widespread adoption of these four varieties underscores their crucial role in enhancing rice productivity within Ebonyi State. FARO 44 demonstrates significant post-adoption utilization, with 86.67% of surveyed farmers reporting its use. This high percentage suggests that FARO 44 possesses characteristics highly valued by farmers in the region, such as superior yield potential, robust disease resistance, or strong market demand. This finding aligns with previous research (Adeleke *et al.*, 2022; Mba *et al.*, 2021) which also indicated FARO 44's preference, adoption, and widespread utilization among farmers. Specifically, Mba *et al.* (2021) attributed this preference to FARO 44's early maturing and increased yield potential. The consistent and continued use of a technology in rice farming is generally linked to its ability to increase yields (Ndip and Sakurai, 2025; Islam *et al.*, 2024; Addison *et al.*, 2023; Rizieq *et al.*, 2023; Edwards *et al.*, 2023; Bannor *et al.*, 2020). Overall, these findings suggest a generally high extent of improved rice variety utilization among small-scale farmers in Ebonyi State, particularly concerning the four major varieties identified in the study. This widespread adoption and utilization is a positive indicator for regional efforts aimed at bolstering rice productivity and ensuring food security.

Table 1: Multiple response and percentage distribution of small-scale rice farmers based on the improved rice varieties utilized

Varieties	Frequency	%Distribution
FARO 44	104	86.67*
FARO 46	21	17.50
FARO 52	7	5.83
FARO 55	10	8.33
FARO 57	17	14.17
ITA 306	88	73.33*
MAS 11	82	68.33*
NERICA 8	73	60.83*

* Major varieties utilized $\geq 50\%$

Source: Field Survey Data, 2018

Intensity of Improved Rice Variety Utilization among Small-scale farmers

Table 2 shows the estimated intensity of improved rice variety utilization among small-scale farmers in the study area. This metric is crucial for understanding not only if farmers utilize improved varieties, but also to what extent they integrate them into their farming systems. Results showed that the average rice land area sown with improved seeds/seedlings was 0.78 hectares (ha). This figure represents the actual land area dedicated by farmers to cultivating improved rice varieties. In comparison, the average total rice land area cultivated by these farmers was 1.28 ha.

Results further showed that the intensity of improved rice variety utilization was 60.94%, with utilization score of 2. This percentage indicates that, on average, roughly three-fifths of a small-scale farmer's total rice cultivated land is dedicated to improved varieties. This suggests a significant, but not complete, shift towards modern rice cultivation practices. While demonstrating a strong embrace of improved seeds, it also highlights that a substantial portion (approximately 39.06%) of the rice land is still potentially under traditional or non-improved varieties, as reported by Abebrese and Yeboah (2020) that farmers still rely on traditional local rice varieties, and prioritize traditional farming practices (Borah *et al.*, 2024). Given this reliance, farmers are often unwilling to entirely replace the traditional local varieties with improved rice varieties (IRVs) or commit a larger proportion of their land to IRVs even after initial adoption (Checco *et al.*, 2023). Consequently, the area of land sown with improved seeds remains very low (Checco *et al.*, 2023; Kassa *et al.*, 2021). The IRV utilization score (2) for the study area revealed a medium to moderate level of intensity in the utilization of improved rice varieties. This aligns with the calculated percentage of 60.94%, which is neither extremely low nor extremely high, but rather falls into a moderate range. This is an indication that small-scale rice farmers in Ebonyi State, Nigeria have integrated improved rice varieties into a substantial portion of their farming operations, covering nearly two-thirds of their rice land. This moderate intensity of utilization implies a positive trend towards modern agricultural practices, yet

it also indicates room for further expansion and complete utilization across all arable land suitable for rice cultivation.

Table 2: Estimated intensity of improved rice variety utilization among small-scale rice farmers in the study area

Items	Values
Average rice land area sown with improved seeds/seedlings (ha)	0.78
Average total rice land area of farmers (ha)	1.28
Intensity of improved rice variety utilization (%)	60.94
Level of utilization score	2

Source: Field Survey Data, 2018

$0 \leq \mu \leq 25 \rightarrow$ Low utilization = 1; $26 \leq \mu \leq 75 \rightarrow$ Medium utilization = 2; $76 \leq \mu \leq 100 \rightarrow$ High utilization = 3.

Farmer's Perception of the Factors Influencing the Intensity of Improved Rice Variety Utilization in the area

Table 3 shows the frequency distribution farmers' perception of factors influencing the intensity of improved rice variety utilization in the study area. The mean score for each factor helps to determine its overall significance, with a general acceptance threshold seemingly around a mean of 2.00. Results showed that availability of improved seeds (Mean = 2.60), cost of improved seeds (Mean = 2.40), access to credit (Mean = 2.38), quality of rice (Mean = 2.48), farm location (Mean = 2.63), and land type (Mean = 2.40) were accepted as major influencing factors on the intensity of improved rice variety utilization, with mean scores consistently above the apparent acceptance threshold. The availability of improved seeds was the most crucial factor, with 70% of farmers identifying it as a "Major" influence. This highlights that despite efforts to promote improved varieties, their physical accessibility remains a primary determinant of its utilization. If seeds are not readily available, farmers cannot cultivate them regardless of other benefits. Poor accessibility to improved seeds or seedlings hinders agricultural productivity by forcing farmers to use low-quality seeds (Olomu *et al.*, 2020), and limits farmers' plans to expand the area planted with improved rice varieties (Assaye *et al.*, 2022; Bannor *et al.*, 2020). Results also showed that farm location (Mean = 2.63) was identified as the highest-ranked factor, with 66.67% of farmers considering it a "Major" factor. This suggests that geographical positioning significantly impacts access to inputs, extension services, markets, or even the suitability of specific varieties to local agro-ecological conditions. Remote farms might face greater challenges in obtaining improved seeds or advanced technologies (Barbosa *et al.*, 2025). Results also showed that 55% of farmers considered the quality of the rice (the end product) a "Major" factor (Mean = 2.48). This is an indication that traits like cooking quality, market appeal,

and milling recovery of the improved varieties are critical considerations for farmers. If the quality of the harvest from improved varieties is not acceptable to farmers or consumers, the intensity of its utilization will be limited. High quality seeds produce healthy crops that are acceptable to both farmers and consumers (Bairagi *et al.*, 2021).

The financial burden of acquiring improved seeds was a significant deterrent, with 53.33% perceiving cost of improved seeds (Mean = 2.40) as a "Major" factor. This underscores the economic vulnerability of small-scale farmers and the need for affordable input options, as high costs of improved seeds inhibits the adoption and utilization of improved rice varieties (Addison *et al.*, 2023). Consistent with the cost of inputs, access to credit (Mean = 2.30) was another vital financial factor, with 55% seeing it as a "Major" influence. Without adequate credit, farmers struggle to afford improved seeds and other necessary inputs, thereby limiting their capacity to intensify utilization (Thanh and Duong, 2021). The land type (Mean = 2.40), with 53.33%, was also accepted as a major influencing factor. This indicates that the specific characteristics of the farmer's land, such as, soil fertility, water availability, topography, play a crucial role in determining which improved varieties can be successfully cultivated and to what extent. Some improved varieties may be more suited to certain land types, such as, lowland or upland, sloped or flatland. According to Wang *et al.* (2020), and Nguyen (2020), sloped and less productive land negatively affect the adoption intensity of improved rice varieties. The findings shows that economic and logistical issues, rather than mere awareness, are the primary factors influencing the intensity of improved rice variety utilization. Specifically, the availability and cost of improved seeds, access to credit, farm location, quality of rice, and land type are critical determinants of improved rice variety utilization in Ebonyi State.

Table 3: Frequency distribution of farmers' perceptions of factors influencing the intensity of improved rice variety utilization in the study area

Factors	(3) Major	(2) Minor	(1) Not a Factor	Mean	Remark
Colour of rice	16 (13.33)	20 (16.67)	84 (70.00)	1.43	Rejected
Availability of improved seeds	84 (70.00)	24 (20.00)	12 (10.00)	2.60	Accepted

Extension services	22 (18.33)	38 (31.67)	60 (50.00)	1.68	Rejected
Cost of improved seeds	64 (53.33)	40 (33.33)	16 (13.33)	2.40	Accepted
Access to credit	66 (55.00)	34 (28.33)	20 (16.67)	2.38	Accepted
Inadequate Information	26 (21.67)	20 (16.67)	74 (61.67)	1.60	Rejected
Quality of rice	66 (55.00)	46 (38.33)	8 (6.67)	2.48	Accepted
Farm location	80 (66.67)	36 (30.00)	4 (3.33)	2.63	Accepted
Availability of market	16 (13.33)	20 (16.67)	84 (70.00)	1.43	Rejected
Land type	64 (53.33)	40 (33.33)	16 (13.33)	2.40	Accepted
Total	504	318	373	2.01	Accepted

Field Survey Data, 2018

Mean \geq Cutoff point (2.0) \rightarrow Accepted major factor;

*Figures in parenthesis are percentage;

CONCLUSION

This study reveals a significant, yet not exhaustive, utilization of improved rice varieties (IRVs) among small-scale farmers in Ebonyi State, Nigeria. While varieties like FARO 44, ITA 306, MAS 11, and NERICA 8 are widely utilized, other available IRVs show limited uptake. The intensity of IRV utilization, averaging 60.94% of a farmer's total rice land, indicates a positive shift towards modern practices but also highlights a continued reliance on traditional varieties. Crucially, the study identifies that the intensity of IRV utilization is primarily influenced by economic and logistical factors, rather than simply awareness. Key determinants include the availability and cost of improved seeds, access to credit, farm location, the quality of the harvested rice, and the specific land type. Consequently, bolstering rice productivity and food security in Ebonyi State requires interventions that prioritize improving the physical accessibility and affordability of quality improved seeds. Additionally, efforts to enhance access to credit for small-scale farmers and to address location-specific challenges and land suitability for different IRVs are essential. These targeted approaches will help bridge the gap between initial adoption and full integration of improved rice varieties, ultimately leading to higher yields and better livelihoods for farmers in Ebonyi State, Nigeria.

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