International Journal of Multidisciplinary Comprehensive Research

Profitability differentials between broadcasting and transplanting system of rice production in Southeast, Nigeria

Anyikwa Friday Chikezie [1*], Isibor Annunciata Chinwe [2], Umebali Emmanuel Ejike [3]
[1-3] Department of Agricultural Economics and Extension, Nnamdi Azikiwe University, Awka, Nigeria

* Corresponding Author: **Anyikwa Friday Chikezie**

Article Info

ISSN (online): 2583-5289
Volume: 03
Issue: 02
March-April 2024
Received: 13-02-2024;
Accepted: 16-03-2024
Page No: 79-85

Abstract
The study examined the profitability differentials between the broadcasting and transplanting systems of rice production in the Southeast, A multi-stage sampling method was used to randomly select 384 (192 broadcasters and 192 transplanters). Data collected were analyzed using descriptive statistics, budgetary method, and inferential statistics of paired t-tests. The study found that the mean age of farmers under the broadcasting system and transplanting system were 50yrs and 43yrs respectively. Result on profitability level showed that the Net Returns were ₦1,569,053.11 and ₦5,628,752.33 for farmers under broadcasting and those under transplanting system, the return on investment (ROI) was 0.72 or 72.0% and 1.92 respectively, with a profitability index of 45.5% for broadcasting system and 68.9% for transplanting system respectively. The null hypothesis was rejected because there was a (6.59)*** substantial difference in the profit margin of the production systems. The study identified the following constraints; high cost of labour, poor quality seedlings, climatic changes, inadequate storage facilities and high cost of equipment among others. Policymakers are recommended to proactively address these challenges to enhance the effectiveness and efficiency of these farmers.

DOI: https://doi.org/10.54660/IJMCR.2024.3.2.79-85

Keywords: profitability, production systems, rice, Southeastern, Nigeria

1. Introduction

Food insecurity remains a significant challenge in Nigeria. According to the Food and Agriculture Organization (FAO, 2016), Nigeria is among the countries facing serious food insecurity issues. Weak scores in public expenditure on agricultural research and development contribute to this challenge. Additionally, Nigeria ranks as the second poorest country in food affordability due to conflicts between farmers and armed herdsmen (Ephraim *et al.*, 2021), exacerbating the demand-supply gap in the rice production sub-sector (Obianefo *et al.*, 2022) [13].

Despite being the leading producer of rice in West Africa, Nigeria has not achieved self-sufficiency, as reported by the International Food Policy Research Institute (IFPRI, 2019). Productivity remains below potential yields, with farmers achieving less than half of the yield potential. This is attributed to factors such as increased population pressure, inefficiency of agricultural inputs, inappropriate planting methods, low use of genetically modified seeds (bio-fortification), and high demand for land for non-agricultural purposes (Chete, 2018). The level of rice consumption in Nigeria has risen significantly since the mid-1970s, driven by population growth, rising per capita consumption, and shifting consumer preferences (Idiris *et al*., 2013; Obianefo *et al*., 2023) [14]. Urbanization, ease of cooking, and storage further accelerate rice consumption in the country (Uga *et al*., 2013; Basorun, 2013) [20, 4]. Ensuring sustainability in rice production is crucial to meeting the increasing demand driven by population growth (Ajijola *et al*., 2012; Ojogho and Alufohia, 2014; Ajala and Gana, 2015) [3, 17, 2]. To promote self-sufficiency, the Federal Government of Nigeria has partially banned rice importation (Obianefo *et al*., 2022) [13], leading to increased research interest in local rice production (Mba *et al*., 2021) [10].

Rice production in Southeastern Nigeria relies mostly on traditional methods, with some areas adopting mechanized methods (Ugochukwu and Ezedinma, 2011; Mba *et al*., 2021) [11, 10]. Despite challenges, such as constraints faced by farmers, rice production contributes significantly to regional trade in Nigeria. Addressing issues related to production systems and processes is crucial for achieving profitable and sustainable rice production. While various studies have examined rice production in Nigeria and beyond, none have provided information on production systems and yields from farmers' perspectives on a regional scale. This research aims to fill this gap by analyzing the profitability differentials of rice production systems on a regional scale. Understanding these variations is essential for making informed decisions and recommendations to achieve Sustainable Development Goals (SDGs) on food security. Therefore, this research provides valuable insights into sustainable rice development in the region.

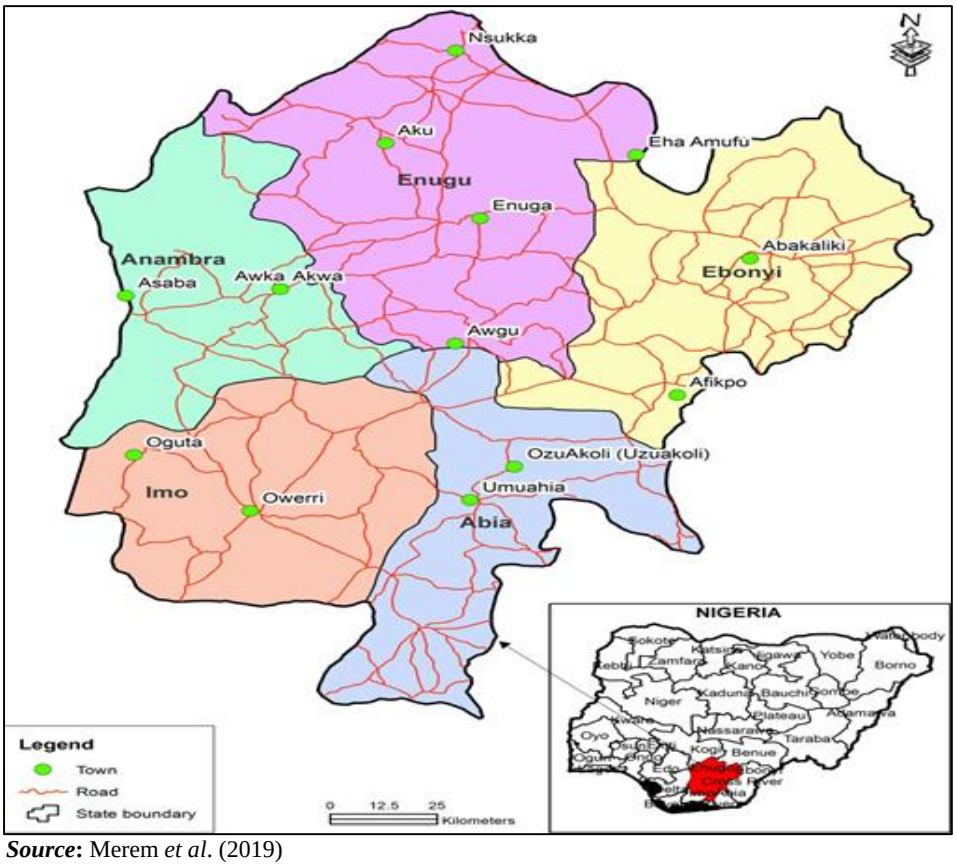
The main research question addressed is: how do variations in rice production systems contribute to rice yields in this area? The null hypothesis is: There is no significant difference in the profitability of rice production systems across the study area.

2. Materials and Methods

2.1 Study Area

The study area for this research is Southeast Nigeria, also referred to as the southeast geopolitical zone. Comprising five states – Abia, Anambra, Ebonyi, Enugu, and Imo – it is one of the six geopolitical zones in Nigeria. Southeast Nigeria has an estimated land area of 41,440 km2 and a population of 22,012,828 as of 2020, according to the National Population Commission (NPC). Geographically, the zone lies between longitude 6º35' and 8º27' East and latitudes 04º47' and 08º71' North of the Equator (Mba *et al*., 2021) [10]. It shares borders with Benue and Kogi States to the north, Rivers, Akwa Ibom, and Bayelsa States to the south, Delta and Edo States to the west, and Cross River State to the east. The southeastern region comprises two distinct ecological zones: the tropical rainforest in the south and the derived guinea savanna in the north. The mean annual temperature ranges from 21.6ºC to 32.4ºC, while the annual rainfall varies from 720 mm to 1440 mm in the rainforest region (NAERLS and FDAE, 2019).

The primary occupations of the people in the area include farming, trading, civil service, and teaching. Major crops cultivated by the inhabitants consist of yam, cassava, cocoyam, maize, vegetables, plantain, and rice. Livestock rearing includes chicken, sheep, goats, pigs, and a small population of Muturu cattle. Additionally, tree crops such as oil palm, citrus, mango, breadfruit, and coconut are commonly grown in homesteads and plantations. Southeast Nigeria ranks fourth among the six geopolitical zones in rice production, with an estimated output of 11.35 million tonnes cultivated on 968,000 hectares of land in 2019, yielding an average of 4.5 tonnes per hectare (NAERLS and FDAE, 2019).



***Source*:** Merem *et al*. (2019)

Fig 1: Map of Nigeria showing Southeast region

2.2. Sampling Techniques

Given that the exact population of rice farmers in Southeast, Nigeria is unknown, an infinite sample size determination technique adapted from Obianefo *et al.* (2021); Obianefo *et al.* (2024) [16] was used to calculate the sample size for the study:

$$n = \frac{Z^2 * P(1-P)}{e^2}$$

Where:
n = sample size
Z = Z-score at 95% confidence interval
P = probability of success
$1-P$ = failure
e = error term at 0.05 level of probability.
However, the sample is calculated as

$$n = \frac{1.96^2 * 0.50(1-0.50)}{0.05^2} = 384$$

The research also employed a multistage and random sampling technique in selection of the study representative.
At stage I, three States namely Ebonyi, Anambra, and Enugu were purposively selected from the five states in the zone, based on their intensity and long history of rice production.
Stage II was the random selection of two Local Government Areas (LGAs) from each of the three States to arrive at six (6) LGAs.
At stage III, two autonomous town communities were selected from each of the six selected LGAs bringing the total number of communities to twelve (12), from where four (4) villages were randomly selected from each community to make a total of forty-eight (48) villages.
The final stage (Stage IV) involves the random sampling of eight (8) rice farmers (4 broadcasters and 4 transplanters) from each village, resulting in a total of 384 respondents (192 broadcasters and 192 transplanters).

2.3. Data Analysis
The study utilized a combination of analytical tools of Descriptive statistics, Budgetary method, and inferential statistics of paired t-test or comparative mean test. Objective I (estimate the profitability level of farmers in transplanting and broadcasting systems) was achieved using the budgetary analysis method. Objective II (identify the constraints to the rice production system) was achieved using descriptive statistics.
Hence, null hypothesis Ho_1 was tested using the paired sample t-test or comparative mean test.

2.4. Model Specification
The budgetary method for objective 1 was stated as:

$$TR = Quantity \times UnitPrice$$

TC= TFC+TVC
GM= TR-TVC
NR=TR-TC or GM-TFC
$TVC = \sum_{i=1}^{n} VC_i$

Where:
TC= Total cost (₦)
TFC= Total fixed cost (₦)
TVC= Total variable cost (₦)
VC= Variable (input) costs (₦)
GM= Gross margin (₦)
TR= Total revenue (income) (₦)

3. Results and Discussion
3.1. Estimation of the Profitability Level of Rice Production
The profitability of rice production under broadcasting and transplanting is presented in Tables 1 and 2
This table illustrates a cost and returns analysis for a broadcasting venture, specifically focusing on the cultivation and sale of paddy. The total sales revenue amounted to N3,759,840.72, representing the income generated from selling paddy by rice farmers utilizing broadcasting technology. Operational costs, as outlined by Ephriam *et al.* (2021), encompass expenses directly associated with the production process. The total operational costs, or variable cost of production, sum up to N2,048,713.50. Additionally, fixed costs are incurred irrespective of the production level and include items such as land expenses and asset depreciation. Rice farmers employing this technology incurred N142,074.11 as fixed production costs. Consequently, the total production cost (the sum of operational and fixed costs) amounts to N2,190,787.62. To clarify, the profit margin denotes the income remaining after deducting operational costs from the sales revenue. Thus, the profit margin (sales revenue minus operational costs) is N1,711,127.22. Conversely, the net return is calculated at N1,569,053.11, which represents the profit margin minus fixed costs. Net returns also signify the profit after deducting both operational and fixed costs.

Table 1: Estimation of the profitability level of rice production under broadcasting technology

ID	Item Description for broadcasting	Quantity	Unit price (N)	Amount (N)
A	Sales revenue:			
	Paddy (tons)	14.44	260,300.00	3,759,840.72
B	Operational cost (OP):			
	Seedlings (kg)	142.96	486.30	69,522.15
	Agrochemical (Litre)	19.37	4,742.19	91,840.18
	Fertilizer (kg)	344.28	661.09	227,600.27
	Labour (man-day)	333	4,988.02	1,659,750.91
	Total OP			2,048,713.50
C	Fixed cost:			
	Landholding	3.68	30,754.45	113,086.68
	Depreciation on assets			28,987.43
	Total fixed cost			142,074.11
D	Total cost			2,190,787.62
E	Profit margin (A-B)			1,711,127.22
F	Net returns (E-C)			1,569,053.11
	Profitability index (E/A)*100			45.5%
	Return on investment (ROI) (F/D)			0.72
	Profit/hectare			465,349.04

***Source*:** Field Survey, 2023

Moreover, the profitability index for this venture stands at 45.5%. This index serves as a gauge of the enterprise's profitability. In this context, it implies that approximately 45.5% of the sales revenue contributes to the gross profit after deducting operational costs. Additionally, it suggests that the profit from this season can finance 45.5% of the next season's operational costs. Additionally, the return on investment (ROI) is calculated at 0.72 or 72.0%. ROI serves as a ratio indicating the efficiency of an investment. In this case, the 72% ROI suggests that for every Naira invested, there is a 72% return. When the net returns were divided by the landholding, the profit per hectare amounted to N465,349.04. This metric provides insight into the profit generated per hectare of land used for cultivation.

From an economic standpoint, the venture appears to be profitable, as evidenced by the positive profit margin and net returns. It is essential to acknowledge, however, that economic conditions, market fluctuations, and other external factors can significantly influence the success and sustainability of rice production under broadcasting technology.

Table 2: Estimation of the profitability level of rice production under transplanting technology

ID	Item Description for Transplanting	Quantity	Unit price (N)	Amount (N)
A	Sales revenue:			
	Paddy (tons)	24.51	349,000.00	8,553,163.61
B	Operational cost (OP):			
	Seedlings (kg)	79.20	902.84	71,505.27
	Agrochemical (Litre)	16.53	4,183.10	69,131.47
	Fertilizer (kg)	411.49	594.21	244,513.65
	Labour (man-day)	476	4,780.80	2,275,044.28
	Total OP			2,660,194.68
C	Fixed cost:			
	Landholding	4.58	51,329.58	235,229.16
	Depreciation on assets			28,987.43
	Total fixed cost			264,216.60
D	Total cost			2,924,411.27
E	Profit margin (A-B)			5,892,968.93
F	Net returns (E-C)			5,628,752.33
	Profitability index (E/A)*100			68.9%
	Return on investment (ROI) (F/D)			1.92
	Profit/hectare			1,285,910.46

***Source*:** Field Survey, 2023

According to the data presented in Table 2, the total sales revenue for this enterprise amounts to N8,553,163.61. This substantial sales revenue suggests significant income potential from rice production under transplanting technology. Operational costs represent expenses directly linked to the production process utilizing transplanting technology. The study revealed a total operational cost of N2,660,194.68, along with a fixed cost of N264,216.60, resulting in a total cost of N2,924,411.27.

The profit margin for transplanting technology is calculated at N5,892,968.93, while the net returns (profit margin minus fixed costs) amount to N5,628,752.33. The high profitability index of 68.9% indicates that a significant portion of the sales revenue contributes to profit after covering operational costs. Additionally, the ROI stands at 1.92, implying that for every Naira invested, there is nearly twice the initial return. This underscores the efficiency and profitability of rice production under transplanting technology. The profit per hectare serves as a crucial metric for evaluating the economic success of rice production, and the high value of N1,285,910.46 suggests a favorable economic outcome. Importantly, these results indicate a highly profitable venture with substantial profit margins and net returns.

These findings align with those of Mba *et al.* (2021) [10], who reported in their study on patterns of rice production and yields in southeastern Nigeria that the transplanting system of rice cultivation yields more and is highly profitable. Similarly, Agric-food Consulting International (2016) found in their study of the rice value chain in Vietnam that different production technologies had varying gross margins, attributed to differences in the cost of labor operations utilized in those technologies.

3.2. Constraints to rice production technology in the study area

The findings regarding constraints to the rice production systems in the study area are presented in Tables 3 and 4. Regarding the challenge of poor access to information, the study revealed that 72.9% of farmers utilizing broadcasting methods and 67.9% of farmers using transplanting methods faced difficulties accessing information. Access to information is crucial in the production process, and, notably, farmers employing transplanting methods had better access to information, with a lower percentage (67%) encountering challenges, compared to their counterparts using broadcasting methods, where up to 72% faced information access issues. This suggests that farmers employing transplanting methods may be more informed and have broader access to agricultural knowledge, particularly as agricultural production is increasingly digitalized. However, it is essential for the government to further ensure that farmers receive all necessary information promptly, as this can enhance their production and contribute to mitigating food insecurity. This finding resonates with the work of Adewuyi and Amurtiya (2021) [1] on the economic analysis of rice production by smallholder women farmers in Adamawa state, which highlighted the poor dissemination of information, with over 50% of farmers not receiving the necessary firsthand information they require.

Table 3: Constraints to rice production under the broadcasting method

SN.	Challenges for broadcasting	Frequency	Percentages
1	Poor access to information	140	72.9%
2	Inadequate storage facility	190	99.0%
3	Inadequate access to quality seed	146	76.2%
4	Climate change	187	97.4%
5	Transportation issue	90	46.8%
6	High cost of equipment	192	100.0%
7	High cost of input	189	98.4%
8	High cost of labour during broadcasting	50	26.0%
9	Cattle menace	10	5.2%
10	High cost of water management	89	46.4%
11	Heavy reliance on traditional tools	167	87.0%

***Source*:** Field survey, 2023

Additionally, farmers employing either of the systems encountered challenges with storage facilities. Specifically, 99.0% of farmers using broadcasting methods and 89.3% of those employing transplanting methods faced this issue. The prevalence of storage facility problems appears to be lower in transplanting technology, possibly because farmers in this method are more exposed and readily adopt innovations. Regarding access to quality seed, farmers using both methods faced the challenge of poor seedlings in the market. A significant percentage (76.2%) of farmers using each technology encountered this challenge. This finding is consistent with the work of Madugu *et al.* (2017) [9] on the economics of rice production in Mubi-North LGA of Adamawa State, who recommended that the government establish designated centers where farmers can access good quality seedlings. Results on climate change revealed that a higher percentage (97%) of farmers using broadcasting methods were adversely affected, compared to 90.3% of farmers using the transplanting method.

The transplanting technique helps crops resist some climate-related challenges such as flooding, which is why farmers are advised to adopt this method. Broadcasting methods are more vulnerable to flooding, as seeds or seedlings can easily be washed away. Climate change negatively affects crop production and output, as reported by Obianefo *et al.* (2020) [15] on the technical efficiency of rice farmers in Anambra State, citing reductions in crop yield and grain quality, destruction of farmland by floods, increased incidence of weeds, pests, and diseases, as well as a decrease in soil fertility. Regarding transportation problems, farmers encountered similar challenges across the board, as they needed to transport their produce from farms to markets. Poor road infrastructure can lead to food wastage and increase the cost of food in markets.

Concerning the cost of equipment, a higher percentage (100%) of farmers using broadcasting methods could not afford the high cost of equipment, while approximately 78% of farmers using transplanting methods faced the same issue. The high cost of equipment may deter farmers from adopting best practices in rice production, as the transplanting method requires the use of certain equipment that increases costs but yields better results and higher income for farmers. It is recommended that the government subsidize this equipment for the benefit of farmers.

Table 4: Constraints to rice production under the transplanting method

SN.	Challenges for Transplanting	Frequency	Percentages
1	Poor access to information	130	67.9%
2	Inadequate storage facility	171	89.3%
3	Inadequate access to quality seed	146	76.2%
4	Climate change	173	90.3%
5	Transportation issue	90	46.8%
6	High cost of equipment	151	78.5%
7	High cost of input	126	65.8%
8	High cost of labour during transplanting	180	94.0%
9	Cattle menace	39	20.1%
10	High cost of water management	66	34.3%
11	Heavy reliance on traditional tools	134	69.8%

***Source*:** Field survey, 2023

Concerning input costs, a greater percentage of farmers using broadcasting methods (98%) were affected, while only 65% of farmers using transplanting methods faced such challenges. Broadcasting methods of rice production require more inputs compared to transplanting methods. In transplanting, only viable seeds are utilized, whereas broadcasting lacks means to check seed viability before sowing, resulting in additional costs for variables like fertilizer to achieve the desired output. Regarding labor costs, farmers using broadcasting methods spend less on labor (26%), while farmers using transplanting methods spend more (94%). Broadcasting methods are known to reduce overall production costs. However, it is recognized that sowing rice in nurseries and then transplanting, though more costly, yields better results. This is because farmers are certain of transplanting only viable seedlings.

Regarding cattle menace, only about 5.2% of farmers using broadcasting methods were affected, while in transplanting methods, approximately 20% experienced attacks. This indicates more attacks on farmers using transplanting methods. Additionally, water management was reported to be high, with 46.4% of farmers using broadcasting methods and 34% of those using transplanting methods facing challenges

in this regard.
Furthermore, in terms of reliance on traditional tools, farmers using broadcasting methods heavily rely on traditional tools (87%), while those using transplanting methods have a lower reliance (about 69%).

3.3. Test of Hypotheses

Hypothesis one; There is no significant difference in the profitability of rice production under broadcasting and transplanting technologies.

Table 5: Hypothesis one: There is no significant difference in the profitability of rice production under broadcasting and transplanting system

	Transplanting	Broadcasting
Mean	1,285,910.46	465,349.04
Variance	28886211275551.00	6807580755640.27
Observations	192	192
Pearson Correlation	-0.015	
Hypothesized Mean Difference	0	
Degree of freedom	191	
t Stat	6.59***	
t Critical two-tail	1.97	

***Source*:** Field Survey, 2023. Significant at 10% (*), 5% (**), and 1% (***)

The significant disparity in means indicates that, on average, the profitability of rice production is notably higher under the transplanting system/technology compared to the broadcasting system. Additionally, the variance in profitability is considerably higher for transplanting technology compared to broadcasting technology. While variance measures the spread of data, it does not directly indicate the statistical significance of the difference.
The Pearson correlation coefficient of -0.015 suggests a very weak negative correlation between the profitability of the two systems. However, it's important to emphasize that correlation does not imply causation. On the other hand, the t statistic of 6.59*** is highly significant. This implies that the difference in means is statistically significant, supporting the rejection of the null hypothesis. The three asterisks (***) denote a very high level of significance.
In light of these findings, farmers and policymakers may contemplate promoting or incentivizing the adoption of the transplanting system, given its higher average profitability. This could entail providing training, resources, or financial support to encourage farmers to transition to more profitable technologies.

Conclusion

The study demonstrated that rice farming proved to be a profitable venture in the study area, evidenced by a net farm income of N1,569,053.11 and a return on investment (ROI) of 0.72 or 72.0% for farmers employing broadcasting methods. A ROI of 72% suggests that for every Naira invested, there is a 72% return.
Similarly, for farmers utilizing the transplanting system, the study revealed a net farm income of N5,628,752.33 and a return on investment of 1.92, indicating that for every Naira invested, there is a return of almost twice the initial investment. This underscores the profitability of rice farming, particularly under the transplanting system.
Farmers are thus encouraged to engage in rice farming due to its profitability. Furthermore, adopting modern farming methods such as the transplanting technology is advocated, as it allows for increased yields and income.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The government should assist in the fight against the use of poor-quality seeds, provide improved varieties and other agricultural inputs, allocate adequate funds to farmers, and especially ensure the delivery of quality extension services. This will enhance farmers' output.
2. The government should support the training and retraining of farmers to ensure their continuous active participation in government policies and development programs. Additionally, it should encourage farmers to form cooperatives to enhance their economic empowerment.
3. Agricultural policy measures should focus on providing ready markets with stable prices for rice produced. This can be achieved through the establishment of marketing boards by the government.
4. Labor has been identified as the variable that accounts for the highest cost of production. Therefore, government efforts to reduce labor costs by introducing more advanced and affordable technological farm implements will lead to greater net farm income.
5. Farmers should be discouraged from practicing conventional farming methods, such as the broadcasting method, and encouraged to adopt modern practices, including the use of improved seeds and fertilizers. Furthermore, access to credit facilities should be made available to farmers to support their transition to modern agricultural practices.

References

1. Adewuyi AK, Amurtiya M. Economic analysis of rice production by smallholder women farmers in Adamawa state, Nigeria. Croat Rev Econ Bus Soc Stat. 2021; 7(1):1-12.
2. Ajala AS, Gana A. Analysis of challenges facing rice processing in Nigeria. J Food Process. 2015; 6:20-37. http://doi.org/10.1155/2015/893673
3. Ajijola S, Usman JM, Egbetokun OA, Akoun J, Osalusi CS. Appraisal of rice production in Nigeria: A case study of north central states of Nigeria. J Stored Prod Postharvest Res. 2012; 3(9):133-136.
4. Basorun JO. Expository analysis of rice processing activities in Igbemo, rural Nigeria. Am J Social Issues Humanities. 2013; 3(2):79-81.
5. Cheta OB. Enterprise factors influencing gender involvement in rice enterprise in southwestern Nigeria. Asian J Agric Horticultural Res. 2018; 1(1):1-12.

6. Ephriam SC, Abu IA, Suleiman A. Adoption of rice production technologies among women farmers in the central zone of Bauchi State, Nigeria. J Agripreneurship Sustainable Dev (JASD). 2021; 4(4):2651-2665.
7. Food and Agricultural Organization of the United Nations. Bridging the rice yield gap in the Asia-Pacific Region. A report submitted at an expert consultation. 2016.
8. Idris A, Rasaki K, Hodefe OJ, Hakeem B. Consumption pattern of ofada rice among civil servants in Abeokuta metropolis of Ogun State, Nigeria. J Biol Agric Healthcare. 2013; 3(6):106-112.
9. Madugu AJ, Moses JD, Zalkuwi JW. Economics of rice production in Mubi-North LGA of Adamawa State, Nigeria. IOSR J Agric Veterinary Sci. 2017; 10(2):62-65.
10. Mba CI, Madu AI, Ajaero CK, Obetta AE. Patterns of rice production and yields in southeastern Nigeria. Afr J Food Agric Nutr Dev. 2021; 21(7):18330-18348.
11. Merem EC, Twumasi Y, Wesley J, Isokpehi P, Shenge M, Fageir S, Criler M, Romorno C, Hines A, Hirse G, Ochai S, Leggett S, Nwagboso E. Analyzing rice production issues in the Niger state area of Nigeria's middle belt. Food Public Health. 2019; 7(1):7-22. https://doi.org/10.5923/j.fph.20170701.02.
12. National Agriculture Extension and Research Liaison Service and Federal Department of Agricultural Extension. Agricultural performance survey report of the wet season in Zaria, Nigeria, 2019.
13. Obianefo CA, Okoroji NO, Obiekwe NJ, Osuafor OO, Shah ZA. Economics of Good Agronomic Practices Adoption by Rice Farmers in Value Chain Development Programme, Anambra State, Nigeria. Afr J Food Agric Nutr Dev. 2022; 22(8):21309-21412.
14. Obianefo CA, Ezeano IC, Isibor CA, Ahaneku CE. Technology Gap Efficiency of Small-Scale Rice Processors in Anambra State, Nigeria. Sustainability. 2023; 15:4840. https://doi.org/ 10.3390/su15064840
15. Obianefo CA, Nwigwe CA, Meludu TN, Anyasie IC. Technical efficiency of rice farmers in Anambra State value chain development programme. J Dev Agric Econ. 2020; 12(2):67-74.
16. Obianefo CA, Isibor AC, Umebali EE, Efobi CO. Analysis of the effect of climate-smart agricultural practices (CSAPs) on food security of maize production in Southeast, Nigeria. Int J Multidiscip Res Growth Evaluation. 2024; 5(2):429-440. DOI: https://doi.org/10.54660/.IJMRGE.2024.5.2.429-440
17. Ojogho O, Alufohai GO. Comparative demand analysis for rice in Edo, Delta and Lagos states of Nigeria. Agrosciences J. 2014; 1(12):1-10.
18. Okeke CG, Oluka SI. A survey of rice production and processing in Southeast Nigeria. Niger J Technol (NIJOTECH). 2017; 36(1):227-234.
19. Omofonmwan SI, Kadiri MA. Problems and prospects of rice production in the central district of Edo State, Nigeria. J Human Ecol. 2017; 22(2):123-128.
20. Uga Y, Sugimoto K, Ogawa S, Rane J, Ishitani M. Control of root system architecture by DEEPER ROOTING 1 increases rice yield under drought conditions. Nat Genet. 2013; 45:1097-1102.
21. Ugochukwu AI, Ezedinma CI. Intensification of rice production systems in South Eastern Nigeria: A policy analysis matrix approach. Int J Agric Management Dev (IJAMAD). 2011; 1(2):89-100.