**ANALYSIS OFALLOCATIVE EFFICIENCY OF SWAMP RICE PRODUCERS IN IMO STATE, NIGERIA**

**Abstract**

This study evaluated the allocative efficiency of swamp rice producers in Imo State, Nigeria. The specific objectives of the study were to: determine the costs and returns associated with swamp rice production, and measure the allocative efficiency of resource use in swamp rice production. Data were collected using structured and validated questionnaires from 102 swamp rice farmers in Imo State. Data were analyzed using inferential statistics. Results showed that the net return of swamp rice farmers was N81,595 per hectare with a return on naira spent of 23.75% or N23.75. The allocative efficiency indices estimated showed that all the resources were inefficiently allocated in all the production systems. While some resources like seed, agrochemicals and depreciation were underutilized others like labour, fertilizer and land were overutilized. Furthermore, there is a need to bring in more land under rice cultivation for improvement of the rice production in the State and Nigeria as a whole.

**Key Words: Allocative, Rice, Swamp, Production, Efficiency**

**Introduction**

Rice with the botanical name *Oriza sativa* is a staple crop, rich in carbohydrates and has gained global acceptance. It is consumed in most if not all households in Nigeria. Globally, “rice is consumed by more than 4.8 billion people in 176 countries and is the most important food crop for over 2.89 billion people in Asia, over 40 million people in Africa and over 150.3 million people in America” (Okolo &Olotu, 2020). According to IITA (2023), “Nigeria ranks the highest as both a producer (producing over 46% of the total harvest in West Africa) and a consumer of rice in the West African sub-region. Rice is an increasingly important crop in Nigeria and it is grown in all the agro-ecological zones in Nigeria as noted by” (Akinbile, 2023) andSalihu, Abdullahi, Jibbrin, Hassan, Aliyu, &Ibeh,(2021).

It is a “strategic product” along with wheat in many developing countries, including Nigeria. There are different production systems involved in the production of rice. These include: traditional extensive lowland rice production found in waterlogged lowlands with variable flooding levels, traditional intensified lowland rice production found in lowlands that are not waterlogged, modern rice production commonly practised in fields either upland or lowland and traditional upland rice production established through drilling and intercropping (Bwire, Saito, Sidle &Nishiwaki, 2024).

“An important source of economic growth for the agricultural sector is efficiency gain through greater technical and allocative efficiency by producers in response to quality information and education. To improve efficiency, the existing levels of resource allocation must be known” (Okello, Bonabana-Wabbi&Mugonola, 2019). If farmers were not making efficient use of existing technology, the efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output. Allocative efficiency therefore reflects the ability of a farm to use the inputs in optimal proportions given their respective prices.

“Although rice production had increased in Nigeria, the country’s production capacity had remained far below the national requirement and the optimum level of input utilization was yet to be attained” (Toba, Fangbin&Shiping, 2022). “Nigeria’s inability to meet her rice consumption needs through local production has resulted in high cash outlays for importation” (Osanyinlusi and Adenegan, 2016). Farm input allocation and optimal use of these farm inputs were imperative in maximizing rice output and returns. Rice farmers in Nigeria and Imo State in particular have not attained optimal resource allocation and this is fingered in the supply-demand gap in the local production system. Although the poor socio-economic disposition of farmers has been reported by previous researchers (Igboji*et. al*., 2015 and Yusuf, Abdu, Ilu & Ibrahim, 2022), it has not been documented especially in Imo State. There is a need therefore to analyze the economic aspects of swamp rice production in the study area to enhance productivity. It is also important that farmers use resources efficiently to achieve the maximum yield.

**Objectives of the Study**

The broad objective of this study was to analyze the allocative efficiency of \_swamp rice producers in Imo State, Nigeria. Specifically, the Study:

i. determined the costs and returns associated with swamp rice production,

ii. measured the allocative efficiency of resource use in swamp rice production.

**Hypothesis of the Study**

The following hypothesis was tested:

H0: Farmers are allocatively inefficient in the use of resources in swamp rice production.

**LITERATURE REVIEW**

**Allocative Efficiency:** Although there are different standards of evaluation for the concept of allocative efficiency, the basic principle asserts that in any economic system, choices in resource allocation produce both "winners" and "losers" relative to the choice being evaluated. The principles of rational choice, individual maximization, [utilitarianism](https://en.wikipedia.org/wiki/Utilitarianism) and market theory further suppose that the outcomes for winners and losers can be identified, compared and measured. An allocatively efficient economy produces an "optimal mix" of commodities. A firm is allocatively efficient when its price is equal to its [marginal costs](https://en.wikipedia.org/wiki/Marginal_costs) (that is, P = MC) in a perfect market. The [demand](https://en.wikipedia.org/wiki/Demand) curve coincides with the [marginal utility](https://en.wikipedia.org/wiki/Marginal_utility) curve, which measures the (private) benefit of the additional unit, while the [supply](https://en.wikipedia.org/wiki/Supply_%28economics%29) curve coincides with the [marginal cost](https://en.wikipedia.org/wiki/Marginal_cost) curve, which measures the (private) cost of the additional unit. According to Shao & Tang (2024), “allocative efficiency in agriculture refers to the ability to choose optimum input levels for given factor prices. Allocative efficiency could also mean an output level where the price equals the Marginal Cost (MC) of production. This is because the price that consumers are willing to pay is equivalent to the marginal utility that they get. Therefore, the optimal distribution is achieved when the marginal utility of the good equals the marginal cost”.

**Allocative inefficiency**: “A production process may be allocatively inefficient in the sense that the marginal product of input might not be equal to the marginal cost of that input; allocative inefficiency results in the utilization of inputs in the wrong proportions, given input prices” (Okoye, Onyenweaku, &Asumugha, 2009).

**Theory of Allocative Efficiency**

 Allocative efficiency according to Badunenko, Fritsch & Andreas, (2008) has traditionally attracted “the attention of economists: what is the optimal combination of inputs so that output is produced at minimal cost? A firm is said to have realized allocative efficiency if it is operating with the optimal combination of inputs given the prices of inputs”.

**Example using diagram**

Fig. 1 Allocative Efficiency

40

70

Q2, Allocatively inefficient MU > MC

Price

15

11

6

0

Q

S = MC

D = MU

Q1, Allocatively efficient

MU = MC

“At an output of 40 units, the marginal cost of the good is N6, but at this output, consumers would be willing to pay a price of N15. The price (which reflects the good’s marginal utility) is greater than marginal cost – suggesting under-consumption. If output increased and price fell, society would benefit from enjoying more of the good” (Tejvan, 2017).

**Methodology**

**Study Area**



**Fig 2: Map showing study location**

The study area is Imo State. Imo State is one of the 36 [states of Nigeria](https://en.wikipedia.org/wiki/States_of_Nigeria) and is in the South East region of Nigeria. [Owerri](https://en.wikipedia.org/wiki/Owerri) is its capital and among the largest cities in the state. It consists of three agricultural zones namely: Owerri, Orlu and Okigwe and 27 Local Government Areas. It occupies the area between the lower [River Niger](https://en.wikipedia.org/wiki/River_Niger) and the upper and middle [Imo River](https://en.wikipedia.org/wiki/Imo_River). The state has over 4.8 million people and the population density varies from 230 to 1,400 people per square kilometre (Achigbu&Ezeanosike, 2017). Christianity is the predominant religion. In addition to English being the official language, Imo state is a predominantly [Igbo](https://en.wikipedia.org/wiki/Igbo_language)-speaking state, with [Ibo people](https://en.wikipedia.org/wiki/Igbo_people) constituting a majority (98%).

Imo State is bordered by [Abia State](https://en.wikipedia.org/wiki/Abia_State) on the East, River Niger and [Delta State](https://en.wikipedia.org/wiki/Delta_State) to the West, [Anambra State](https://en.wikipedia.org/wiki/Anambra_State) on the North and [Rivers State](https://en.wikipedia.org/wiki/Rivers_State) to the South (Amakom, 2017). The state lies within Latitudes 4°45'N and 7°15'N, and Longitude 6°50'E and 7°25'E with an area of around 5,100 sq km. The economy of the state depends primarily on agriculture and commerce. Besides Owerri, Imo state's major towns are Isu, Okigwe, Oguta, Orlu, Mbaise, Mbano, Mbieri, Orodo and Orsu.The rainy season begins in April and lasts until October, with annual rainfall varying from 1,500mm to 2,200mm (60 to 80 inches). An average annual temperature above 20 °C (68.0 °F) creates an annual relative humidity of 75%. With humidity reaching 90% in the rainy season. The dry season experiences two months of Harmattan from late December to late February. The hottest months are between January and March (imostateweb, 2023). The chief occupation of the local people is farming while according to Aziza Goodnews (2019), the cash crops include oil palm, raffia palm, rice, groundnut, melon, cotton, cocoa, rubber, and maize. Consumable crops such as yam, cassava, cocoyam and maize are also produced in large quantities. The state has several natural resources including [crude oil](https://en.wikipedia.org/wiki/Crude_oil), natural gas, limestone lead, Calcium Cabornate and [zinc](https://en.wikipedia.org/wiki/Zinc) (Chikezie, Henri-Ukoha&Ibeagwa, 2020). Profitable flora found in the State include iroko, mahogany, obeche, bamboo, rubber tree and [oil palm](https://en.wikipedia.org/wiki/Oil_palm). Additionally, white clay, fine sand and limestone are also found in the state.

**Sample Selection**

In this study, a multi-stage sampling method was employed in selecting the respondents. The first stage was the purposive selection of the three Agricultural Zones (Owerri, Orlu, and Okigwe) in Imo State. The purposive selection was based on the fact that the three Agricultural Zones have areas where swamp rice is grown. The second stage was the purposive selection of two Local Government areas (Owerri Zone: Ohaji and Oguta; Orlu Zone: Ideato North and Ideato South and Okigwe Zone: IhitteUboma and Okigwe being the Local Government Areas that produce rice in large quantities in the Agricultural Zones) making a total of six LGAs. The third stage involved the random selection of one community from each of the six Local Government Areas, making a total of six communities (Mmahu in Ohaji and Akiri/Eziorsu in Oguta for Owerri Zone; Ohiauchu in AroNdiIzuogu for Ideato North and Ogboko/Umuezeala in Ideato South for Orlu Zone; OnichaUboma in IhitteUboma and Umulolo in Okigwe for Okigwe Zone). The fourth stage involved the proportionate selection of swamp rice farmers from each of the communities. The fifth and final stage was the random selection of swamp rice farmers from each of the communities to obtain a total sample size of 102 swamp rice farmers for the study.

The model for determining the sample size is specified as follows:

$n=\frac{N}{1+N( e^{2})}$

Where:

n = Sample size for the study

N = Total sampling frame

e = tolerable error level (at 5% level)

The proportionate sampling model is stated as follows:

$$nh = \frac{Nhn}{N}$$

Where:

nh= Sample size selected from each community

Nh = Sampling frame in each community

n = Sample size for the study

N = Total sampling frame

The distribution of the sampling frame and sample size of the swamp rice farmers in the communities is presented in Table 1.

**Table 1: Distribution of sampling frame and sample size of swamp rice farmers**

|  |  |  |
| --- | --- | --- |
| Name of Community | Sampling Frame | Sample size |
|  |  | Swamp |  | Swamp |
| Mmahu |  | 11 |  | 3 |
| Akiri/Eziorsu |  | 60 |  | 45 |
| Ohiauchu in Arondizuogu |  | 40 |  | 30 |
| Ogboko/Umuezeala |  | 6 |  | 4 |
| OnichaUboma |  | 13 |  | 16 |
| Umulolo |  | 8 |  | 4 |
| Total |  | 138 |  | 102 |

**Source: Survey Data: 2021**

**Data Collection.**

Primary data were collected through a structured questionnaire.

**Data Analyses**

Data were analyzed using Production function Model, Allocative Efficiency Model, Net Return model and Costs and Returns Model.

**Objective i** was achieved using the Net Return Model

It is specified as follows:

Net Return (NR) = Total Revenue – Total Costs

$NR\_{i}= \sum\_{j=1}^{n}TVPi-\sum\_{j=1}^{n}(TVC\_{j}^{i}+TFC\_{j}^{i})$ ………………eqn(1)

Where:

i = ith rice farmer.

j = The jth rice farmer

n = number of farmers

TVP= Total value of Production (or gross output)

TVC = Total variable Costs

FC = Fixed Costs

**Objective ii** was achieved using the allocative efficiency model applied to the results of the production function fitted to the data. The production function is implicitly specified as follows;

Yi = f(X1, X2, X3, X4, X5, X6, e) …………….eqn(2)

where;

Y= Output of Rice (Kg/ha)

i = 1 for swamp rice production.

X1 = labour (mandays)

X2 = seed (kg)

X3 = fertilizer (50kg bag)

X4 = Agrochemicals (litres)

X5 = Depreciated value of fixed inputs (N)

X6 = farm sixe (ha)

e = error term.

Four functional forms of the production function; linear, semi-log, double-log and exponential were fitted to select the lead equation based on having the highest value of the coefficient of multiple determination (R2), highest F-value and highest number of significant variables.

**Allocative Efficiency Model**

The allocative efficiency model is achieved when a given input is used to maximize profit given its price. Therefore, allocative efficiency is achieved when input is used in such a way that the marginal value product from the input equals it price or marginal cost (Ajoma, *et. al*., 2016).

The average physical product APP is calculated by;

$APP\_{i }=\frac{Y}{X}$ ………………………………………eqn(3)

Where Y and X are the mean of the output and input respectively.

The marginal physical product MPP (For Double log function being the lead equation) was given as;

$MPP\_{xi}= b\_{i}.APP\_{i}$ …………………………………….eqn(4)

The formular for the computation of the marginal physical product (MPP) is given as:

$MPP\_{xi }=\frac{b1Y}{X1}$ …………………………..eqn(5)

Where:

b = Coefficients or elasticities of the double log Function

Y = Mean level of output and

 X = Mean input.

The Marginal value product (MVP) of production is given as:

$MVP=MPP\_{xi}.PY\_{i}$ ………………………………….eqn(6)

 PY is the output (paddy) price

Pxi is the price per unit of resource input used.

 Marginal factor cost (MFC) is the price for each input used estimated as the average acquisition cost.

$r=\frac{MVP}{MFC}$ ………………………………………eqn(7)

Where: MVP = marginal value product

 MFC = marginal factor cost

 R = numerical constant (In a way to substitute the efficiency focus will be based on the estimated value of R and its closeness to unity).

 Allocative Efficiency is attained if: MVP = MFC…………..eqn(8)

**Test of Hypothesis**

**a. Test of hypothesis 1**

The results of the production function fitted to achieve objective 2 were used to derive allocative efficiency which was used to test hypothesis 1.

**Decision Rule:**

 Allocative Efficiency is attained if: MVP = MFC = 1 or r = MVP/MFC = 1. If r ≠ 1, it suggests that resources are not efficiently utilized or farmers are inefficient in resource use.

**Results and Discussion**

**Costs and Returns Associated with Swamp Rice Production**

The Cost and returns associated with swamp rice production is presented in Table 2 below

Table 2: Presenting Cost and returns associated with swamp rice production

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** |  |  | **Unit Price(N)** | **Quantity** | **Amount (N/Ha)** |
| A **Revenue (R)** |  |  |  |  |  |  |
|  (i) Sales of Rice Paddy | 82000/MT | 4.7 MT |  | 385400 |
|  (ii) Sales of Rice bran |  |  |  |  | 39750 |
| **B Total Revenue (TR)** |  |  |  |  | **425150** |
| C **Variable Costs (VC)** |  |  |  |  |  |
| (i) Capital Operating |  |  |  |  |  |
| Inputs |  |  |  |  |  |  |
| Seed |  | 140/kg |  | 41kg |  | 5740 |
| Fertilizer |  | 7500/50kg | 200kg |  | 30000 |
| Manure |  | 2700/50kg | 300kg |  | 16200 |
| Herbicide |  | 2500/litre | 4L |  | 10000 |
| Insecticide |  | 1300/litre | 1L |  | 1300 |
| **Total Capital Operating**  |  |  |  |  |
| Expenses |  |  |  |  |  | 63240 |
| (ii) Labour inputs (Mandays) |  |  |  |  |
| Land Clearing |  | 1200 |  | 18 |  | 21600 |
| Land Preparation | 1500 |  | 14 |  | 21000 |
| Nursery |  | 1000 |  | 12 |  | 12000 |
| Planting /Transplanting | 1200 |  | 16 |  | 19200 |
| Application of Agro Chemicals | 1000 |  | 5 |  | 5000 |
| Application of Fertilizer | 1000 |  | 5 |  | 5000 |
| Application of Manure | 500 |  | 8 |  | 4000 |
| Weeding |  | 2500 |  | 13 |  | 32500 |
| Bird Scaring |  | 3000 |  | 3 |  | 9000 |
| Harvesting |  | 1500 |  | 85 |  | 127500 |
| Threshing/Winowing | 1000 |  | 10 |  | 10000 |
| Others (Bagging) |  | 1000 |  | 4 |  | 4000 |
| Total Labour Input Cost |  |  |  |  | 155050 |
| Transportation  |  |  |  |  |  | 36300 |
| Utilities |  |  |  |  |  |  | 9850 |
| D. Total Variable Cost (TVC) |  |  |  |  | 264440 |
| E. Gross Margin (TR - TVC) |  |  |  |  | 160710 |
| F. **Fixed Cost (FC)** |  |  |  |  |  |  |
| Depreciation on Equipment |  |  |  | 33065 |
| Rent on Land |  |  |  |  |  | 26400 |
| Interest on loan  |  |  |  |  |  |  | 19650 |
| G. Total Fixed Cost (TFC) |  |  |  |  | 79115 |
| H. Total Cost (TC) = (TFC + TVC) |  |  |  | 343555 |
| I. Net Return (TR - TC) |  |  |  |  | 81595 |
| J. Return on Naira spent (I/H x 100) |  |  |  | 23.75% |
|  |  |  |  |  |  |  | (**N**23.75) |

The results of the costs and returns of the swamp rice farmers showed that the rice farmers had a net return of N81,595 per hectare with a Return on Naira spent of 23.75% indicating a N23.75 return on every N1.00 spent in swamp rice farming. The implication of this result is that the swamp rice farming in the study area is very profitable. The result is similar to the findings of Chidiebere-Mark (2019) who reported that “swamp rice farming with return on naira spent of 37.3% is profitable.Labour was a major component of input cost, constituting 59.14% of total cost in swamp rice production. In this respect, one important finding of the costs analysis was that labour costs are high in rice production in Imo State”. This result is in line with the findings of Ohajianya&Onyenweaku (2003) who found that in Ebonyi State labour constituted the highest cost (59.9% and 67.9% for large and small scale rice farmers respectively) and Chidiebere Mark (2017) who found that “labour constituted 64.4% and 66.8% for upland and swamp rice farming respectively in Ebonyi State. The high cost of labour can be attributed to the use of manual labour in major operations in rice production, inefficiency in labour utilization in agricultural production and the high labour rate due to rural-urban migration in Nigeria” (Obasi *et al*, 2013; Ehirim*et al*, 2012; Ogundele and Okoruwa, 2006). The swamp rice farmers depend largely on family labour for activities like weeding to reduce the cost of hired labour.

**Measurement of the Allocative Efficiency of Resource Use in Swamp Rice Production**

To achieve this objective, the resource inputs were first fitted with the output of rice in multiple regression analysis and in four functional forms linear, semi-log, double-log and exponential. The marginal physical product (MPP) was then computed from the coefficients of the lead equation. The results of the multiple regression analysis for the swamp rice farmers are presented in Table 3.

**Table 3: Results of Four Functional forms of multiple regression analysis on the relationship between Output of swamp rice farmers and resource inputs**

**Explanatory Linear Semi-log Double-log Exponential**

**Variables Function Function Function Function**

Constant 271.3449 203.4106 147.3393 108.2067

Labour (X1) 16.0231 1.6591 0.0918 0.0052

 (1.1181) (1.2751) (3.0197)\* (3.2093)\*

Seed (X2) 19.4492 3.0216 0.0667 0.0088

 (1.0877) (1.0033) (2.9127)\* (1.2394)

Fertilizer (X3) 16.1126 1.4415 0.0843 0.0071

 (4.0144)\* (1.2749) (3.9028)\* (2.5135)\*\*

Agrochemicals (X4) 19.0027 4.7026 0.0015 0.0093

 (2.1085)\*\* (1.2749) (3.3585)\* (2.5135)\*\*

Depre. (X5) 16.6667 3.0037 0.0022 0.0039

 (1.1192) (1.0075) (1.1538) (1.0833)

Farm size (X6) -14.1022 -2.0617 -0.0045 -0.0046

 (-1.0523) (-1.0246) (-3.46150)\* (-1.3143)

R2 0.4823 0.4012 0.7619 0.5526

F-value 12.5273\* 8.9554\* 43.5371\* 16.4464\*

Sample size (n) 102 102 102 102

Figures in Parentheses are t-ratios

\*Significant at 1% level

\*\*Significant at 5% level

**Source:** Survey Data, 2021

“The result shows that the double-log functions gave the lead equations having produced the highest value of the coefficient of multiple determinations (R2), the highest number of significant variables and highest F-values. The results of the double-log functions were therefore used for analysis and discussions. The value of R2 was 0.7619 for the rice farmers, which implies that about 76% of the variations in rice outputs for the swamp rice farmers were accounted for by the joint actions of the independent variables included in the multiple regression models. The coefficients of Labour, Seed, Fertilizer and Agrochemicals were statistically significant at 1% level. These significant variables are the resource inputs affecting the output of rice farmers in swamp production. The coefficient of depreciation was not statistically significant at 5% level. These non-significant variables are not factors that influence output of rice farmers. The coefficients of labour, seed, fertilizer and agrochemicals were positive and significant, which implies that increases in the magnitude of these variables will lead to increases in the output of rice farmers in the respective production systems” (Souri and Hatamian, 2019). The coefficient of land rent was negative and significant which implies that an increase in land rent leads to a decrease in rice output. The value of the marginal physical products (MPP) was used in the computation of the allocative efficiency of resource use. This was obtained from the product of the coefficients of the double log functions and the mean level of output divided by the mean inputs for each resource input. The results of the computation of allocative efficiency in swamp rice production are presented in Table 4. The table of the ratios of marginal value product (MVPx) to marginal factor cost (MFCx) shows that labour, seed, fertilizer, agrochemicals, depreciation and land have values of 0.23, 4.28, 0.52, 1.64, 114.8 and - 0.99 for swamp rice farmers. Within the limits of statistical error, none of the swamp rice farmers can be said to be allocatively efficient in the use of the resource inputs indicated. The implication of these values for seed, agrochemicals and depreciation is that these resources were underutilized, while those of labour, fertilizer, and farm size were overutilized. This may suggest that there still exists the possibility of increasing rice output under the existing level of technology through the use of higher levels of seed, agrochemicals and depreciation (capital), and reduction in the amounts oflabour (number of hours the workers put in so it does not exceed their daily capacity), fertilizer and farm size in swamp rice production systems. These findings agree with that of Nanette, Kwabena &Ditchfield (2021) in their study on the evaluation of resource use efficiency of guinea fowl production in the Savelegu-Nanton District of Northern Region of Ghana.

**Table 4 : Computation of Allocative Efficiency of Swamp and Upland Rice Farmers**

|  |  |  |
| --- | --- | --- |
| **Item** | **Swamp Rice Farmers (n = 102)** |  |
| Resource Inputs | Marginal Physical Product (MPP)/Production Elasticities |
| Labour | 0.0021 |  |
| Seed | 0.0073 |  |
| Fertilizer | 0.0474 |  |
| Agrochemicals | 0.0759 |  |
| Depreciation | 0.0014 |  |
| Land | -0.0145 |  |
|  |  |  |
| **Sample Means** |
| Labour (Mandays) | 193 |  |
| Seed (kg) | 41 |  |
| Fertilizer (50kg bag) | 4 |  |
| Agrochemicals (litres) | 5 |  |
| (Depreciation)(₦) | 5 |  |
| Land (Ha) | 1.4 |  |
| Output (₦)  | 82000 |  |
|  |  |  |
| **Marginal Value Products (MVP)** |
| Labour (₦ /Manday) | 172.2 |  |
| Seed (₦kg) | 598.5 |  |
| Fertilizer (50kg bag) | 3886.8 |  |
| Agrochemicals (litre) | 6223.8 |  |
| Depreciation(**₦)** | 114.8 |  |
| Land (Ha) | -1189 |  |
|  |  |  |
| **Factor Prices** |
| Labour (₦ /Manday) | 742.74 |  |
| Seed (₦/kg) | 140 |  |
| Fertilizer (₦/50kg bag) | 7500 |  |
| Agrochemicals (₦/ litre) | 3800 |  |
| Depreciation (₦**)** | 1 |  |
| Land (₦/Ha) | 12000 |  |
|  |  |  |
| **Allocative Efficiency (AE)** |
| Labour | 0.23 |  |
| Seed  | 4.28 |  |
| Fertilizer  | 0.52 |  |
| Agrochemicals | 1.64 |  |
| Depreciation | 114.8 |  |
| Land  | -0.99 |  |
|  |  |  |

**Source: Survey Data, 2021**

**Test of Hypothesis**

To test thehypothesis which stated that farmers are allocatively inefficient in the rice production systems, the allocative efficiency indices in Table 4 were used. The results of the allocative efficiency indices showed that the swamp rice farmers were allocatively inefficient in resource use. Therefore, the hypothesis was accepted since none of the rice farmers were found to be allocatively efficient in resource use.

**Conclusion**

The study analyzed the allocative efficiency of swamp rice producers in Imo State, Nigeria. Net return analysis confirmed that swamp rice farming was profitable. The swamp rice farmers were found to be allocatively inefficient in the use of labour, seed, fertilizer, agrochemical, capital and land. The swamp rice farmers underutilized resources of seed, agrochemicals and capital (depreciation), but overutilized resources of labour, fertilizer and land.

**Recommendations**

The following recommendations were made based on the findings of this study.

1. The rice farmers were found to be small-scale operators. There is a need to allocate more land for rice cultivation in order to improve rice production. The government should encourage increased rice production by formulating policies guided to make more land available to rice farmers for production.
2. Extension agents should be motivated to educate the rice farmers on best practices for efficient and optimal rice production and resource allocation.

**Contribution to Knowledge**

The research provides valuable insights into the allocation of resources in rice production systems in Imo State, Nigeria and examined the efficiency indices for various inputs and offers a sound understanding of how these resources are allocated among rice farmers.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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