FACTOR SHARES IN SWAMP RICE PRODUCTION SYSTEM IN IMO STATE, NIGERIA

[1]Onyewuchi, U.U., [2]Orebiyi, J.S., [2]Odii, M.A.C.A. &[1]Ezebuike I. R.
[1]Department of Agricultural Science, Alvan Ikoku Federal College of Education, Owerri
[2]Federal University of Technology Owerri
Email: u.uonyewuchi@gmail.com; Phone: 08038943120

ABSTRACT
The study analyzed the factor shares in swamp rice production system in Imo State Nigeria. The specific objective of the study was to assess the relationship between output and factor shares in the rice production systems. Data were collected using structured and validated questionnaire from proportionately and randomly selected 68 swamp rice farmers from Imo State. Data were analyzed using inferential statistics (OLS Cobb-Douglas Production Function Model). Results of the factor shares showed that there was positive and significant relationship between output of rice and labour, seed, fertilizer, farm size, and capital in the swamp rice production system. Extension agents should be motivated to educate the swamp rice farmers on best practices for efficient and optimal rice production and resource allocation.

INTRODUCTION

Rice is the staple food for over half the world's population and the most important among all the cereal crops. Rice (Oryza sativa) is an important staple in Nigeria and is internationally consumed by all social and economic classes. Rice production is important in Nigerian agriculture and forms vital element in the government's efforts to promote food security and curb food imports to feed the population (Taofeeq, Stanley & Egwue, 2022). Approximately 480 million metric tons of milled rice is produced annually. In Nigeria rice has consumption per capita of 32kg indicating 4.7% increase in the past decade making the total consumption to be 6.4 million tonnes in 2017 as against 3.7 million tonnes produced per year (Mohammed, Ibrahim, Hayatu &Mohammed, 2019). One of the production systems involved in the production of swamp rice include: traditional extensive lowland rice production found in waterlogged lowlands with variable flooding levels.

Factor share is the fundamental concept in economics that plays a critical role in research concerning production structure, costs and return analysis, income distribution, and technology choices (Kikuchi, 1991). Factor shares are the share of production given to the factors of production, usually capital and labour. According to Sephorah (2013), the key inputs determining aggregate output in rice production are capital and total labour force or number of potential workers, who may end up either employed or unemployed, while Ohajianya, Ibekwe, Onyeagocha, Nwosu, Nwaiwu, Henri-Ukoha *et.al.(*2019) found that labour, fertilizer and seeds were the most important factors of production employed by the rice farmers. Mattews, Feinstein & Odling-smee (2003) were of the view that factor shares are relevant to the weighting of labour and capital inputs in total factor input and are of interest.

Farm input allocation and optimal use of these farm input is 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 supply-demand gap in the local production system. Although poor socio-economic disposition of farmers has been reported by previous researchers (Igboji *et. al.*, 2015 and Ayoola, *et. al.,* 2011), it has not been documented especially in Imo State.

The broad objective of this study was to analyze the factor shares in swamp rice production system in Imo State, Nigeria. The specific objective of the study is to:

i. assess the relationship between output and factor shares in the rice production systems. The following hypothesis was tested: There is no significant relationship between rice output and factors of production (factor shares) in the various production systems.

In this era of structural reforms where the government and other stake holders are devising blue prints for bridging the gap between the demand and supply of food, it was pertinent to look at how inputs are shared in rice production so as to realize an optimum yield.

FACTOR SHARES IN SWAMP RICE

Concept of Factor shares

According to Kikuchi, (1991), factor share is a fundamental concept in economics that plays a critical role in research concerning production structure, costs and returns analysis, income distribution and technology choice. Because the factor share concept often is a starting point in these types of economic analysis, it is important that researchers who study these issues fully understand the concept.

He therefore defined factor shares as the ratio of costs of factor inputs (labour, land, capital and

current input used in a production process) to the total value of output.

Theory of Factor shares in rice production system

Factor shares are the ratio of costs of factor inputs used in a production process to the total value of output as calculated by Kikuchi, (1991). i.e. total revenue. Consider a production process in which a firm uses four inputs as the following: Current input (Rice seeds) (C), Capital (K), Labour (L) and Land (A) to produce a single output, Rice (Q). All variables are defined in terms of flow. If the farmer purchases inputs and sells output at constant unit prices (p, i, w, r, and P respectively) Factor shares of the farmer's input are:

Factor share of current input = $\frac{pC}{pQ}$ ….. (1)

Factor share of capital = $\frac{iK}{pQ}$ … (2)

Factor share of labour = $\frac{wL}{pQ}$ ….. (3)

Factor share of land = $\frac{rA}{pQ}$ … (4)

Where: C, K, L, and A are the physical quantities of each input factor used in production and Q is the physical quantity of output (rice) produced. The numerators are the farmer's factor costs and the common denominator is total revenue (Paddy price x output quantity). Factor costs are payments for inputs purchased and are also called factor payments.

MATERIALS AND METHODS

Study Area

The study area is Imo State and is in the South East region of Nigeria. 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 and the upper and middle Imo River with over 4.8 million people and the population density varies from 230 to 1,400 people per square kilometer (Achigbu & Ezeanosike, 2017). Christianity is the predominant religion. In addition to English being the official language, Imo state is a predominantly Igbo speaking state, with Ibo people constituting a majority (98%).

Imo State is bordered by Abia State on the East, River Niger and Delta State to the West, Anambra State on the North and 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, natural gas, limestone lead, Calcium Cabornate and zinc. Profitable flora found in the State include iroko, mahogany, obeche, bamboo, rubber tree and oil palm. Additionally, white clay, fine sand and limestone are also found in the state.

Sample Selection

In this study, multi-stage sampling method was employed in selecting the respondents. The first stage was the purposive selection of the two Agricultural Zones (Owerri and Okigwe) in Imo State because they have areas where swamp rice is grown. The second stage was the purposive selection of two Local Government areas (Owerri Zone: Ohaji and Oguta and Okigwe Zone: Ihitte Uboma and Okigwe being the Local Government Areas that produce rice in large quantities in the Agricultural Zones) making a total of four LGAs. The third stage involved the random selection of one community from each of the four Local Government Areas, making a total of four communities (Mmahu in Ohaji and Akiri/Eziorsu in Oguta for Owerri Zone; Onicha Uboma in Ihitte Uboma and Umulolo in Okigwe for Okigwe Zone). The fourth stage involved the proportionate selection of swamp rice farmers from each of the communities. The model for determining the sample size is specified as follows:

$$n = \frac{N}{1+N(e^2)} \quad \text{…….(5)}$$

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:

$$n_h = N_h\left(\frac{n}{N}\right) \quad \text{……(6)}$$

Where:

n_h= Sample size selected from each community

N_h = Sampling frame in each community
n = Sample size for the study
N = Total sampling frame
The fifth and final stage was the random selection of rice farmers from the communities to obtain a total sample size of 68 swamp rice farmers for the study. The distribution of sampling frame and sample size of the rice farmers in the communities by production systems 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
Mmahu	11	3
Akiri/Eziorsu	60	45
Onicha Uboma	13	16
Umulolo	8	4
Total	**92**	**68**

Source: Survey Data: 2023

Data Collection.
Primary data were collected through a structured questionnaire.
Data Analyses
The objective was realized with the production function analysis using the ordinary least squares (OLS) multiple regression model. Production function analysis using multiple regression model of the Cobb-Douglas type was employed in assessing factor shares/contribution in rice production systems. Khan & Maki (1979), Yahaya & Arigo (2000) and Ohajianya, et. al., (2019) justifies the use of such model for an analysis of cross-sectional data on the ground that the model provides a direct test on the existence of rational production behavior and that it accounts only for the second stage of the neoclassical production function. Similar model was used by Mbanasor & Obioha (2003) and Mohammed & Agbo (1991) to study input use productivity and efficiency in irrigated rice farming.
The OLS Regression Model for achievement of objective ii is specified implicitly as follows:

$$Q_i = f(x_1, x_2, x_3, x_4, x_5, x_6, e) \quad \ldots\ldots(7)$$

and explicitly as follows:

$$LnQ_i = b_0 + b_1 Lnx_1 + b_2 Lnx_2 + b_3 Lnx_3 + b_4 Lnx_4 + b_5 Lnx_5 + b_6 Lnx_6 + e \ldots\ldots\ldots\ldots\ldots\ldots(8)$$

Where:
Q = Paddy rice yield (kg/ha)
x_1= Quantity of labour used (Mandays/ha)
x_2 = Seed rate (kg/ha)
x_3 = Quantity of chemical fertilizer applied (kg/ha)
x_4 = farm size (ha)
x_5 = Capital inputs (Depreciation) (₦)
x_6 = Agrochemicals (Litres)
b_0 = Constant
Ln Natural Logarithm
$b_1 – b_6$ = Parameters to be estimated
e = error term

TEST OF HYPOTHESIS
The hypothesis was tested using the results of multiple regression analysis performed to achieve the objective. The multiple regression analysis generated t-ratios that were compared with tabulated t-values to test the hypothesis. The t-values were tested for significance at 5% level and n-k degrees of freedom.
Decision Rule:
If $t_{cal} > t_{tab,}$ reject the H_0 and if otherwise, accept the H_0.

RESULTS AND DISCUSSION
Relationship between output and factor shares in swamp rice Production system
In other to assess the relationship between output and factors of production (factor shares) in swamp rice production system, the data were fitted to the four functional forms of multiple regression analyses; linear, semi-log, double-log, and exponential. This was to select the lead equation on the basis of having the highest coefficient of multiple determinations (R^2), highest F-value and highest number of significant variables. The results of the multiple regression analyses are presented in Table 2

Table 2 Results of Multiple Regression Analyses on Relationship between output and factor shares in swamp rice production system

Explanatory Variables	Linear Function	Semi-log Function	Double-log Function	Exponential Function
Constant	664.9822	408.3319	343.0679	239.1182
Labour (X_1)	21.0694	3.8867	0.0648	0.0089
	(2.5914)**	(4.3085)*	(2.1457)**	(4.2381)*
Seed (X_2)	17.1167	1.4291	0.0713	0.0072
	(1.0751)	(1.3428)	(1.1708)	(3.2727)*
Fertilizer (X_3)	10.3825	9.3042	0.0529	0.0069
	(1.1674)	(1.1463)	(1.2809)	(2.4643)**
Farm Size (X_4)	13.1064	7.4821	0.0492	0.0094
	(3.9756)*	(0.9964)	(4.5981)*	(3.2414)*
Capital (X_5)	16.4193	3.1155	0.0671	0.0075
	(1.0969)	(1.0839)	(1.2684)	(3.1251)*
Agrochemicals (X_6)	12.1824	4.9882	0.0593	0.0058
	(1.0992)	(1.2792)	(5.0684)*	(1.2341)
R^2	0.4536	0.3937	0.5742	0.7442
F- value	13.0345*	10.2526*	21.2667*	45.9383*
Sample Size (n)	68	68	68	68

Figures in Parentheses are t-ratios
*Significant at 1% level
**Significant at 5% level
Source: Survey Data, 2023

The results showed that the exponential function produced the highest value of R^2, highest number of significant variables and, highest F-value and it was therefore chosen as the lead equation, and its results were used for analyses and discussion. The value of R^2 was 0.7442, which implies that about 74% of the variation in output of swamp rice farmers was accounted for by the combined action of the independent variables included in the exponential function.

The F-value was 45.9383, which was significant at 1% level, and implies that the exponential model gave a good fit to the data used. The coefficients of labour (X_1), seed (X_2), farm size (X_4), and capital (X_5) were significant at 1% level, while the coefficient of fertilizer (X_3) was significant at 5% level, implying that these variables are the factors of production affecting rice output in swamp rice production system in the study area. The coefficient of agrochemicals (X6) was not significant at 5% level, implying that this variable is not a factor that affects output of swamp rice farmers in the study area.

The coefficient of labour, seed, fertilizer, farm size and capital were positive and significant, while the coefficient of agrochemical was also positive and non-significant. This implies that there is direct relationship between output and factors of production in swamp rice production system in the study area which conforms to the findings of Sant. Nalini, Rajni & Abamanyu, (2021). This direct relationship between output and factor shares in swamp rice production system indicates that increases in the magnitude of these factors of production lead to increases in rice output in swamp rice production system in the study area. However, this differs from the findings of Yusuf, Yong & Rabiul (2020) that fertilizer and farm size were negative and have indirect relationship with output.

TEST OF HYPOTHESIS

This Hypothesis was therefore rejected with respect to the significant factors of production, and accepted with respect to the non-significant factor of production.

CONCLUSION

The study analyzed the factor shares in swamp rice production and found out that **there** was positive and significant relationship between output of rice and labour, seed, fertilizer, farm size, and capital while agrochemicals was also positive and not significant in swamp rice production system.

RECOMMENDATION

1. Extension agents should be motivated to educate the swamp rice farmers on best practices for efficient and optimal rice production and resource allocation.
2. Most of the swamp rice farmers did not belong to social organizations. Rice farmers in Imo State should be encouraged to belong to social organizations as this would enhance the delivery of agricultural extension services to them and higher benefits with respect to sourcing of funds,

leasing equipments for pre-planting, planting and post-planting operations as well as enjoy better prices for their produce.

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