Diyala Agricultural Sciences Journal, 2023, Vol. (15) No. 2: 11-24
ISSN: 2073-9524
eISSN: 2310-8746

Competitiveness and Comparative Advantage of Rice Production in Katsina State, Nigeria

Abdullahi Sani[1], Hassan I. Ibrahim[2], Segun S. Adeola[3]
[1,2,3]Department of Agricultural Economics, Faculty of Agriculture, Federal University Dutsin-Ma, Katsina State, Nigeria.
[1]Corresponding author: abdulzk18@gmail.com

Article history:

Received: 20 April 2023
Accepted: 27 June 2023
Published: 30 December 2023

Keywords: *Policy Analysis Matrix, Comparative advantage, Competitive advantage, Rice, Farmers, Agricultural policies.*

Abstract
The study was carried out to analyze the competitiveness and comparative advantage of rice production in Katsina state. A total of 196 farmers were sampled using a multi-stage sampling technique. Both primary and secondary data were utilized in the study. The primary data was collected using a structured questionnaire by trained enumerators, while the secondary data on international market prices were collected from various government and non-governmental agencies. Policy Analysis Matrix (PAM), Profit share analysis and farm budgeting techniques were used for data analysis. The result of the financial profitability analysis revealed that a typical rice farmer earned an average revenue and profit of ₦663,799.25/ha and ₦322,356/ha, respectively. The result of the Policy Analysis Matrix (PAM) indicator (Domestic Resource Cost) showed that the farmers had a comparative advantage in rice production by having a ratio of less than one (0.46). Similarly, the percentage of the Unit Cost Domestic index (UCD) and Unit Cost Export index (UCX) for the farmers were less than 0.51 and 0.57, respectively, showing that the farmers were competitive in domestic and international markets. The Effective Protection Coefficient (EPC) ratio of greater than one showed that the farmers were positively affected by the government's agricultural policies. It was recommended that the current combined trade policies in the rice sector should be sustained to strengthen the comparative advantage and increase the competitiveness of the local rice.

https://dx.doi.org/10.52951/dasj.23150202

Introduction

Rice, one of the most consumed staples after maize and wheat, has an annual national consumption value of over 7.0 million metric tonnes in Nigeria (FAO, 2022). The crop is rich in different nutrients for example. For every 100g of rice, there is 79g of carbohydrate, 7.13g of protein, 1.3g of fiber, 11.6g of water, 0.66g of fat, 0.12g of sugar, 0.07g of vitamin B and 365kcal. of calories (Vetland, 2018). The per capita consumption of rice in Nigeria has been estimated to be about 32kg/annum (Thomas, 2020).

The crop is cultivated across all Nigerian ecological zones and among all the socio-economic classes. The rice value chain has emerged as one of the fastest-growing sub-sector in Nigerian agriculture (Abdulwaheed *et al.*, 2017). Still, only about 2.6% of the annual production is exported from the country, showing its weakness to produce more for national consumption. This leads the country to have a supply deficit of about 1.9 million metric tonnes which are mostly illegally imported. In 2021, Nigeria’s rice import valued up to $8.84 million becoming the 144th largest importer of rice in the world. With the rapid growth in the country’s population which was estimated to have exceeded 200 million in 2019, it is expected that the demand for rice will be sustained and increased in the foreseeable future (Stephen, 2020). The rice production and consumption trend in Nigeria between 2010 and 2021 is shown in Figure 1.

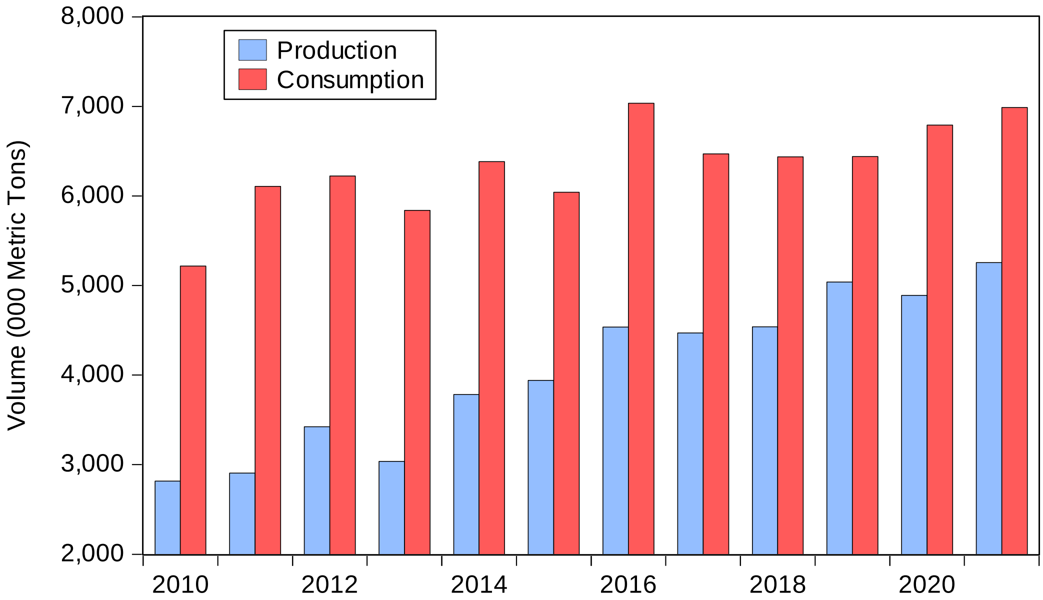

Figure 1. Rice Production and Consumption Trend in Nigeria (2010-2021)
Source: United State Department of Agriculture (USDA), (2021).

The dependency on rice imports is a major concern of Nigeria's government, and since the early 1980s, numerous policies and strategies have been implemented to encourage domestic rice production and processing activities to achieve rice self-sufficiency. In particular, rice featured prominently in the Agricultural Transformation Agenda (ATA) in 2011, which had guided the Federal Ministry of Agriculture and Rural Development (FMARD) in Nigeria as the central agenda of the country's Agricultural policy. The ATA included major investments and programs related to rice production, processing, and marketing (Guisse, 2013; Ajala and Gana, 2017). In addition, currently, there is a notable active policy known as combined trade policies in the rice sector, which involves a comprehensive ban on rice imports through land borders and an increase in import tariff through sea borders. Yet, the rice sector has not been transformed from its low productivity status. The self-sufficiency level in the rice sector is still lagging because the farmers are still producing below the potential yield of six tons per hectare in addition to poor rice processing facilities (FAO, 2020).

It is in the light of the above that the study attempted to analyze the following research objectives:

i) To determine the comparative advantage of the rice farmers in the study area

ii) To determine the competitive advantage of the rice farmers in the area

Materials and Methods

Description of the study area

The study was conducted in Katsina State. The State covers an area of about 23,983 square kilometers with a projected population of 9,921,456 by 2021 (National Population Commission (NPC), 2017; Ibukun, 2019). The State is located in the North-western part of the country and lies in between latitudes 11^0 03′ and 13^0 05′ N and longitudes 07^0 21’ and 09^0 02′ east of Greenwich Meridian. It has two climatic seasons; rainy and dry seasons, with a mean rainfall of 1300mm. The climate favours maize, rice, cowpea, groundnut, millet and guinea corn. Major livestock in the state include cattle, sheep, goats and poultry (Saleh and Oyinbo, 2017).

Sampling Procedure

Multi-stage sampling technique was employed in the study. The first stage involved the purposive selection of four Local Government Areas because of their high intensity of rice value chain activities. The areas selected were Dutsin-Ma, Dandume, Funtua and Danja which were selected from the total of 34 Local Government Areas in the state. The second stage was the random selection of three farming communities from each of the four sampled Local Government Areas to give a total of 12 farming communities. The third stage was the application of proportionate sampling to select the appropriate number of respondents (rice farmers) for the respective communities using the sample size recommended by the Raosoft sample size calculator. The following expression of the proportionate sampling was used to select a total of 196 rice farmers.

$$n = \frac{X}{D} * N$$

Where:
n= Sample size of farmers selected per community
X= Number of farmers in a farming community
D= Total number of farmers in all 12 farming communities
N= Recommended sample size by Raosoft sample size calculator
The proportionate distribution of the rice farmers was computed in Table 1 that follows.

Table 1. A sample size of the farmers

S/N	LGA	Villages Selected	Population of farmers	Number Selected
1	Dutsin-Ma	Darawa Makera Shema	100 95 90	19 18 17
2	Dandume	Dantakari Dandume Mahuta	85 110 100	15 20 19
3	Danja	Jiba Dabai Danja	65 70 105	12 13 20
4	Funtua	Maska Maigamji Dukke	100 70 60	19 13 11
Total	**4**	**12**	**1050**	**196**

Source: Reconnaissance survey and Author’s computation (2021).

Data Collection and Analysis

Primary and secondary data were used for the study. The primary data was collected with the aid of a structured questionnaire administered to the sampled farmers by trained enumerators. Data were collected on socio-economic variables, input and output data on rice production, the domestic market price of output per kg, and the cost of various inputs used such as fertilizer, seed, land, labour, capital and agro-chemicals. Additional secondary data for international market prices (Free On Board (FOB) and Cost, Insurance and Freight (CIF) of the rice output (milled) per kg and the unit prices of all tradable inputs used by the farmers, as well as the exchange rate for computing social prices were obtained from Government documentations and non-governmental organizations such as the Central Bank of Nigeria (CBN), International Fund for Agricultural Development (IFAD), Food and Agriculture Organization of the United Nation (FAO) and World Bank database of prices for agricultural inputs and outputs. Policy Analysis Matrix (PAM) and sensitivity analysis were used to achieve the stated objectives.

Economic Profitability

The economic profitability of the farmers was determined using economic prices for revenues and the costs incurred by the respondents. It is computed as the divergence between the value added for the social revenue and the summation for both the social tradable inputs costs and social domestic factor costs (Bellu, 2013). The expression of the computation is as follows:

$$Л_j = P^w Q^d - \sum (P_i^w Q_i^d + W_j^r I_j^d) \;\ldots\ldots \text{(i)}$$

Where:

$Л_j$ = Economic profitability of farmers

P_i^w = World price per unit of tradable input *i* used

Q_i^d = Average quantity of tradable input *i* used at the domestic level

$\sum$ = Summation sign

W_j^r = Rural factor market price per unit of the domestic factor *j* used

I_j^d = Average quantity of domestic factor *j* used

Computation of social or economic prices

Social prices are those prices that would prevail in the free market if there were no government policies. The prices are what the private prices would be in the absence of policy interventions. The often starting point for estimating social prices is the parity price. Parity prices are usually calculated for internationally tradable goods and services, i.e. products for which exchange opportunities exist on international markets. For exportable and exported commodities, both outputs and inputs, the export parity prices are computed using FOB prices as a benchmark for world prices. In the case of import substitutes, both outputs and inputs, import parity prices are calculated by employing CIF prices as world prices. Parity prices for non-tradable commodities (domestic factors) cannot always be computed based on a world price. Hence, in this case, the rural factor market for the primary domestic factors could be studied to estimate their social prices (Monke and Pearson, 1989).

Import parity price

This is the border price plus all other costs necessary to deliver a commodity from the national entry point to the domestic market of reference. Such costs include import tariffs, subsidies, storage costs, transportation costs and all other transaction costs. Table 2 below depicts the budgets of the computations.

Table 2. Computing Import Parity Prices for Tradable Inputs and foreign rice

Item	**Description**	**Computation**	**Currency**
A	CIF price (foreign currency)	A	Foreign
B	Official Exchange Rate (OER)	B	Domestic
C	Border price (local currency)	C = A*B	Domestic
D	Import tax (ad valorem %)	D (%)	
E	Unit import tax	E	Domestic
F	Total import tariff	F = C*D+E	Domestic
G	Transport Cost from border to the domestic market	G	Domestic
H	Handling Cost from border to the domestic market	H	Domestic

I	Storage Cost from border to the domestic market	I	Domestic
J	Import Parity Price at Market level (IPPM)	J = C+F+G+H+I	Domestic
K	Transport Cost from domestic market to the production site	K	Domestic
L	Handling Cost from the domestic market to the production site	L	Domestic
M	Storage Cost from the domestic market to the production site	M	Domestic
N	Import Parity Price at Production Level (IPPP)	N = J+K+L+M	Domestic

Source: Bellu (2013).

Policy Analysis Matrix (PAM)

The Policy Analysis Matrix (PAM) is a computational framework, developed by Monke and Pearson (1989) and augmented by Masters and Winter-Nelson (1995), for measuring input use efficiency in production, comparative advantage, and the degree of government interventions through a set of policies in the Agricultural systems. The PAM is a principal tool needed for easy communication between economic analysts and policymakers. This is because many decision makers often have only limited exposure to the principles of economics and little time to digest the results of economic analyses (Kanaka and Chinnadurai, 2015). PAM enables the evaluation of price-based trade policy affecting an agricultural system by comparing enterprise outcomes at market prices with outcomes at social prices. The difference between the two outcomes represents the policy effects, which in PAM methodology are called 'actual policy transfers' between economic actors. The main assumption made in conducting such a comparison is that reference prices are the best proxy for the scarcity value of resources used in the commodity production process, while market prices reflect the trade policy effects (Taure, Groenewald, Seck, and Diegne, 2015). The structure of the policy analysis matrix is shown in Table 3 and Table 4.

Table 3. Structure of the Policy Analysis Matrix

		Input	Costs	
	Revenue	**Tradable Inputs**	**Primary Domestic factors**	**Profit**
Private	A	B	C	D
Social	E	F	G	H
Policy Transfers	I	J	K	L

Source: Monke and Pearson (1989)

Table 4. Disaggregated view of the Matrix

		Input	Costs	
	Revenue	**Tradable Inputs**	**Primary Domestic factors**	**Profit**
Private	$P^d Q^d$	$\sum P_i^d Q_i^d$	$\sum W_j^d I_j^d$	D
Social	$P^w Q^d$	$\sum P_i^w Q_i^d$	$\sum W_j^r I_j^d$	H
Policy Transfers	I	J	K	L

Source: Monke and Pearson (1989)

The first row of the Policy Analysis Matrix (PAM) is obtained from observed domestic market prices for output and inputs. This row is termed as private profitability, denoted by the letter D. It is computed as the difference between the values added for the private revenue (A) and the summation of private tradable inputs costs (B) and private domestic factors costs (C) (Mohanty *et al.*, 2008). This is the row of the matrix that measures the competitiveness of an agricultural system. Thus:

$D = A - (B + C)$ …………………… (ii)

Where:

D = Private Profit

$A = P^d Q^d$

P^d = Observed domestic market price per unit of output

Q^d = Average quantity of output

$B = \sum P_i^d Q_i^d$

P_i^d = Observed domestic market price per unit of tradable input *i* used

Q_i^d = Average quantity of tradable input *i* used at the domestic level

$\sum$ = Summation across all private tradable inputs used

$C = \sum W_j^d I_j^d$

W_j^d = Domestic Market price per unit of domestic factor *j* used

I_j^d =Average quantity of domestic factor *j* used

$\sum$ = Summation across all private primary domestic factors used

The second row of the Matrix is the row for social prices known as the world prices or efficiency prices that intended to show what the private costs and revenues in the first row would be if there were no government policies. This row is used to measure the efficiency and comparative advantage of an agricultural system (Ugochukwu and Ezedinma, 2011). The social profit (H), therefore is measured in a manner analogous to the calculation of private profitability. Thus:

$H = E - (F + G)$ …………………… (iii)

Where:

H = Social Profit

$E = P^w Q^d$

P^w = World price per unit of output (international market price)

Q^d = Average quantity of output (output at domestic level)

$F = \sum P_i^w Q_i^d$

P_i^w = World price per unit of tradable input *i* used

Q_i^d = Average quantity of tradable input *i* used at the domestic level

$\sum$ = Summation across all social tradable inputs used.

To compute the social revenue (E), the CIF price of imported rice (Thailand) was used. This is because, in trade statistics, importable commodities are usually valued at their CIF prices (Bellu, 2013). Rice in this case, is an import substitute. Similarly, CIF prices for the identified tradable inputs were used to compute the social tradable inputs cost (F). The CIF (Cost, Insurance and Freight) is the price of the commodity at the frontier of the importing country. This price includes the cost of the commodity itself, the cost of insurance and the cost of transporting the commodity from the frontier of the exporting country to the frontier of the importing country before any import duties or other taxes are paid for the commodity and also before transporting the commodity between the margins of the importing country. Such prices are needed because in the balance of payment and trade statistics, importable goods are usually valued at their CIF prices (Bellu, 2013).

The FOB and CIF prices were converted to local currency (NGN) using an official exchange rate (OER) of ₦415/$1 as the conversion factor at the time of the analysis which was then augmented to import parity price, respectively. Similarly, to centralize the *numeraire* (unit of measurement) for the currencies, the US dollar was assumed to be the world reference currency.

$G = \sum W_j^r I_j^d$

W_j^r = Rural factor the market price per unit of domestic factor *j* used

I_j^d = Average quantity of domestic factor *j* used

$\sum$ = Summation across all social domestic factors used

Since the primary domestic factors (such as land, labour, firewood, manure, water and capital) are non-tradable inputs which means their prices cannot be obtained from the international market, therefore, according to Monke and Pearson (1989); such a situation, the researcher studied the rural factor market for the respective domestic factors and estimated their prices used in computing the social prices for (G). Similarly, the values for G (social domestic factor cost) were additionally computed by applying to the private prices for the domestic factors the average ratio that exists between the private prices for the tradable inputs and their prevailing social prices. The average ratio was multiplied by the observed private prices for the domestic factors to generate a new price schedule for computing "G" (Lorenzo, 2013).

The third row of the Policy Analysis Matrix (PAM) is the last row of the matrix that measures the transfer effects of policies thereby determining the degree or extent of government interventions (Musa and Ibrahim, 2017). It accounts for the divergences between the entries in the first row (measured in private prices) and entries in the second row (measured in social prices) (Fang and Beghin, 2000). The effects of divergences are disaggregated into three categories-distorting policies, market failure and efficient policies (Fazleen and Stephan, 2015). Therefore, the net transfer (L) was computed as follows:

$L = I – (J + K)$ …………………… (iv)

Where:

L = Net transfers that measure the degree of government interventions

I = A – E (Output transfers that measure subsidies on output)

J = B – F (Input transfers that measure subsidies on inputs)

K = C – G (Factor transfers that measure subsidies on primary domestic factors)

Matrix Indicators

Policy Analysis Matrix (PAM) was used to generate various indicators such as Effective Protection Coefficient (EPC), Domestic Resource Cost (DRC), and Cost Competitiveness Criteria (C_3) index (Unit Cost Domestic index and Unit Cost Export index).

Effective Protection Coefficient (EPC)

This is the measure that is used to determine if the rice farmers are protected through policy interventions or they are not protected. It has been widely used in developing countries as a coefficient for measuring policy guidance and reforms (Ngwira *et al.*, 2012). Thus, the indicator is computed as follows:

$$\text{EPC} = \frac{(P^d\,Q^d) - (\sum P_i^d\,Q_i^d)}{(P^W\,Q^d) - (\sum P_i^W\,Q_i^d)} \quad ..(v)$$

Ratio: > 1 = The farmers are protected through policy interventions

< 1 = The farmers are not protected through policy interventions

Domestic Resource Cost (DRC)

The domestic resource cost ratio was used to determine the efficient utilization of the scarce resources which consequently measures the comparative advantage of an agricultural system. Though the DRC indicator is widely used in academic research, however, its primary use has also been in applied works by the World Bank, the food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute to measure comparative advantage in many developing countries (Mohanty *et al.,* 2008). The computation of this indicator is expressed as follows:

$$\text{DRC} = \frac{(\sum W_j^r\,I_i^d)}{(P^W\,Q^d) - (\sum P_i^W\,Q_i^d)} \quad . \quad (vi)$$

Ratio: <1 = Efficient utilization of scarce resources which denotes comparative advantage

> 1 = Inefficient utilization of the scarce resources (lack of comparative advantage)

= 1 = No gain or loss of forex from farming ac tivity

Cost Competitiveness Criteria (C_3)

This is an index that contains two different indices which are used in determining the ability of the farmers to compete favorably in the domestic and international markets given the current technologies and observed market prices. These indices include the Unit Cost Domestic (UCD) index and the Unit Cost Export (UCX) index (Najarzadeh *et al.,* 2011).

i) **Unit Cost Domestic (UCD) Index**

The Unit Cost Domestic index shows the ability or in-ability of the rice farmers to compete favorably in the domestic market under the existing market prices. This index is measured in the following manner:

$$\text{UCD} = \frac{\left(\sum P_j^d\,Q_j^d\right) + \left(\sum W_j^d\,I_j^d\right)}{(P^d\,Q^d)} \qquad (vii)$$

Ratio: < 1 = The farmers will be competitive in the domestic market

> 1 = The farmers will not be competitive in the domestic market

ii) **Unit Cost Export (UCX) Index**

The unit cost export index on the other hand shows the ability or in-ability of the rice farmers to compete favorably in the international market given the current technologies and observed market prices. This index is measured as follows:

$$\text{UCX} = \frac{\left(\sum P_j^d\,Q_j^d\right) + \left(\sum W_j^d\,I_j^d\right)}{(P^w\,Q^d)} \;\ldots\ldots \qquad (viii)$$

Ratio: < 1 = Value chain actor will be competitive in the international market

> 1 = Value chain actor will not be competitive in the international market

Sensitivity Analysis

Some researchers including Mohanty *et al.* (2008) made a criticism that the Policy Analysis Matrix is a static approach and homogenous in nature. In order to make the matrix a dynamic heterogeneously computational approach and avoid shortcomings, sensitivity analysis, therefore, becomes necessary. The analysis was conducted under different assumptions and the initial computations served as the baseline or reference result. In this case, the observed domestic market price per unit of output (P^d), average quantity of output and the official exchange rate (OER) at the time of the analysis, all increased and decreased by 10% and 20% respectively. By so doing, all the elements as well as the various indicators in the matrix have changed, thereby replicating a given situation in the economy which was subsequently reported and interpreted.

Results and Discussion

The Policy Analysis Matrix (PAM) elements for rice farmers

The matrix elements for the rice farmers in the area were computed and presented in Table 5:

Table 5. Computations of PAM Elements for Farmers

		Input	Costs	
	Revenue(₦)	**Tradable Inputs(₦)**	**Primary Domestic factors(₦)**	**Profit(₦)**
Private	663,799.25	124,428.39	217,014.86	322,356.00
Social	600,597.25	157,170.97	203,678.91	239,747.37
Policy Transfers	63,202.00	-32,742.58	13,335.95	82,608.63

Source: Author's computation (2022).

The result reveals that there is a positive divergence between the private revenue and social revenue, because the value added for the shadow revenue is less than that of the private revenue. Thus, the policy transfer on output is positive. This implies that the government protective policies are affecting the rice farmers positively. The farmers were able to realize maximum revenue by selling the domestic rice on the domestic market, thereby indicating that the domestic rice can be a perfect substitute to the imported rice. However, the value of tradable input transfers (divergence between private tradable input cost and social tradable input cost) is negative. This implies that the rice farmers purchase production inputs at lower prices than they appeared in the international markets. Hence, the total cost is expected to be lower than in the social prices and invariably increases the private revenue. This can be attributed to subsidy policy especially on chemical fertilizers and agrochemicals. The policy transfer on primary domestic factors had a positive value. This indicates that the farmers incurred higher cost of non-tradable inputs at the domestic markets than in the international market, showing disincentives to the factors, because the value of the private domestic factor cost is higher than its corresponding social prices. This may be related to the fact that the factors of production (land, labour, capital) are the major component of non-tradable inputs at the farming stage, and thus, the result implies that despite the large portion of total cost consumed by these primary domestic factors, the system is still feasible even in the absence government interventions on the domestic factors. However, in a period of unfavorable economic conditions, if the farmers continue to incur such high costs, the net private profitability may be negatively affected.

Similarly, the value of the net transfers (divergence between private profit and social profit) had a positive sign. This indicates that the observed domestic market prices of production inputs incurred and the supernormal revenue gained by the farmers have made the private profitability greater than the social profitability. This implies that rice farmers have the potential to expand the system, so long as the farming area can be expanded and or substitute crops are not more profitable. The lower value of the social profit compared to private profit, is an encouragement to rice farmers, as it signifies that rice farming enterprise is more profitable at the domestic level than on the international markets. The overall net transfers revealed the extent to which the government efficient policies have overcome the effects of market failures and distorting government policies as the causes of unwanted discrepancies between the private and social prices. The result supports the findings of Fazleen and Stephan (2015) in Malaysia where they found that rice farming generates relatively low social profits and hence positive value of net transfers was observed, showing that the government policies were protecting the system.

Important Policy Analysis Matrix (PAM) indicators

The matrix indicators computed for the rice farmers in the study area are presented in Table 6.

Table 6. Matrix Indicators of Rice Farmers

Indicator / Actor	EPC	DRC	UCD	UCX	PC	SCB
Farmers	1.22	0.46	0.51	0.57	1.34	0.60

Source: Author's computation (2022)

In the case of the Effective Protection Coefficient (EPC), the value obtained by the farmers are greater than one (1.22), which means negative divergence in inputs is offset by positive divergence in output. This implies that the farmers are protected through policy interventions; hence, the government trade policies such as a ban on rice importation had positive effects on the farmers in the area. Thus, domestic rice is said to be protected against the competitive ability of imported rice. This can be confirmed by the larger private revenue obtained by the farmers. The findings support the work conducted by Ude *et al.* (2017) in Ebonyi state where it was uncovered that rice farmers were protected by government agricultural policies in the area. The Effective Protection Coefficient (EPC) is a useful matrix indicator because it nets out the effect of government policy protection on inputs and output and also reveals the degree of the protection according to the value-added process in the production, processing and marketing activities of the relevant commodity (Kanaka and Chinnadurai, 2015). On the other hand, the value of the Domestic Resource Cost (DRC) ratio for the farmers was less than one. This reveals that the farmers were efficiently utilizing the scarce resources which led to the achievement of comparative advantage. In this case, the comparative advantage is the ability of the rice farmers to produce an output at a lower cost which results to the attainment of an efficiency objective. Hence, given the DRC ratio obtained, it implies that the rice farmers in the area have the comparative advantage to produce domestic rice and thus, they are saved from the dilemma of non-efficiency objective which entails wastage of the scarce resources; that is when the costs of the domestic production, processing or marketing exceed the costs of importing the quantity of the commodity under investigation. This was confirmed by the farmers' positive values of social profits. Similarly, the ratio of Unit Cost Domestic index (UCD) for the farmers was less than one. This indicates that rice farmers have the ability to compete favorably in the domestic market given the current technologies and the observed market prices. However, the ratio of the Unit Cost Export index (UCX) (O.57) for the farmers shows that given the existing domestic market prices, the farmers seemed to be competitive in the international market. This implies that rice farmers can compete with other crops value chain actors in terms of revenue generation. The result somewhat contradicts the work conducted in Nasarawa state by Felerk *et al.* (2018) who discovered that the processors were competitive in the domestic market but uncompetitive in the international market, while the farmers were competitive in both the domestic and international markets.

Sensitivity analysis

The sensitivity analysis was conducted to determine the responsiveness of the rice farmers to changes that might occur in the policy analysis matrix. Hence, the analysis was based on different assumptions and the results are presented in the following sub-headings.

Sensitivity analysis on changes in import parity price of rice

Changes in the import parity price of rice (social price) can be induced by change in the value of the Official Exchange rate (OER) used in the initial computations. Thus, 10%, 20%, -10% and -20% increase and decrease respectively were assumed. The results are shown in Figure 1.

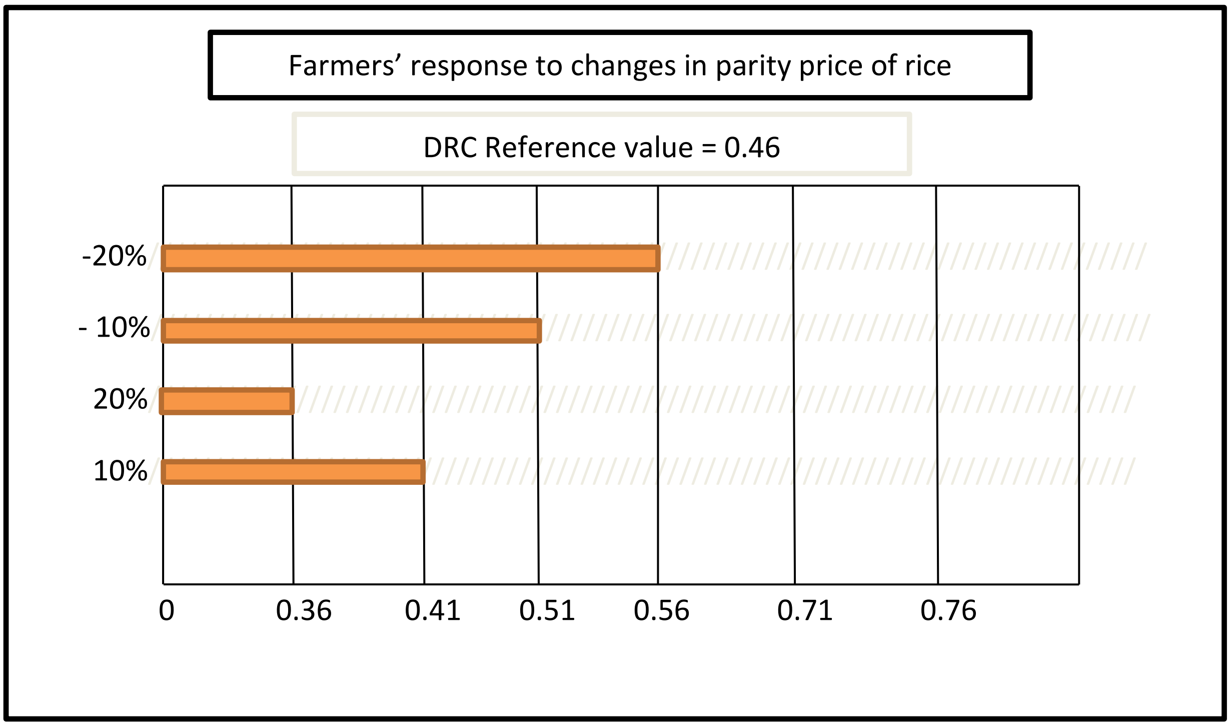

Figure1. Sensitivity Analysis of Farmers on DRC Changes

Source: Field survey (2022)

The analysis in Figure 1 demonstrates that the estimated ratio of Domestic Resource Cost (DRC) of farmers is sensitive to changes in the import parity price of rice. A 10% and 20% increase in the social price of rice would make the DRC stronger from 0.46 to 0.41 and 0.36, respectively since the lower the DRC ratio the stronger the comparative advantage and vice versa.

While a 10 and 20 percent decrease in the parity price of rice didn't exhibit a serious pitfall in rice production. This implies that rice farmers may not quickly lose their comparative advantage in a period of unfavorable economic conditions. The import parity price of rice is highly ex ante to change due to the rampant fluctuations of the official exchange rate. The result does not corroborate the work of Fazleen and Stephan (2015) in Malaysia where they disclosed that a 20% decrease in the import parity price of rice would cause the rice farmers to lose their comparative advantage in rice production.

Sensitivity analysis on changes in the quantity of output

The responsiveness of the rice farmers to changes in the average quantity of output observed was computed based on Unit Cost Domestic Index (UCD) and the result is shown in Table 7.

Table7. Actors' Response to Changes in Quantity of Output

	UCD Baseline value	10% increase	20% increase	-10% decrease	-20% decrease
Farmers	0.51	0.47	0.43	0.57	0.64

Source: Author's computation (2022)

The result in Table 7 shows the trend of changes to the level of competitiveness of the rice farmers when the quantity of output changes. The UCD ratio of less than one determines the ability of the farmers to compete in the domestic markets. As shown in the analysis, the farmers' level of competitiveness remains the same despite the increase and decrease in their output level according to the underlined assumptions. This implies that the rice farmers have the potential to sustain their competitive advantage in the domestic market thereby placing barrier for the competitors, since the more sustainable the competitive advantage, the more difficult it becomes for the competitors to neutralize the advantage.

Conclusion

Based on the research findings, it can be concluded that the rice farmers in the area have a comparative advantage in rice production. Hence, it is better to produce the rice at the domestic level than to import foreign rice. Similarly, the farmers are competitive in both the domestic and international markets. It is recommended that the government combined trade policies (Import tariff and ban) should be sustained to strengthen the comparative advantage of the rice farmers and at the same time increase the competitiveness of the local rice. There is also the need to accelerate the farmers' access to essential inputs particularly fertilizers, agrochemicals, and improve/quality seeds. This would minimize the higher cost incurred on variable tradable inputs.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Acknowledgment

The efforts made by Prof. Hassan I. Ibrahim and Dr. Segun S. Adeola towards executing this research are highly appreciated.

References

Abdulwaheed, A., Opadotun, O.O. and Amusat, M.A. (2017). Rice self-sufficiency: A Review of government policies on rice production. *International Journal of Scientific and Engineering Research, 8*(2), 1289-1302.

Bellu, L.G. (2013). Value chain analysis for policy making: Methodological guidelines and country cases for a quantitative approach. *Food and Agriculture Organization of the United Nations, (FAO), Conceptual and Technical Material, EasyPol Series 178 p.*

Fang, C. and Beghin, J. C. (2000). Food self-sufficiency, comparative advantage, and agricultural trade: A policy analysis matrix for Chinese agriculture. *CARD Working Papers.* p 270.

Fazleen, A., and Stephan, V. C. (2015). The policy analysis matrix of profitability and competitiveness of rice farming in Malaysia. *International Conference of Agricultural Economics, Mllan Italy 8-14 August.* http://dx.doi.org/10.22004/ag.econ.210872

Felerk, E., Hoesten, W.D. and Tukur, G. (2018). Comparative advantage and competitiveness of rice processing and marketing in Nasarawa state. A policy analysis matrix approach. *Journal of International Development*, *7*(3), 45-58. http://dx.doi.org/10.22004/ag.econ.303617

Food and Agriculture Organization of the United Nation (FAO) (2020). Sustainable rice based production and people's livelihood, *International Rice Commission Newsletter (Special Edition) vol. 52, 24-36.*

Gana, A. and Ajala, A.S. (2015). Analysis of challenges facing rice processing in Nigeria: A review article. *Journal of Food Processing*, *2015*(893673), 1-6. https://doi.org/10.1155/2015/893673

Guisse, R. (2013). Post-harvest losses of rice (*Oriza Spp*) and policy: A case study of southern Nigeria. *A Thesis Submitted To The Board Of Postgraduate Studies Kwame Nkrumah University Of Science And Technology, Kumasi, Ghana.*

Ibukun, I. (2019). Top ten most populated state in Nigeria by 2021. Projected population of Katsina state.

Kanaka, S. and Chinnadurai, M. (2015). The policy analysis matrix of rice cultivation in India. *European Journal of Basic and Applied Sciences*, *2*(1), 33-45. http://dx.doi.org/10.17306/J.JARD.2018.00411

Lorenzo, G.B. (2013). Value chain analysis for policy making: Methodological guidelines and country cases for a quantitative approach. *Food and Agriculture Organization of the United Nations, (FAO), Conceptual and Technical Material, EasyPol Series, 129.*

Masters, W. A., and Winter-Nelson, A. (1995). Measuring the comparative advantage of agricultural activities: Domestic resource costs and the social cost-benefit ratio. *American Journal of Agricultural Economics*, *11*(77), 243-50. https://doi.org/10.2307/1243534

Mohanty, S., Fanga, C. and Chaudhary, J. (2008). Assessing the competitiveness of Indian cotton production among competing crops: A Policy Analysis Matrix Approach. *Journal of Agricultural Economics*, *2*(12), 76-96.

Monke, E. A., and Pearson. S. R. (1989). *The Policy Analysis Matrix for Agricultural Development*. Cornell University Press, Ithaca and London.

Musa, S. and Ibrahim, H.Y. (2017). Competitiveness and comparative advantage of date palm fruit in selected markets in Jigawa State, Nigeria: A Policy Analysis Matrix Approach. *Nigerian Journal of Agricultural Extension*, *18*(2), 62-70.

Najarzadeh, R., Rezagholizadeh, M., Saghaian, S., Reed, M. and Aghaie, M. (2011). The impact of trade liberalization on Persian rugs: A Policy Analysis Matrix Approach. *Journal of Food Distribution Research*, *42*(1), 91-95.

National Population Commission (NPC) (2017). Population Projection Report for states in Nigeria.

Ngwira, A.L., Simtowe, F. and Moses, S. (2012). Assessing the competitiveness of groundnut production in Malawi: A Policy Analysis Matrix Approach. *Selected Poster prepared for presentation at the International Association of Agricultural*

Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.

Saleh, M. K. and Oyinbo, O. (2017). Rice production under different weed management technologies adopted by rice farmers in Katsina state, Nigeria. *Journal of Agricultural Extension, 21*(1), 1-15. http://dx.doi.org/10.4314/jae.v21i1.12

Stephen, K. (2020). The quality of Nigerian home-grown rice. The conversation Trust. https://theconversation.com

Taure, A.A., Groenewald, J., Seck, P.A. and Diegne, A. (2015). Analyzing policy-induced effects on the performance of irrigated rice in West Africa. *African Journal of Agricultural and Resource Economics, 8*(1), 68-77. https://doi.org/10.22004/ag.econ.156986

Thomas, H. (2020). *Rice production in Nigeria*. A growing problem: Nigerian rice farmers fall short after borders close. https://www.reuters.com/article/us-nigeria-economy-rice-idUSKBN1ZM109

Ude, M., Iyabo B. A., Sulaiman, A.Y., Balogun, O.L. and Akinlade, R.J. (2017). Competitiveness of rice processing and marketing in Ebonyi State: A policy analysis approach. *International Journal of Agricultural Science, 3*(2), 410-418.

Ugochukwu, A.I., and Ezedinma, C. I. (2011). Intensification of rice production systems in South-eastern Nigeria: A Policy Analysis Matrix Approach. *International Journal of Agricultural Management and Development, 1*(2), 89-100. http://dx.doi.org/10.22004/ag.econ.143498

United State Department of Agriculture (USDA). (2021). Rice production and consumption statistics for Nigeria. *Working paper 0988.*

Vetland, E. (2018). Rice production and self-sufficiency in Nigeria. *Research Journal of Integrated Economics, 2*(1), 23-28.