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An Econometric Model-Based Projection of Nigeria's Rice Self-Sufficiency

R.Y. Abdulsalam[1*], M.N. Shamsudin[2], A.H.I. Abdul Hadi[3]

1- Department of Agricultural Economics and Agribusiness, Federal University Dutse, Jigawa State, Nigeria
(*- Corresponding Author Email: r.abdulsalam@fud.edu.ng)
2- Putra Business School, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
3- Department of Agribusiness and Bioresource Economics, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

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Abstract

Motivated by Nigeria's persistent pursuit of rice self-sufficiency, this paper projects the country's future rice self-sufficiency levels. These projections could guide policy decisions in areas of the rice market that show potential for growth, aiding in the achievement of Nigeria's goal through improved planning strategies. Using time series data covering the period from 1980 to 2018, this study adopted an econometric technique to model Nigeria's rice market which was estimated using a dynamic Autoregressive Distributed Lag (ARDL) approach. The results revealed that paddy producer price elasticity was 0.206 and had no influence on paddy area harvested. On the other hand, the national policy of rice credit guarantee scheme variable displayed a positive relationship with paddy area harvested. Lagged yield and lagged area harvested had positive influences on yield and area harvested, respectively. This could mean that paddy producers were motivated by previous year's yield levels and area harvested. The demand own-price elasticity of rice was -0.321 and its cross-price elasticity was 0.193, with wheat revealed to be a substitute. The obtained elasticities were then used to make a ten-year projection. Results suggested that by 2028, increasing rice production relative to dwindling imports will boost rice self-sufficiency level to 71%. However, the average yearly rice self-sufficiency level was 53%, requiring 3.85 million Mt of rice imports. The projections revealed that Nigeria will not achieve rice self-sufficiency by 2028 unless intensive yield enhancing policy-supporting efforts are pursued.

Keywords: Autoregressive distributed lag, Elasticities, Projection, Rice, Self-sufficiency

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Introduction

In Nigeria, annual rice consumption per capita in 2021 was estimated at 33.35 kg (FAOSTAT Online database), making it an important national staple. With a growth rate of 5.3% between 2007 and 2018, the country's regional consumption was estimated to be 20.74% of Sub-Saharan Africa (USDA PSD Online database). Within the same decade, the country's rice supply was estimated at 8735 thousand Mt (USDA PSD Online database). This figure included import volumes of 2133 000 Mt (24%) as the country is incapable of satisfying the demand with domestic supply, which has costed it huge import bills over the years. According to KPMG (2019), Nigeria spends approximately US$5 million daily on rice imports which is expected to increase because the Nigeria's rice outlook for the 2019–2028 period shows rice imports are expected to reach 5274.73 thousand Mt, and world rice prices are expected to increase by 5.15% to US$470 Mt^{-1} by 2028 from 2018 (OECD/FAO, 2019). These unfavorable import dependence and bleak forecast incited a renewed policy directive of pursuing self-sufficiency in rice since 2005 and have been fostered by various government regimes at both federal and state levels. Nevertheless, the self-sufficiency level (SSL) of 64% in 2018 puts the successes of these policies/projects/programs into question. Under the existing circumstances, the inability of the country to achieve its policy goal of self-sufficiency in rice might be related to a lack of information supported by empirical evidence on the capability of the country to reach self-sufficiency in rice in the first place. As supported by Kholikova (2020), such information is considered a key factor in the successful development of an industry (Kholikova, 2020) and this is true for Nigeria's rice industry.

Agricultural policy analysts have benefited from considerable advances in forecasting/projection over the past decades. With particular reference to agricultural commodity markets, forecasting serves to not only provide relevant information on agricultural commodities in advance, which decision-makers rely on but also reduces uncertainties and risks in agricultural markets (Wang, Yue, & Wei, 2017).

The food self-sufficiency (FSS) agenda pursued by many countries has inspired a large collection of studies on the topic, focusing on a variety of different aspects including forecasting. Studies adopting econometric techniques are motivated by interests in predicting self-sufficiency while considering influencing factors like levels of input use, climate change and policies, as can be found in the works of Kurnia and Iskandar (2019), Hudoyo *et al*. (2016) and Seng *et al*. (2017). The gaol of this study was substantiated by the argument that projecting the country's rice self-sufficiency level and its associated parameters serves in understanding the dynamics of the country's rice market which could facilitate national policy formulations. Hence, a key question is whether Nigeria can be self-sufficient in rice given its current market environment. In this regard, this study sought to project Nigeria's rice SSL using an econometric approach.

Methodology

Data Source

The dataset for this study spanned 38 years, from 1980 to 2018. Data on paddy/rice production, consumption and population were obtained from the International Rice Research Institute (IRRI) online database, retail prices of rice and wheat were obtained from FAO'S FPMA online database, various issues of Nigeria's National Bureau of Statistics Annual abstract of statistic and various issues of Central Bank of Nigeria's statistical bulletin, paddy producer price were sourced from FAOSTAT online database, data on Gross National Income per Capita was retrieved from Central Bank of Nigeria database, and Nigeria's currency exchange rate, as well as the world price of rice, were retrieved from UN Comtrade online database.

Conceptual Framework of Nigeria's Rice Model

This study adopts a commodity market approach based on the concepts proposed by Labys (1973). A simple commodity market model for a non-storable product is a multi-equation market equilibrium formulation consisting of three main components - demand, supply, and price (Labys, 2003). As this market model approach relates to a single economic sector (Labys, 2003), it lends itself well to FSS analysis. Therefore, drawing inspiration from the conceptual framework established by Labys (1973) with modifications by Shamsudin (2008), the Nigeria rice market was modelled, based on available data. The model, depicted in Fig. 1 comprised of the demand, the supply and the price components. The rice market price was determined based on the market clearing condition which equates the total supply of rice to its total demand.

The Econometric Model

Following FAO's definition, the country's rice self-sufficiency is calculated as the ratio (in percentage) of domestic rice production to domestic rice demand. The model developed by Abdulsalam *et al*. (2021) consisted of four structural equations and five identities as presented in Table 1.

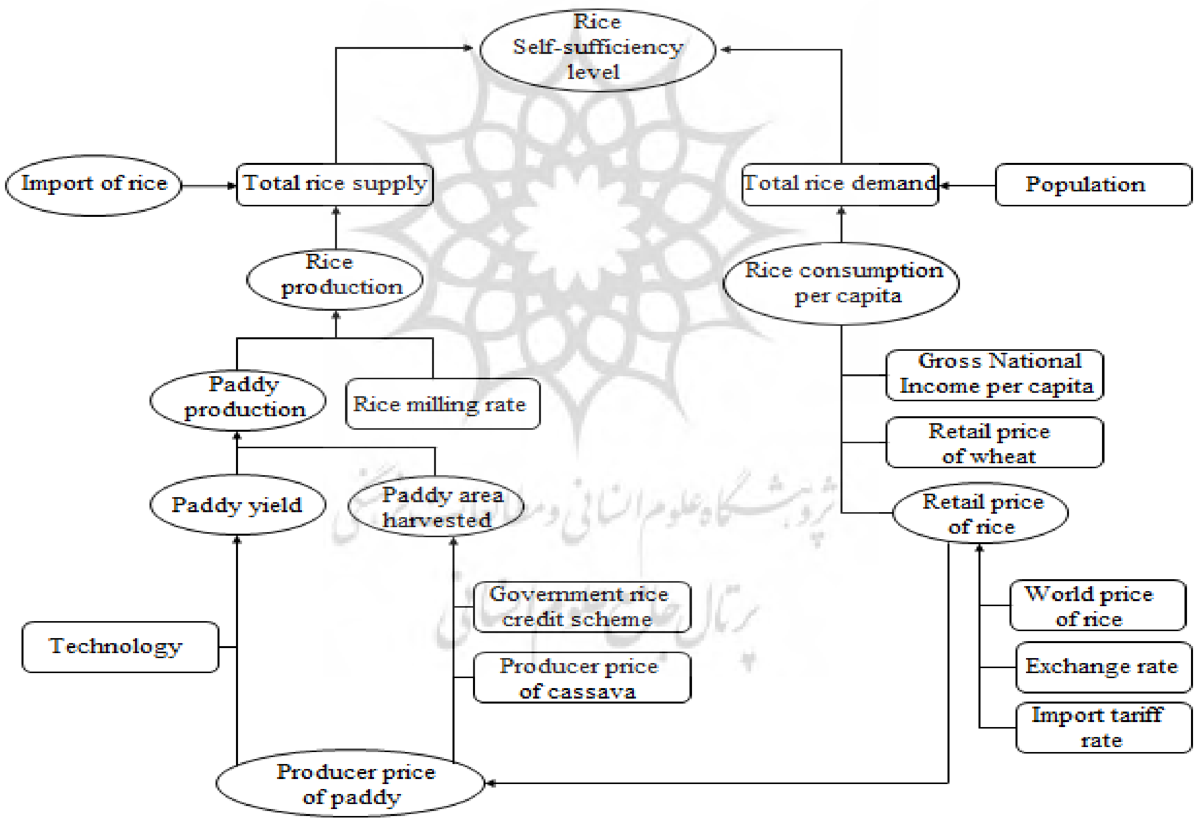

Figure 1- Conceptual framework of Nigeria's rice market

Table 1- The Nigeria's rice market model specification

S/N0	Equation
Supply	
[1]	$PYAH_t = f(PYAH_{t-1}, PYPP_{t-1}, CVPP_{t-1}, CGSF_{t-1})$
[2]	$PYYD_t = f(PYYD_{t-1}, PYPP_{t-1}, TREND_t)$
[3]	$PYPN_t = PYYD_t * PYAH_t$
[4]	$REPN_t = PYPN_t * PYMR_t$
[5]	$REIM_t = NTRD_t – REPN_t$
	Demand
[6]	$REPC_t = f(REPC_{t-1}, RERP_t, WTRP_t, GNIPC_t)$
[7]	$NTRD_t = REPC_t * POP_t$
	Price
[8]	$RERP_t = [REWP_t (1 + REIT)] * EXRT_t$
[9]	$PYPP_t = (PYPP_{t-1}, RERP_t)$
	SSL
[10]	REPN x 100 / (REPN + REIM)

Definitions of Variables
$PYAH_t$: Paddy Area Harvested in Hectares
$PYYD_t$: Paddy Yield in Mt ha^1
$PYPN_t$: Paddy Production in Mt
$REPN_t$:Rice Production in Mt
$PYPP_t$:Paddy Producer Price in ₦ Mt^{-1}
$CVPP_{t-1}$: Cassava Producer Price in ₦ M^{-1}
$GCSF_{t-1}$: Government Rice Credit Guarantee Scheme Fund in '000 ₦
$TREND_t$: Time Trend as a proxy of technology change
$PYMR_t$: Milling Rate of Paddy in %
$REIM_t$: Rice Import in Mt
$NTRD_t$: Total Rice Demand in Mt
$REPC_t$:Per Capita Domestic Demand of Rice in Kg $Capita^{-1}$
$RERP_t$: Retail Price of Rice in ₦ Mt^{-1}
$WTRP_t$:Retail Price of Wheat in ₦ Mt^{-1}
$GNIPC_t$:Gross National Income per Capita in '000 ₦
POP_t : Population in Millions
$REWP_t$: World Price of Rice in US$ Mt^{-1}
REIT : Rice import tariff in percent
$EXRT_t$: Nigerian Currency Exchange Rate in ₦ US$$^{-1}$

Model Estimation

In the estimation phase of this analysis, an autoregressive distributed lag (ARDL) approach was adopted due to some advantages it possesses such as its applicability to variables of mixed or single order of integration. The ARDL modelling approach had the following structure: -

$$y_t = \alpha + \beta x_t + \delta z_t + e_t \quad (1)$$

the error correction version of the ARDL model is given by: -

$$\Delta y_t = \alpha_0 + \sum_{i-1}^{p} \beta_i \Delta y_t + \sum_{i-1}^{p} \delta_i \Delta x_i + \sum_{i-1}^{p} \varepsilon_i \Delta z_{t-1} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \lambda_3 z_{t-1} + \mu_t \quad (2)$$

the first part of the equation with β, δ and ε represents the short-run dynamics of the model. The second part with λs represents the long-run relationship. The null hypothesis in the equation is $\lambda_1 + \lambda_2 + \lambda_3 = 0$, which means the non-existence of long-run relationship.

Model Validation

The basic concept of model reliability is to identify models that effectively explain the past behavior of the time series variable under consideration. Two common approaches are often used: a graphical method, where line graphs of actual data are compared against the model's predicted values, and a statistical approach, which involves conducting a series of tests on the model. In this study, both approaches were adopted using four statistical measures namely Mean Absolute Error (*MAE*), Mean Absolute Percent Error (*MAPE*), Root Mean Square Percent Error and Theil's inequality coefficients (U) (Pindyck &

Rubinfeld, 1998). These quantities measure the differences between the actual values in the time series and the predicted or fitted values generated by the projection technique.

Projection Technique

In the second stage, the estimated model was used to project rice SSL for ten-years from 2018 base year. To obtain the projected values, the elasticities of the estimated model and annual rates of change of the associated variables were used. :

$$lnY = \delta_0 + \delta_1 lnX_1 + \delta_2 lnX_2 + \delta_3 lnX_3 + \cdots + \delta_n lnX_n + \varepsilon \quad (3)$$

where, Y denotes an endogenous variable, X_i is independent variables with $i = 1, 2, 3 \ldots n$, δ_i with $i = 0,1,2,3 \ldots n$ are coefficients to be estimated and ε is error term.

The projections, represented by their rates of change are generated using the following equation:

$$Y_t = Y_{t-1} + Y_{t-1}(\phi Y) \quad (4)$$

Where Y is the variable under consideration, ϕY is the annual growth rate for Y - either exogenously or endogenously determined, and t is the current year.

The annual rates of change for the endogenous variable were given by a generic formula of the form.

$$\phi Y = \delta_1 * \phi X_1 + \delta_2 * \phi X_2 + \delta_3 * \phi X_3 + \cdots + \delta_n * \phi X_n \quad (5)$$

where ϕY is the calculated annual growth rate of the endogenous variable, Y, δ is the elasticity of variable Y with respect to X_i for $i = 1,2,3, \ldots n$, and ϕX_i is the annual percentage rate of change for variable X for $i = 1,2,3 \ldots n$

A base year of 2018 was established where the tariff rate was 70% while growth rates for the exogenous variables were referenced from their last five-year averages.

Results and Discussion

Unit Root and Co-integration Tests

Aligned with the study's objective, it was necessary to test the data series for non-stationarity—a condition where the series exhibits a time-varying mean, time-varying variance, or both, thereby violating classical econometric assumptions. As a result, modeling non-stationary data using traditional econometric techniques can lead to spurious regression results (Granger & Newbold, 1974), undermining its effectiveness for forecasting purposes. To test for stationarity, this study employed the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests. The findings (Table 2) showed that the regressors were all of I (1). Additionally, the result of the unit root test validated the adoption of the unrestricted ARDL Bound Test to estimate the model.

Table 2- ADF and PP Unit Root Tests (with intercepts)

Variable	ADF		PP		Conclusion
	Level	First difference	Level	First difference	
	t-statistic	t-statistic	t-statistic	t-statistic	
lnPYAH	-1.792	-8.090***	-1.998	-8.071***	I(1)
lnPYPP	-2.657	-6.801***	-2.616	-6.772***	I(1)
lnCVPP	-0.438	-8.814***	-0.697	-9.428***	I(1)
lnCGSF	-1.877	-4.033***	-1.593	-4.010***	I(1)
lnPYYD	-1.554	-8.142***	-1.669	-8.126***	I(1)
lnREPC	-1.080	-7.504***	-0.655	-7.709***	I(1)
lnRERP	-1.768	-6.559***	-1.767	-6.845***	I(1)
lnWTRP	0.170	-2.742***	-1.213	-8.859***	I(1)
lnGNIPC	0.453	-4.318***	0.113	-4.343***	I(1)

Following the stationarity test was a bounds test of co-integration to determine whether the variables share a long-run association. The bounds test is mainly based on the joint F-statistic in which its asymptotic distribution is non-standard under the null hypothesis of no co-integration. Therefore, the four specified equations were subjected to an F-test for the joint significance of the coefficients of the lagged levels of the variables. As a criterion, the null hypothesis of no co-integration is rejected when the value of the test statistic exceeds the upper critical bounds provided by Narayan (2005), otherwise it is accepted if the F-statistic is lower than the lower bounds value. Accordingly, based on the results in Table 3, the null hypotheses were rejected, thus indicating the existence of long run relationships (co-integration) between the variables of each of the four equations.

Table 3- ARDL bounds test of co-integration

Dependent variable	K	Lag	F-statistic	Narayan (2005) Critical values	
				I(0)	I(1)
lnPYAH	3	2	4.081*	2.933	4.020
lnPYYD	2	2	4.591*	3.373	4.377
lnREPC	3	2	11.023***	5.018	6.610
lnPYPP	1	2	6.497**	5.260	6.160

Note: ***, ** and * denotes significant at 1%, 5% and 10% levels, respectively.

Estimated Long-run Coefficients

A presentation of the ARDL long-run coefficients of the estimated model including results of the necessary diagnostic statistics are provided in Table 4. In general, the estimated equations fitted the data in a manner consistent with economic theory. The statistical properties of the model viz Ramsey's RESET test for functional form misspecification, Breusch Godfrey LM (BG-LM) test for serial correlation, Breusch-Pagan-Godfrey (BP-G) test for heteroskedasticity and Jarque-Bera (JB) test for normality of residuals fell within acceptable statistical thresholds, and all the equations had at least 92% of their historical variations explained.

In the supply sub-model, the paddy area harvested was significantly influenced by the lagged area harvested and the government rice credit guarantee scheme fund. As reflected by the paddy's own price elasticity of 0.206, it was observed that the paddy area harvested was unresponsive to paddy producer price. It makes sense that the slow response could be caused by agricultural commodities' typically long production cycles, which make it challenging for producers to adjust production activities quickly. It follows that farmers' decisions about the size of their farms are only slightly influenced by paddy prices. Similar rice studies in Nigeria found slightly higher own-price elasticities of paddy. They reported 0.633 (Ayinde & Bessler, 2014), 0.23 (Takeshima, 2016) and 0.34 (Okpe, Abu, & Odoemenem, 2018), respectively. The rice credit guarantee scheme variable showed a positive relationship with paddy area harvested with a coefficient of 0.162 and had a statistically significant effect on paddy area harvested at a 5% level. As for paddy yield, the result showed that a 1% rise in the producer price of paddy will cause a yield improvement of 0.220%. This result paralleled Boansi's (2014) who observed a 0.210 elasticity. As expected, lagged yield had a positive effect on yield by about 0.49% because higher volumes of yield may drive producers to increase their investment in yield-enhancing inputs subsequent production seasons.

On the demand sub-model, all the featured variables carried their expected signs, more so, significantly. The own-price elasticity of rice was -0.321 and the cross-price elasticity was 0.193, meaning that a higher retail price of rice suppressed its quantity demanded. The relationship between per capita rice demand

and income was described by the income elasticity of demand value of 0.95. This means that rice is a normal good, more so, a necessity, therefore, consumers' demands for rice are tied to their income levels - more incomes means more quantity demanded. The behaviour of wheat was expected since wheat is also a staple in Nigeria and therefore, a substitute. Other researchers like Makama *et al*. (2017), found a higher own price elasticity (-0.55) for rice. In the paddy producer price equation, rice retail price was positive with an elasticity of 0.168.

Model Validation

As a necessary step in time series forecasting studies, the estimated model's forecasting ability was examined to establish its validity and reliability. This was done via both graphical and statistical methods. A visual examination of the graphical method depicted in Fig. 2 shows that each of the endogenous variables tracked fairly well over its historical data. Although some variations were observed, this is not uncommon (Pindyck & Rubinfeld, 1998).

Table 4- Estimated results of Nigeria's rice market model

Variable	Sub-model			
Regressor	**Paddy harvested area**	**Paddy yield**	**Rice consumption per Capita demand**	**Producer price**
Constant	9.520*** (3.830)	3.272 (2.724)	-8.799 (-4.350)	-0.622 (-0.807)
$PYAH_{t-1}$	0.260 (1.555)			
$PYPP_{t-1}$	0.206 (4.170)	0.220** (2.569)		0.985*** (38.915)
$CVPP_{t-1}$	-0.076 (-1.433)			
$CGSF_{t-1}$	0.162** (2.252)			
$PYYD_{t-1}$		0.488*** (3.557)		
$TREND_t$		0.292** (3.041)		
$REPC_{t-1}$			0.493*** (5.646)	
$RERP_{t-1}$			-0.321*** (-5.380)	
$WTRP_{t-1}$			0.193*** (3.754)	
$GNIPC_{t-1}$			0.951** (2.693)	
$REDP_t$				0.168 (1.588)
Diagnostic test				
Adjusted R^2	0.951	0.951	0.920	0.987
BG-LM	0.888[0.422]	0.932[0.437]	0.244[0.786]	2.675[0.084]
JB	19.556[0.000]	1.592[0.451]	1.037[0.595]	2.413[0.299]
RESET	0.084[0.774]	0.008[0.929]	2.633[0.116]	3.447[0.072]
BP-G	1.051[0.406]	0.695[0.601]	0.884[0.542]	1.431[0.253]

Note: ***, ** and * denote significant at 1%, 5% and 10% levels, respectively. Figures in parenthesis (…) are t-statistics while figures in brackets […] are p-values.

Results of the validity tests are presented in Table 5 and they allow a satisfactory confirmation of the model's forecasting ability and performance. The value of the MAPE revealed a reasonable forecast accuracy since the simulated values were off by less than 3%. The RMSPE of the yield equation was quite high but this can be explained. According to literature, the RMSPE can be misleading when the variable under consideration has a wide variability or volatility (as is the case with the historical yield data) which can lead to larger errors when calculating the percentage errors. It can also be due to unpredictability nature of these types of data such as yield. Additionally, if the yield equation has small magnitudes, any minute error of prediction creates a high proportion of error when such error is compared to the small actual value. In such cases, other model validation measure such as Theil statistics would be more convincing. The individual components of U^T showed that the model had a good fit with little to no systematic forecasting error and overall, possessed a good forecasting ability. This was supported by Pindcyk and Rubinfield (1998) who suggested that U^b values above 0.1 or 0.2 would indicate the presence of systemic bias, necessitating a possible re-specification of the model.

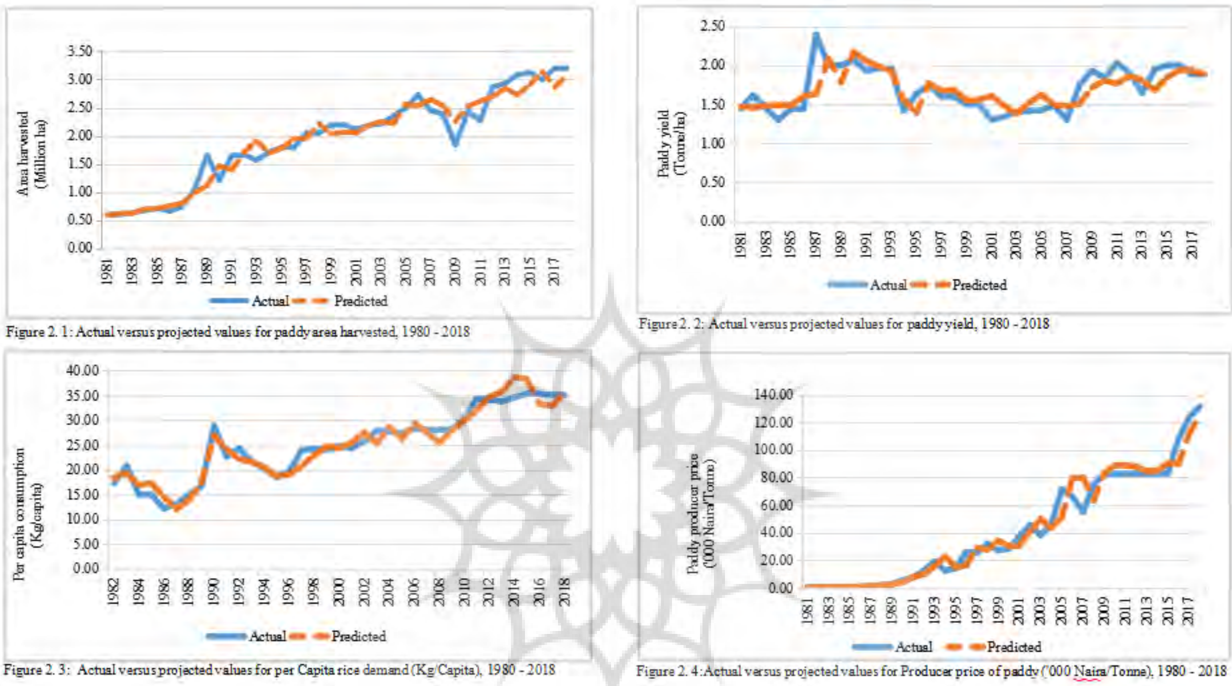

Figure 2- Graphical representation of within-sample validation

Rice Self-sufficiency Level Baseline Projections

The basic idea in this analysis was to replicate and project the market situation using historical data from 1980 to 2018. At a SSL of 67% in 2018, Nigeria was far behind its official goal of reaching SSL by the year 2020, as targeted in the Agricultural Promotion policy of reaching rice self-sufficiency by 2020. In an effort to use the latest available estimate, 2018 was set as the baseline in which official import tariff was 70% while a last five year average growth rates were used for the exogenous variables. A ten years projection reported in Table 6 shows a generally uneven trend. It revealed a sharp drop from the baseline estimate of 67% to 51.34% in 2019. Nonetheless, it gradually increased in 2022 to reach 70.96% in 2028, while maintaining a yearly average of 53%. This outcome was unsurprising for two reasons. First, the projected trend mirrored the erratic nature of the historical data (Fig. 2). Second, it reflected the inherent instability of Nigeria's rice production-consumption dynamic, particularly given the smallholder nature of the country's production systems. Overall, the results indicated the country's inability to meet its population's demand for rice. Additional related variables were examined to understand their influence on SSL.

Rice production will average 4.30 Mt per year, mainly as a result of an average yield of 2.12 Mt ha^{-1}, equivalent to a 3.06% growth rate. Yield growth (3.06%) appeared to be the primary driver for paddy production relative to the paddy area harvested. Complementing the yield growth is an annual area harvested growth of 1.14% so that projections topped 3.46 hectares in 2028. Together, these variables spiked a 4.25% growth in rice production, which is expected to reach 5.44 million Mt in 2028.

Average annual figures showed demand increasing by 0.65% per year, averaging 8.15 Million Mt. The highest estimates were recorded in 2022 with 8.63 million Mt of rice to be demanded compared to a rice production volume of 3.91 million Mt in the same year. This meant that, despite the growth in rice production by 2028 (5.44 million Mt), it would be insufficient to satisfy a demand of 7.66 million Mt by 2028. As explained earlier, demand for rice is driven by population which has a 2.4% annual growth rate in 2022 (World Bank Online database) and urbanisation, which has a growth rate of 4.1% in 2020 (Index Mundi database). Therefore, imports will be unavoidable with its forecast averaging 3.85 million Mt yearly. At the initial stage, demand increases due to quality differentials in favour of imported rice which urban households usually prefer. However, consistent with the theory of demand, there is a drop in demand from 2023 due to high retail price which may cause affordability concerns resulting in a substitution reaction for wheat in the long run.

As an important factor in total demand, per capita demand started at 36.41 kg $Capita^{-1}$ in 2019, it increased to 40.64 kg $Capita^{-1}$ in 2021 but then declined to 30.87 kg $Capita^{-1}$ in 2028. Two factors could explain this behaviour. First, retail prices gained, owing to increasing exchange rates and higher world market prices. Consequently, consumers will experience higher retail prices of ₦409 thousand Mt^{-1} on average, equivalent to an 11.11% yearly growth rate, causing a reduction in per Capita demand. Secondly, this weakening rice consumption could result from the positive income elasticity. Based on the estimation result, rice was determined to be a normal good. As income increased, consumers respond initially by increasing rice consumption, but in the long run, a continuous rise in income could encourage consumers taste to evolve in favour of other healthier eating habits featuring options like brown rice and basmati rice. Other additional element of uncertainty, such as high exchange rate and high inflation can cause a shift from imported rice for domestically produced rice in the long run. Overall, the projections show that the demand for rice is expected to be shaped by the population growth, price of rice and income. Their individual influences on quantity demanded are considered while keeping other factors constant in line with economic theory. Nonetheless, their aggregate influence results in a declining per capita consumption in the long run projection figures which began in 2023.

The results of this study revealed a bleak outlook for Nigeria's rice self-sufficiency goal. This gloomy future was shared by Van Oort *et al*. (2015) adopted a yield gap assessment technique to determine Nigeria's SSL of 54% for 2025 projection, given a one one Mt ha^{-1} yield increment. An average SSL of 53% for the 10-year projected period means that Nigeria will need to almost double its average production volumes of 4.3 million Mt or increase production by about 47% to be self-sufficient in rice. Decomposing the rice production sub-model from a yield perspective to consider this goal, IRRI estimates the required yield to attain rice self-sufficiency for Nigeria is 5.30 Mt h^{-1} (Gloria-Pelicano & Prandelli, 2013). This means that Nigeria will have to more than double its current average yield of two metric tonnes per hectare. On a positive note, this seems feasible, given the tremendous rice production potential of the country available for intensive exploitation for a productive and sustainable national rice market.

Table 5- Results of Within-Sample Validation

Statistic	Notation	Endogenous variable			
		PYAH	PYYD	REPC	PYPP
Mean Absolute Error	MAE	0.077	0.093	0.065	0.216
Mean Absolute Percent Error	MAPE	0.533	1.271	2.113	2.541
Root Mean Squared Percent Error	RMSPE	0.763	24.53	2.501	3.030
Theil Inequality Coefficient	U^T	0.004	0.008	0.014	0.014
Bias proportion	U^B	0.000	0.001	0.000	0.032
Variance proportion	U^V	0.014	0.015	0.055	0.193
Covariance proportion	U^C	0.986	0.984	0.945	0.775

Table 6- Summary of Nigeria's rice market projection

Variable	Unit	Projection											
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Average 2019-2028	
Supply													μ	Δ
Harvested area	Million ha	3.20	3.13	3.12	3.12	3.12	3.13	3.17	3.22	3,28	3.36	3.46	3.21	1.14
Paddy yield	Mt h^{-1}	1.88	1.90	1.94	1.96	1.99	2.03	2.09	2.16	2.25	2.36	2.49	2.12	3.06
Paddy production	Million Mt	6.12	5.95	6.05	6.11	6.21	6.37	6.61	6.94	7.38	7.93	8.63	6.82	4.25
Rice production	Million Mt	5.34	3.75	3.81	3.85	3.91	4.01	4.17	4.37	4.65	5.00	5.44	4.30	4.25
Rice import	Million Mt	3.00	3.55	4.36	4.70	4.72	4.55	4.26	3.87	3.41	2.86	2.23	3.85	-4.27
Demand														
Domestic demand	Million Mt	6.90	7.30	8.17	8.55	8.63	8.56	8.42	8.24	8.05	7.86	7.66	8.15	0.64
Per capita demand	Kg $Capita^{-1}$	35.23	36.41	39.79	40.64	40.08	38.83	37.29	35.65	34.01	32.41	30.87	36.60	-1.72
Price														
Retail Price	‘000 ₦ Mt	305.04	243.33	270.36	300.39	333.76	370.84	412.03	457.80	508.65	565.16	627.93	409.02	11.11
Producer price	‘000 ₦ Mt^{-1}	52.94	53.92	53.06	53.22	54.37	56.54	59.83	64.36	70.37	78.15	88.13	63.19	5.71
Self-sufficiency														
SSL	Per cent	64.00	51.34	46.64	45.06	45.33	46.88	49.46	53.05	57.71	63.60	70.96	53.00	3.87

Note: Mt denotes metric tonnes, μ denotes variable average and Δ denotes average growth rate in percentage.
Note: 306.08 Naira = 1 US dollar

Conclusion

Strengthening rice self-sufficiency has gained priority in Nigeria's staple food policy agenda. Nonetheless, there is a lingering situation of demand-supply imbalance. An important step is to understand the dynamics of the demand for food staples and production potentials in relation to rice SSL. Such analysis serves as a valuable tool for guiding policy design that could help to create efficient agricultural food market systems and promote sustainable economic development. This study empirically projected rice SSL, which will help provide insight into the ability of the country to achieve rice self-sufficiency in the future and thus guide the formulation of future national rice market policies. The analysis adopted a theory-oriented market model for a non-storable commodity to provide a 10-year projection of rice self-sufficiency level for Nigeria based on an econometric approach. The model performance was validated by the results of the statistical tests showing appreciable model forecasting strength. The result of this paper underscored a broader policy message that, given the current policy environment of the country's rice market, achieving self-sufficiency is unfeasible in the future, despite many past intervention projects. Such a situation will push the country towards a continuous dependence on imports at the expense of affordable domestically produced substitutes, consequently creating a risk of a deteriorating rice market as well as threatening food security. One effective way to improve SSL is to design policies towards investing in yield enhancing technology. In this study, the appreciation for adopting the econometric market model approach extends beyond producing the projections of FSS level to highlighting the dynamics of the key variables as they influence the country's rice market system.

Since this article aimed to replicate the Nigerian rice market as a foundation for making projections, several limitations are worth noting. First, the initial model specification included weather-related variables, such as rainfall and temperature, as well as policy variables like fertilizer subsidies, which were theorized to influence paddy production in the national paddy production sub-model. However, the estimated functions had unacceptable results in terms of their signs and their result diagnostic tests, hence the model had to be re-specified with those variables removed for an acceptable result. Secondly, there were issues of few missing data entries for some variables and these issues were resolved by interpolation. Ultimately, the presented results were based on available data and are believed to be the acceptable of the specifications attempted from an economic theory point of view.

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پیش‌بینی مبتنی بر الگوی اقتصادسنجی برای خودکفایی محصول برنج در نیجریه

راکیا عبدالسلام[1]*- مدنصیر شمس الدین[2]- احمد هنیس ایزانی عبدالهادی[3]

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چکیده

خودکفایی در محصول برنج از اولویت‌های سیاست کشاورزی کشور نیجریه قلمداد می‌شود و این مقاله درصدد آن است سطح خودکفایی محصول برنج را مورد بررسی قرار دهد. بدین منظور، داده‌های سری زمانی برای دوره ۱۹۸۰ تا ۲۰۱۸ از طریق روش اقتصادسنجی خودرگرسیون پویا با وقفه توزیع شده برای الگوسازی بازار برنج نیجریه مورد استفاده قرار گرفت. نتایج نشان داد کشش قیمتی شلتوک معادل ۰/۲۰۶ و بدون معنی است. همچنین، سیاست ملی تضمین مالی کاشت برنج تأثیر مثبت بر نواحی کاشت برنج داشت. وقفه متغیر عملکرد و وقفه سطح کشت با تأثیر مثبت به افزایش عملکرد و سطح زیرکشت منجر شده است. کشش خود قیمتی تقاضای برنج و کشش قیمتی متقاطع، به‌ترتیب، -۰٫۳۲۱ و ۰٫۱۹۳ برآورد شد، که کشش قیمتی متقاطع به جایگزینی با گندم اشاره دارد. پیش‌بینی دوره ده ساله با استفاده از کشش‌های به‌دست آمده نشان داد، تا سال ۲۰۲۸، افزایش تولید برنج نسبت به کاهش واردات به خودکفایی تا سطح ۷۱ درصد منجر می‌شود. همچنین، سطح متوسط خودکفایی سالیانه ۵۳ درصد، معادل ۳٫۸۵ میلیون تن از وادرات برنج، برآورد شد. با استفاده از این نتایج، انتظار می‌رود خودکفایی برنج در نیجریه تا سال ۲۰۲۸ محقق نشود، و تنها در صورت بهبود عملکرد برنج از طریق استمرار سیاست‌های حمایتی تحقق خودکفایی ممکن خواهد بود.

واژه‌های کلیدی: پیش‌بینی خودکفایی برنج، کشش، وقفه توزیع شده خودرگرسیونی

۱- گروه اقتصاد کشاورزی و تجارت کشاورزی، دانشگاه فدرال دوتسه، ایالت جیگاوا، نیجریه

(*- نویسنده مسئول: Email: r.abdulsalam@fud.edu.ng)

۲- دانشگاه پوترا مالزی، سلانگور، مالزی

۳- گروه تجارت کشاورزی و اقتصاد منابع زیستی، دانشگاه پوترا مالزی، سلانگور، مالزی

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