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Original Research Article

Trend analysis of milled rice consumption in Nigeria

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This study was carried out to determine the trend of rice consumption and its implication on rice self sufficiency target by the year 2020. Data on milled rice consumption over a period of fifty four years, 1960 to 2013 was used in the study. The trends of four different periods, 1960-2013, 1970-2013, 1980 to 2013 and 1990 to 2013 were separately analyzed. For each of these periods, four functional equations were estimated using ordinary least square regression. Based on statistical and econometric criteria semi-log equations best fit three periods while double-log equation best fit one of the equations. When the four best fit equations were subject to further econometric analytical criteria, the double log was finally selected and used to forecast milled rice consumption for year 2020. Results showed that 6,720,512 metric tons of milled rice will be required in the year 2020 if the current trends continue. In order to meet this demand, the national rice production would have to increase by 100%. Promotion of improved technologies among rice farmers was suggested as the best option towards achieving the target.

Key words : Nigeria rice, supply deficit, consumption, technology option, multi-period trend

INTRODUCTION

Rice (*Oryza sativa*) is one of the cereals that has been playing crucial role as major source of food, income and employment in Nigeria. It is widely grown in all agro-ecological zones of the country in various production systems such as swampy lowland, rain-fed upland, irrigated, deep water and mangrove. Despite the considerable potential for rice production expansion in all these production ecologies, the rice sector has not been able to satisfy the demand of rice consumers. About 70 percent of the annual rice demand is met by local rice producers. The deficit has to be imported to the extent that Nigeria has become the largest importer of rice in Africa (FAO, 2012) and second in the world (Cardoni and Angelucci, 2013). To bridge the demand-supply gap, milled rice worth N356 billion was imported into the country (ATA, 2011, Ayanwale and Amusan, 2012). The growing concern about the foreign currency drains resulting from rice import has influenced the decision of the Nigeria government to give high priority to rice production in the Agricultural Transformation Agenda. If self sufficiency in rice is to be achieved, what are the likely policy measures to be adopted? The goal of this paper is to provide answer to this question by assessing the past trends of rice consumption and forecast the future milled rice demand with a view to estimate the quantity of paddy that will be required to meet the Nigeria consumers' demand.

Several literatures have treated issues concerning growth trends in agricultural production (Gupta et al*.,* 1999, Kamal and Meenu, 2000, Thanh and Singh, 2006, Khan and Imon, 2008, Abdullahi, et al*.,* 2013, Nmadu, et al*.,* 2013, Oyinbo, et al*.,* 2013) but literatures that strictly treated issues on Nigeria milled rice consumption trend are scanty. The use of multi-period trends approach makes this study different from past studies. The justification for multi-period approach adopted in this study lies in the fact that no standard was established till now with regards to the length of period to be used in trend analysis. However, it has been observed that different results were generated for different period even when data from the same source were used for analysis. Multi-period approach ensures that the

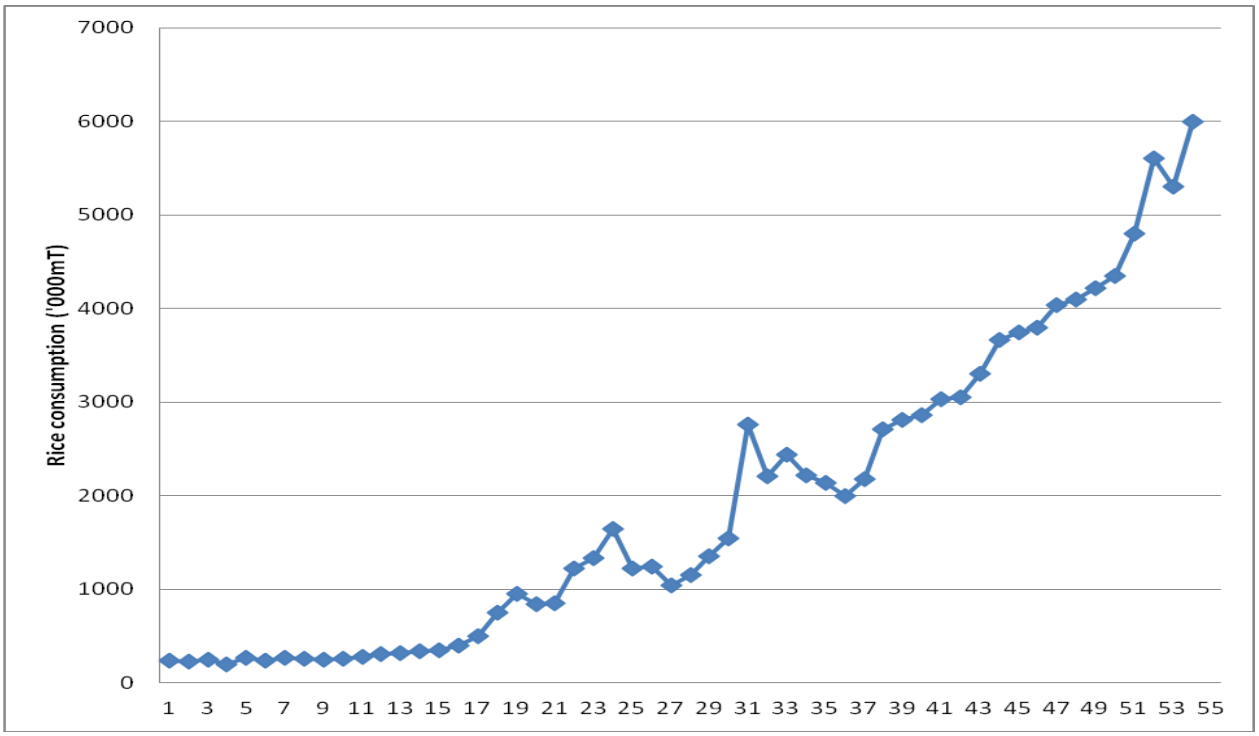

Figure 1: Rice consumption trend 1960 (T= 1) to 2013(T = 54)

prediction errors are reduced to the barest minimum by making allowance for the choice of the best out of many tested trend periods. The specific objectives of this study are: to estimate the trend of rice consumption and forecast the rice paddy requirement by the year 2020. The study will provide information to guide policy makers on the type of policies that are required to attain the status of self-sufficiency in rice production by that year.

MATERIALS AND METHODS

Data on milled rice consumption was collected from the United States Department of Agriculture Foreign Agricultural Service (USDA, 2014). The data covered a period of fifty four years, 1960 to 2013. Data were analyzed using time series regression model (Peterson, 2002, Upender, 2012). The quantity of rice consumed was made a deterministic function of time trend as employed by Kamal and Meenu, 2000, Thanh and Singh 2006, Abdullahi, et al., 2013 and Nmadu, et al., 2013). The following equations were estimated using ordinary least square regression technique:

i. Simple linear, $Q = a + bT + e$
ii. Double-log, $\ln Q = a + b\ln T + e$
iii. Right-sided semilog , $Q = a + b\ln T + e$
iv. Left-sided semilog, $\ln Q = a + bT + e$

Where Q = Quantity of rice consumed for the year 't'
T = time variable (1, 2... n) for each year.
a = intercept, b= regression coefficients e = error term

The four equations were estimated for each of the following periods: 1960-2013, 1970-2013, 1980-2013 and 1990-2013. The estimated functional equations were subjected to some statistical test in order to select the best for prediction of future rice consumption trend. The adequacy of the chosen model was determined using Theil's inequality coefficient, computed as:

$U = [\sum(Q_t - q_t)^2 / \sum(Q_t - q_{t-1})^2]^{1/2}$

Where Q_t is the actual observation in period t, q is the predicted value of observations and q_{t-1} is one year lag of the actual observation. U has a lower limit of zero but no upper limit. If it is zero, the prediction is perfect because it implies that $Q_t = q_t$. If U is 1, it implies that $q_t = q_{t-1}$, the prediction for a particular year was approximately equal to one year lag of the actual observation for the year. If U >1, the predictive power of the model is worse than the zero-change prediction. The smaller the value of the inequality coefficient the better is the forecasting performance of the model (Koutsoyiannis, 1977).

RESULTS AND DISCUSSION

Trend of milled rice consumption

The trend lines of rice consumption in Nigeria from 1960 to 2013 were presented in Figure 1. The results indicated that there was general increase in consumption during this

Table 1. Results of OLS regression of functional equations for milled rice consumption

Period	Functional forms	Intercept	Coefficient	R^2	Adj.R	t-stat	F-ratio
1960	Q = a + bT + e	-797.503	98.69102	0.9018	0.8999	21.858	477.768
to		(142.7211)	(4.515119)				
2013	LnQ = a + bLnT+e	3.736323	1.097066	0.8025	0.7987	14.536	211.290
		(0.239197)	(0.075473)				
	Q = a +bLnT + e	-2348.45	1401.577	0.5876	0.5797	8.608	74.102
		(516.0159)	(162.8172)				
	LnQ = a + bT +e	5.204186	0.068017	0.9548	0.9539	33.146	1098.675
		(0.064864)	(0.002052)				
1970	Q = a + bT + e	-1567.79	118.8852	0.9332	0.9316	24.234	587.266
to		(171.1768)	(4.905807)				
2013	**LnQ = a + bLnT+e**	0.92028	1.919942	0.9660	0.9652	34.570	1195.107
		(0.189957)	(0.055537)				
	Q = a +bLnT + e	-8569.33	3203.908	0.8329	0.8290	14.471	209.420
		(757.2558)	(221.3967)				
	LnQ = a + bT + e	5.290329	0.065876	0.9254	0.9237	22.840	521.660
		(0.10064)	(0.002884)				
1980	Q = a + bT + e	-2259.9	135.5323	0.9189	0.9164	19.644	362.85
to		(275.7948)	(7.115065)				
2013	LnQ = a + bLnT+e	1.234778	1.833913	0.9156	0.9129	18.631	347.113
		(0.354198)	(0.098434)				
	Q = a +bLnT + e	-13948.8	4674.585	0.8822	0.8579	14.152	200.279
		(1188.577)	(330.3124)				
	LnQ = a + bT + e	5.874598	0.05173	0.9236	0.9212	19.671	386.936
		(0.101936)	(0.00263)				
'1990	Q = a + bT + e	-3035.31	153.127	0.8853	0.8801	13.035	169.903
to		(505.8543)	(11.74766)				
2013	LnQ = a + bLnT+e	1.429948	1.785831	0.8686	0.8627	12.062	145.494
		(0.55366)	(0.148053)				
	Q = a +bLnT + e	-19790.3	6226.827	0.8420	0.8349	10.829	117.277
		(2150.233)	(574.9905)				
	LnQ = a + bT + e	6.249453	0.043581	0.8994	0.8949	14.029	196.807
		(0.133768)	(0.003107)				

Note: Values in parenthesis are standard errors. The best fit equations are bolded.

period. The increasing growth of milled rice consumption generally could be attributed to population growth, increase in income, increased rice availability and favourable government policies and financial supports. The annual consumption of rice increased gradually from 1960 to 1975, and then rose sharply as from 1975 to 2013. The sharp rise in consumption as from 1975 could be traced to some special agricultural programmes implemented by various governments to increase food production, *viz*: Agricultural Development Programme in 1975, Operation Feed the Nation in 1976, River Basins Development Programmes in 1977, Green Revolution in 1979, National Agricultural Land Development Authority in 1991, National Agricultural Research Programme in 1992, Special Rice Project in 1998, National Fadama Development Project in 1999, Special Food Security Programme in 2001, Presidential Initiative on Rice Production and Multinational NERICA Dissemination Project in 2002, and Rice Transformation Agenda in 2012.

Regression analysis

Table 1 present the results of functional equations estimated with OLS regression. The results showed that all coefficients are significant in explaining the variations in each of the variables. The t-statistics and F-ratios were significant at 1% level. The adjusted R^2 varies from 58% to 96%. Based on these statistical indicators, the left-sided semi-log functional forms were chosen as the best fit equations for three periods; 1960 to 2013, 1980 to 2013 and 1990 to 2013, while double log equation best fit 1970 to 2013 consumption trend. The result of the Theil inequality coefficient analysis indicated that all the equations have good predictive power but the double-log

equation has the least value of Theil inequality coefficient value which was nearest to zero. Hence, double log equation for the period 1970 - 2013 was chosen as the lead equation to predict future trend of rice consumption up to 2020. The double log trend equation is given as:

lnQ =0.92028+1.919942lnT.

Solving for Q in this equation, it was found that 6,720,512 metric tons of milled rice will be required in 2020. To produce this quantity of milled rice, about 10,839,536 million metric tons of rice paddy will be required based on average milling recovery ratio of 62% (NCRI, 2006, Ogunfowora, 2007). This quantity is about twice the current level of paddy production in Nigeria (FAO, 2013). If Nigeria is to become self-sufficient in rice production, rice farm size or rice yields have to be increased by 100%. Although there is high potential for rice land area expansion, the relatively stable national average yields of less than 2 tons per hectare in the last decades (FAO, 2013) is a pointer to declining productivity. This reason couple with the unfavorable land tenure system which makes transfer of land from one farmer to the other very difficult poses a limit to the option of land expansion to increased rice production. The yield increase option could be highly feasible because Nigeria farmers are yet to tap fully the potential of the available rice technologies so far released to Nigeria farmers (Tiamiyu, et al., 2009) leading to low productivity compared to neighbouring countries (Cardoni and Angelucci, 2013). Therefore there is need to improve productivity of rice through intensive promotion of adoption of improved rice production technologies among farmers if Nigeria is to meet the potential demand by 2020. The current average yield of less than two tons per hectare (CBN, 2013; FAOSTAT, 2013) is far below potential yields of 4 tons per hectare obtainable from rice varieties that have been released to Nigeria farmers (NCRI, 2009). Under good soil management and improve agronomic practices 4 tons of paddy can be obtained in one hectare of land under rainfed lowland and even more under irrigated production systems (Usman, et al., 2014). The Nigeria policy makers should therefore formulate policies that will stimulate rice yield improvement through promotion of improved technology adoption and expansion of irrigated farming. This will entail increase funding of yield enhancing research and extension activities as well as provision of irrigation facilities. Although the current government policy impacted positively on rice production growth there is need for improvement. To this end, the following are recommended: There is need to redesign favorable land tenure system to enable rice farmers increase their farm size easily. Research on generation and dissemination of cost effective yield enhancing technologies should be adequately funded. Adoption of modern rice production technologies among farmers should be promoted. Government support embedded in Rice transformation agenda should continue. Irrigation farming should be encouraged to keep the production continue during dry season. Credit facilities should be provided to rice farmers to enable them procure improved inputs. Social infrastructural development should be given high priority in the rural area.

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