

Analysis of the Demand for Rice in Kaduna State, Nigeria

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Abstract

The kernel of this study was to ascertain the determinants of rice consumption and the compensated as well as the uncompensated demand for rice in Kaduna State using household consumption data obtained from a sample of 310 households through the instrumentality of a structured questionnaire. LA-AIDS model was employed to analyse the data and the result of the data analysis showed that the price of rice, price of beans, price of maize, price of yam, food expenditure, age of household head, household income and number of household income earners were all significant in influencing the households demand for rice. The estimated compensated (-0.7921) and uncompensated (-0.8887) own price elasticities of rice indicated that rice was price inelastic and the estimated expenditure (0.69) elasticity of rice indicated that rice is not a luxury in the households food basket but a necessity. From the findings of the study, it is recommended that efforts at increasing supply of local rice should be intensified as this will reduce the prices of local rice brands and invariably enhance demand for local rice by households as rice was estimated to be own-price inelastic and also, rice should be prioritized as a core food crop in food security programmes as it was found to be a necessity in households food basket.

Key words

Consumption, Demand, Rice, LA-AIDS Model, Kaduna State.

Introduction

Rice has become a staple food in Nigeria such that every household; both the rich and the poor consumes a great quantity (Godwin, 2012). A combination of various factors seems to have triggered the structural increase in rice consumption over the years with consumption broadening across all socio-economic classes, including the poor. Rising demand is as a result of increasing population growth and income level (GAIN, 2012). The annual demand for rice in the country is estimated at 6.5 million tonnes, while production is 2.3, resulting in a deficit of 4.2 million tonnes (NRIF, 2008). Rice has changed from being a luxury to a necessity whose consumption will continue to increase with per capita GDP growth, thus implying that its importance in the Nigerian diet as a major food item for food security will increase as economic growth continues (Ojogho and Alufohai, 2010). Over the years, Nigeria has relied upon the importation of rice to meet its growing demand for rice but the increased demand in recent years reflect more of increases in the demand for imported rice brands partly to meet the shortfalls in domestic demand and partly to meet consumers demand in the urban

areas. The importation of rice to bridge the demand-supply gap is worth N365 billion (Ayanwale and Amusan, 2012) and this implies a loss of considerable foreign exchange for the country.

The Nigerian rice sector has witnessed some remarkable developments, particularly in the last ten years. Both rice production and consumption in Nigeria have vastly increased during the aforementioned period (Ojoehemon et al., 2009). However, the demand for rice has continued to outstrip production given the shift in consumption preference for rice especially by urban dwellers. It is projected to reach 35 million tonnes by 2050 from five million tonnes currently, rising at the rate of 7 per cent yearly due to population growth (Ayanwale and Amusan, 2012). Therefore, rice has become a strategic commodity in the Nigerian economy which have continue to attract the attention of all tiers of government, non-governmental agencies, policy makers, researchers and other stakeholders in the rice industry in an effort to address the widening demand-supply gap situation of rice in Nigeria.

The research efforts in ensuring a viable rice industry in Nigeria is very commendable but it is worth

noting that a greater proportion of such previous researches on rice in Nigeria have inter-alia focused on issues bordering on enhancing the supply side of the Nigerian rice industry (Okoruwa and Ogundele, 2006; Kudi et al., Onoja and Herbert, 2012; Dontsop-Nguezet et al., 2011 2003; Mohammed, 2011; Ekeleme et al., 2009; Saka and Lawal, 2009). There exists few research outcomes on the demand side of the Nigerian rice industry with respect to determinants of rice consumption, changes in households rice consumption in response to changes in income level and changes in households rice consumption in response to changes in food prices which is the identified gap in the Nigerian rice industry that this study was designed to address. Therefore, this study was aimed at providing empirical information on the factors influencing rice consumption and the compensated (hicksian) as well as the uncompensated (marshallian) rice demand elasticities of households in Kaduna state.

Material and Methods

Description of the study area

The study was carried out in Sabon Gari, Kaduna South and Soba local government areas of Kaduna state. Kaduna state lies between latitudes $10^{\circ} 21'$ and $10^{\circ} 33'$ North of the equator and longitudes $7^{\circ} 45'$ and $7^{\circ} 75'$ East of the Greenwich meridian and has 23 local government areas. It occupies a total land mass of about 46,053 km² and its population was put at 6,066,526 people in 2006 and had a projected population of 6,903,746 people in 2012 using an annual growth rate of 3.2%. The vegetation in the state is divided into Northern guinea savannah in the northern part of state and southern guinea savannah in the southern part of the state. The state experiences both wet and dry seasons with the wet season commencing in the month of April in the southern part of the state and between May and June in the northern part of the state. Rainfall is heaviest in the southern part of the state and decreases northwards with mean annual rainfall varying between 942 mm and 1000 mm. the rainfall lasts from May to October. The dry season sets in immediately after the rainy season and is characterized by harmattan (dry and dusty West African trade wind that blows between the end of November and the middle of March) period with a temperature ranging from 18°C to 26°C and the heat period with a temperature that ranges from 32°C to 39°C.

Sampling procedure and sample size

A multistage sampling technique was employed to select the households for the study. The first stage involved a random selection of Sabon Gari, Kaduna South and Soba local government areas. The second stage involved the random selection of two districts from each of the selected local government areas. The districts are Muchia and Hanwa in Sabon Gari local government area, Kurmin Mashi and Kakuri in Kaduna South local government area, Yakassai and Rahama in Soba local government area. The third stage involved the random selection of 5% of the households in the selected districts to give a sample size of 310 pooled from Muchia (48), Hanwa (56), Kurmin Mashi (52), Kakuri (56), Yakassai (54) and Rahama (44).

Method of data collection

Primary data on household food consumption and expenditure patterns was used in this study. The primary data were elicited using well-structured questionnaires from heads of household who consulted with their household members on the households food budgetary planning and purchase. Data were collected on the demographic characteristics of households such as sex, age and educational level of household heads, household size, household income, number of household income earners. Data were also collected on the households rice consumption with respect to the type, frequency, quantity, price and expenditure on rice consumed by the households during the sample period. Similarly, data on the quantities, prices and expenditure on other food items consumed by the households were collected.

Analytical Framework

The tool of analysis that was employed in this study is the Linear Approximate Almost Ideal Demand Sytem (LA-AIDS) Model as used by Thompson 2004; Seale et al., 2003; Armagan and Akbay, 2008; Ngui et al., 2011; Guta et al., 2012. The general form of the LA-AIDS model is expressed as:

$$w_i = a_i^* + \sum_{j=1}^n \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{x}{p}\right) + \sum_{j=1}^n \delta_{ij} Z_j + e_i$$

The explicit system of demand equations for rice and other food items namely beans, maize, gari (cassava flakes made from processing of fresh cassava tubers into flakes) and yam captured during the survey was estimated simultaneously using Seemingly Unrelated Regression (SUR) with homogeneity and symmetry restrictions

imposed. The adding up property of demand was satisfied by deleting yam demand equation from the system and the parameters in the deleted equation were calculated in accordance with the adding-up restrictions. Using matrix notation, the system of demand equations was expressed as:

$$\begin{bmatrix} w_R \\ w_B \\ w_M \\ w_G \\ w_Y \end{bmatrix} = \begin{bmatrix} a_1^* \\ a_2^* \\ a_3^* \\ a_4^* \\ a_5^* \end{bmatrix} + \begin{bmatrix} \ln P_R \\ \ln P_B \\ \ln P_M \\ \ln P_G \\ \ln P_Y \end{bmatrix} \begin{bmatrix} \gamma_{11} & \dots & \gamma_{15} \\ \gamma_{21} & \dots & \gamma_{25} \\ \gamma_{31} & \dots & \gamma_{35} \\ \gamma_{41} & \dots & \gamma_{45} \\ \gamma_{51} & \dots & \gamma_{55} \end{bmatrix} + \begin{bmatrix} \ln \left(\frac{X}{P}\right) \\ \ln \left(\frac{X}{P}\right) \\ \ln \left(\frac{X}{P}\right) \\ \ln \left(\frac{X}{P}\right) \\ \ln \left(\frac{X}{P}\right) \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \end{bmatrix} \\ + \begin{bmatrix} Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{bmatrix} \begin{bmatrix} \delta_{11} & \dots & \delta_{15} \\ \delta_{21} & \dots & \delta_{25} \\ \delta_{31} & \dots & \delta_{35} \\ \delta_{41} & \dots & \delta_{45} \\ \delta_{51} & \dots & \delta_{55} \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{bmatrix}$$

Where:

w_R, w_B, w_M, w_G, w_Y = household budget share on rice, beans, maize, gari and yam respectively

P_R, P_B, P_M, P_G, P_Y = price of rice, beans, maize, gari and yam respectively (N/kg)

Z_1 = age of household head (years)

Z_2 = educational level of household head (number of years of schooling)

Z_3 = household size (number)

Z_4 = household income (N/month)

Z_5 = number of household income earners

X = total household expenditure on all the food items within the system

P = stone's price index

$\gamma_{11} - \gamma_{55}$ = price coefficients or the slope coefficients in the share equations of rice, beans, maize, gari and yam respectively.

$\beta_1 - \beta_5$ = expenditure coefficients of rice, beans, maize, gari and yam respectively.

$a_1^* - a_5^*$ = constant terms in the share equations of rice, beans, maize, gari and yam respectively.

$e_1 - e_5$ = error terms in the share equations of rice, beans, maize, gari and yam respectively

$\delta_{11} - \delta_{55}$ = coefficients of demographic variables in the share equations of rice, beans, maize, gari and yam respectively.

The marshallian (uncompensated) demand elasticities, hicksian (compensated) demand elasticities and expenditure elasticity of rice were determined from the estimated coefficients of the LA-AIDS model.

The marshallian (uncompensated) own-price elasticity (ϵ_{ii}^M) and cross-price elasticities (ϵ_{ij}^M) of rice demand was computed as follows:

$$\epsilon_{ii}^M = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i$$

$$\epsilon_{ij}^M = \frac{\gamma_{ij}}{w_i} - \beta_i \left(\frac{w_j}{w_i}\right)$$

The hicksian (compensated) own-price elasticity (ϵ_{ii}^H) and cross-price elasticities (ϵ_{ij}^H) of rice demand was computed as follows:

$$\epsilon_{ii}^H = -1 + \frac{\gamma_{ii}}{w_i} + w_i$$

$$\epsilon_{ij}^H = \frac{\gamma_{ij}}{w_i} + w_j$$

The expenditure elasticity (C_i) of rice demand was computed as follows:

$$\epsilon_i = 1 + \frac{\beta_i}{w_i}$$

Where:

$\epsilon_{ii}^M, \epsilon_{ij}^M$ = marshallian own-price and cross-price elasticities of rice demand respectively

$\epsilon_{ii}^H, \epsilon_{ij}^H$ = hicksian own-price and cross-price elasticities of rice demand respectively

C_i = expenditure elasticity of rice demand

γ_{ii} = price coefficient of rice in its share equation

γ_{ij} = price coefficients of beans, maize, gari and yam in the share equation of rice

w_i = household budget share on i^{th} food item; where i = rice

w_j = household budget share on j^{th} food item; where j = beans, maize, gari and yam

Results and Discussion

Determinants of the demand for rice

The generalized least squares (GLS) was employed to perform the seemingly unrelated regression of the linear approximate almost ideal demand system model for rice, beans, maize, gari and yam with rice as the focal food item and the other food items taken into consideration for comparative purpose. The wald statistic of 39.02 as presented in table 1 shows that the null hypothesis of the restrictions of valid homogeneity and symmetry for the system of demand equations were accepted. The R-squared of the estimated rice, beans, maize, gari and yam demand equations were

0.73, 0.56, 0.69, 0.69, 0.54 and 0.67 respectively with the rice demand equation having the highest R-squared value. The R-squared of 0.73 indicates that 73% of the variability of households budget share on rice was explained by the explanatory variables included in the model.

The price of rice was found to be positive in line with a priori expectation and statistically significant ($P < 0.01$) and this implies that a unit increase in the price of rice will increase the proportion of households expenditure on rice by a unit of 0.0095 ceteris paribus. This finding does not agree with Omonona et al. (2010) who posited that the price of rice is negatively related to households expenditure on rice. The coefficient of beans was found to be negative and statistically significant ($P < 0.1$). This implies that given a unit increase in the price of beans will decrease the households

proportion of expenditure on rice by a magnitude of 0.0103. The price of maize had a negative relationship with the households rice budget share and was significant ($P < 0.01$). The coefficient of yam was statistically significant ($P < 0.1$) and positively related to the households rice budget share. This implies that a unit increase in the price of yam will increase the households rice budget share by a unit of 0.01. Expenditure on food was found to be negative and statistically significant ($P < 0.01$). This implies that a unit increase in food expenditure will decrease the households proportion of expenditure on rice by a unit of 0.0434. Age had a negative relationship with the households rice budget share and was significant ($P < 0.05$). This implies that a unit increase in the age of household heads will decrease the households rice budget share by a unit of 0.0014.

Variable	Rice	Beans	Maize	Gari	Yam
Intercept	0.3759	0.2329	0.4402	0.0324	0.1397
Log of rice price	0.0095† (-3.986)	-0.0103††† (-1.7414)	-0.0137† (-3.5170)	0.0045††† (-1.809)	0.0052 (-0.7248)
Log of beans price	-0.0103††† (-1.7414)	0.0509† (-8.5304)	-0.0166† (-5.1282)	-0.0009 (-0.1004)	-0.0234† (-4.7763)
Log of maize price	-0.0137† (-3.5170)	-0.0166† (-5.1284)	0.0490† (-14.1394)	-3.52E-05 (-0.0263)	-0.0105†† (-2.7637)
Log of gari price	0.0045 (-1.6093)	-0.0002 (-0.1001)	-3.52E-05 (-0.0263)	0.0015††† (-1.9332)	-0.0178† (-3.7260)
Log of yam price	0.0100††† (-1.6624)	-0.0236† (-5.0591)	-0.0187† (-5.1441)	-0.0059† (-3.1073)	0.0465† (-5.5439)
Log of expenditure	-0.0434† (-14.6392)	-0.0009†† (-2.6470)	-0.0043† (-8.9190)	5.33E-07 (-0.692)	1.20E-05 (-0.0268)
Age	-0.0014†† (-2.0194)	0.0005 (-0.7942)	0.0002 (-0.4211)	0.0002 (-0.9154)	0.0006 (-0.5924)
Education	0.0015 (-1.1942)	-0.0005 (-0.4313)	-0.0006 (-0.6573)	0.0002 (-0.6108)	0.0004 (-0.2318)
Household size	0.0075†† (-2.5204)	0.0043 (-1.5201)	-0.0023 (-1.0371)	-0.0001 (-1.0947)	-0.0101†† (-2.3700)
Household income	0.0252†† (-2.4323)	-0.0088 (-0.8904)	-0.0155†† (-2.0240)	-0.0040†† (-2.2520)	0.0063†† (-2.4424)
Income earners	-0.0205†† (-1.9294)	-0.0112 (-1.1224)	-0.005 (-0.6344)	0.0032††† (-1.9781)	0.0243††† (-1.6636)
R-squared	0.73	0.56	0.69	0.54	0.67
F statistic	19.12	8.89	15.91	8.72	13.4
Wald test(χ^2)	102.9251				

NB: Single, double and triple daggers (†) indicate statistical significance at 1, 5, and 10% levels respectively. Values in parentheses are the calculated t values.

Source: own processing

Table 1: Seemingly unrelated regression estimates of LA-AIDS Model.

The coefficient of household size was found to be positive and statistically significant at 5% probability level. This implies that a unit increase in household size will increase the households rice budget share by a unit of 0.0075 and this could be attributed to the increase in the number of persons to be fed in the household. The monthly income of households is positive and statistically significant ($P < 0.05$). The coefficient of household income earners was found to be negative and statistically significant ($P < 0.05$). This implies that a unit increase in the number of household income earners will decrease the households rice budget share by a unit of 0.0205. The price of rice was found to be statistically significant and negatively related to the households expenditure share on beans and maize but positively related to the households expenditure share on gari. Although, price of rice was found to be positively related to households expenditure share on yam, it was not significant.

Uncompensated demand elasticities of rice

The result presented in table 2 shows that the uncompensated own-price elasticity of rice (-0.8887) had the expected negative sign and was price inelastic. This implies that a unit increase in the price of rice will less than proportionately decrease the demand for rice by a unit of 0.8887 *ceteris paribus*. The uncompensated cross price elasticity of rice with respect to beans (-0.0552) and maize (-0.0824) were negative and this implies that they were complementary to rice

consumption by the households with maize having a higher complementarity to rice than beans. The uncompensated cross price elasticity of rice with respect to gari (0.0446) and yam (0.2857) were positive and this implies that they were substitute to rice in the food basket of the households with yam having a higher substitutability to rice than gari.

Compensated demand elasticities of rice

The estimated compensated own price and cross price elasticities of rice as shown in table 3 are higher than the uncompensated own and cross price elasticities of rice. This finding is contrary to that of Erhabor and Ojogho (2011) who found out that the compensated elasticities of rice were higher than the uncompensated elasticities of rice. This implies that the income effect surpasses the substitution effect. The compensated own price elasticity of rice (-0.7921) was similar to the uncompensated own price elasticity in being price inelastic and negative. This implies that a unit increase in the price of rice will less than proportionately decrease the demand for rice by a magnitude of 0.7921.

Expenditure elasticity of rice

The expenditure elasticity of rice as presented in table 4 indicates that rice is a normal good and is expenditure inelastic. This implies that rice is not a luxury in the households food basket but a necessity and a unit increase in the households income will less than proportionately increase the demand

	Rice	Beans	Maize	Gari	Yam
Rice	-0.8887	-0.1696	-0.262	0.1125	0.1731
Beans	-0.0552	-0.1508	-0.3268	-0.0225	-0.78
Maize	-0.0824	-0.276	-0.0157	-0.0009	-0.36
Gari	0.0446	-0.0027	0.0027	-0.9635	-0.5933
Yam	0.2857	-0.3929	-0.3574	-0.1475	0.5333

Source: own processing

Table 2: Estimated uncompensated (marshallian) own price and cross price elasticities of rice and other food items.

	Rice	Beans	Maize	Gari	Yam
Rice	-0.7921	-0.0317	-0.134	0.2525	0.3133
Beans	-0.0136	-0.0917	-0.272	0.0375	-0.72
Maize	-0.0479	-0.2267	0.003	0.0491	-0.3
Gari	0.0721	0.0367	0.0039	-0.9225	-0.5533
Yam	0.1014	-0.3633	-0.344	-0.1175	0.58

Source: own processing

Table 3: Estimated compensated (hicksian) own price and cross price elasticities of rice and other food items within the demand system.

	Expenditure Elasticity
Rice	0.69
Beans	0.985
Maize	0.914
Gari	1
Yam	1.0004

Source: own processing

Table 4: Expenditure elasticity of rice and other food items within the demand system.

for rice by a magnitude of 0.69. This finding disagrees with that of Omonona et al. (2010) who posited that rice is an inferior good as well as an expenditure elastic food item from a households expenditure elasticity of -5.2837 for rice. The status of rice as being a necessity in the households food basket is a pointer to the growing consumer preference for rice in Nigeria. The expenditure elasticities of beans, maize, gari and yam indicates that they were also normal goods like rice in the food basket of the households with beans and maize being expenditure inelastic just as rice but with gari and yam having unitary expenditure elasticity which implies that a proportional increase in the income of households will lead to a proportional increase in the households demand for gari and yam.

Conclusion

This study have established the determinants of the demand for rice and the uncompensated as well as the compensated demand elasticities of rice in Kaduna state using household consumption data obtained from heads of households using structured questionnaire. The data were analysed using LA-AIDS model. The result of the data analysis showed that the price of rice, price of beans, price of maize, price of yam, food expenditure, age of household

head, household income and number of household income earners were all significant in influencing the households demand for rice. The uncompensated and compensated own price elasticities of rice were estimated to be -0.8887 and -0.7921 respectively which implied that rice is price inelastic in the study area. The expenditure elasticity was estimated to be 0.89 and this implied that rice is not a luxury in the households food basket but a necessity. Based on the findings of the study, it is recommended that:

1. Rice should be prioritized as a core food crop in food security programmes as it was found to be a necessity in households food basket.
2. Arising from the significant influence of households demographic characteristics on rice demand, policy measures geared towards enhancing demand for rice by households should take into proper cognisance the demographic characteristics of the target households.
3. Adequate policy framework aimed at increasing supply of local rice should be pursued as this will reduce the prices of local rice brands and invariably enhance demand for local rice by households as rice was estimated to be own-price inelastic.

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