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Demand Analysis for Rice in Nigeria

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Abstract: The study examined demand analysis for rice in Edo, Delta and Lagos States of Nigeria using both primary and secondary data. To achieve this, the study examined the socio-economic characteristics of rice consuming households, estimated the complete demand functions for rice and the selected common food commodities and their price and expenditure elasticities in the study area. A multi-stage sampling technique was used to select households within the study area in the three states from 812 rice-consuming households using the Simple Random Sampling technique. Data collected were subjected to both descriptive and inferential statistics. The result of the descriptive statistics showed that rice constituted the largest share of the household total food expenditure, ranging between about 28 and 21% among the high income and urban household to 28 and 24% among the low income and rural households but mostly among the married and the medium-size male-headed households who had tertiary-education. The result of the multiple regressions showed that besides being a normal good, a necessity with no substitute, price inelastic, expenditure inelastic, rice took an average of 21.25% of the food budget share of a rice-consuming household for ₦1unit income and expenditure but increased budget share of rice by 6.05% for ₦1 increase in its unit price. The prices of beans, yam, garri and meat/fish were also significantly important in the share of rice in household total food expenditure at constant real income.

Key words: Rice, expenditure share, price elasticities, expenditure elasticities, population, Nigeria

INTRODUCTION

Rice is the world's most important staple food crop consumed by more than half of the world population as represented by over 4.8 billion people in 176 countries with over 2.89 billion people in Asia, over 150.3 million people in America and over 40 million people in Africa (FAO, 1996; Bruntrup, 2006; IRRI, 2004; Gulati and Narayanan, 2002). It has been an important food commodity for most people in sub-Saharan Africa particularly West Africa where the consumption of cereals mainly sorghum and millet has decreased from 61% in the early 1970's to 49% in the early 1990's while that of rice has increased from 15-26% over the same period (Jones, 1995; Rosegrant *et al*., 2002).

In Nigeria, the demand for rice has been on the increase since the mid 1970 (Awe, 2006; Daramola, 2005). During the 1960's, Nigeria had a per capita annual rice consumption of 3 kg which increased to an average of 18 kg during the 1980's, reaching 22 kg in the latter half of the 1990's (FAO, 2002; Akpokodje *et al*., 2001). Since the mid-1980's, rice consumption has increased at an average annual rate of 11% with only 3% explained by population growth. Also, within the decade of the 1990's, Erenstein *et al*. (2004) reported a 14% annual increase in the demand for rice in Nigeria. The substitution of rice for coarse grains and traditional roots and tubers shifted the demand for rice to an average annual growth rate of 5.6% between 1961 and 1992 (Osiname, 2002).

An interesting reason for it being so popular, nutritionists suggest is its ease of digestion. Even the sick, elderly and babies can digest this grain very well if cooked. Even people who are allergic to lots of other foods can eat rice. Besides, rice provides 21% of global human per capita energy and 15% of per capita protein. It is low in fat and protein, compared with other cereal grains. Recent studies by the modern nutritionists have compared the easily digestible organic rice protein, a highly digestible and non-allergenic protein to mother's breast milk in the aspect of its nutritious quality and also for the high quantity of amino acid that is common in both rice protein and breast milk. Rice also provides minerals, vitamins and fiber although, all constituents except carbohydrates are reduced by milling. No matter how plausible the reasons by nutritionist for rice consumption, they do not explain the increasing demand for rice in Nigeria.

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However, the literature on the rice market is mainly concerned with the supply-side factors only (Oniki, 1996; Fujiki, 1998, 1999). Considering the uncertain environment of the Nigeria rice market in the future, one cannot neglect the demand-side. The desire to know whether rice in Nigeria is a normal or inferior good and factors that have influenced its consumption is important for evaluating the significance of Nigerian domestic rice consumption in the world rice market. As a result, a clear understanding of the principles and factors influencing the dynamics of rice consumption in Nigeria can constitute a major issue in her policy formulation. Pertinent to such understanding is providing answers to such question as: What is the share of rice expenditure in total household food expenditure; What is the level of rice consumption; What factors explain the increasing demand for rice, leading to the domestic demand-supply gap for rice in Nigeria; What are the effects of expenditure on the demand for rice in Nigeria; What are the effects of the price of rice and of other food commodities on rice demand?

The main objective of this study, therefore is to undertake a demand analysis for rice in Edo, Delta and Lagos states of Nigeria as the focal area of research. The specific objectives are to examine the socio-economic characteristics of rice-consuming households, estimate the complete demand functions for rice and the selected food commodities and their price elasticities in the study area.

MATERIALS AND METHODS

The study was carried out in Edo, Delta and Lagos states of Nigeria. Administratively, the three states are divided into 68 Blocks (Local Government Areas) with 18 in Edo, 25 in Delta and 25 in Lagos State and each State has three Senatorial districts. The location was specifically chosen for its high rice consumption in Nigeria, the three states being among the States in Nigeria with an average percentage rice share of 8-12% (accounting for about 34% of the total consumption) in food expenditure (IRRI, 2004) and rain-fed upland, rain-fed lowland and mangrove swamp production system. According to the 2006 census (www.nigerianstat.gov.ng), the three States has a population of 16 330 257 representing 11.7% of the nation's population who individually consume about 24.6 kg of rice annually (IRRI, 2004). In addition, there are high economic activities in the region which are reflected in the living conditions of the people of the region in comparison with those in Northern Nigeria (Adamu, 2003). Besides Agriculture as the predominant occupation of the people in the region, it is a commercial centre with many industries and hotels for the comfort of visitors. In this study, the two Local Government Areas chosen were Egor and Oredo in Edo state, Ethiope-East and Sapele in Delta state and Lagos Island and Surulere in Lagos state. The target population for this study was the set of households that consume rice whether the local or the imported rice types in the study area.

Both primary and secondary data were used to generate information for the study. The secondary data were obtained from, among other sources, the National Bureau of Statistics (Federal Office of Statistics), Central Bank of Nigeria, World Bank Reports, Journals, Agricultural Development Programme offices (ADP), Research Institutes, Universities and Government Parastatals. The primary data were collected with the use of a structured questionnaire for information on quantity consumed of each food items, income of households, total expenditure and cost per unit of each commodity consumed. Data were also collected on the demographic variables such as age, education level, household size, sex, location (rural or urban), age of members and other socio-economic characteristics of households.

A multi-stage sampling technique was used in this study to select households within the study area in the three states and four stages were involved: selection of senatorial zone, selection of the Local Government Areas, selection of the cells and the selection of households. The first stage involved a simple random sampling of one senatorial district from each state using the lucky-dip approach. The second stage involved a simple random sampling of two blocks (L.G.As) from the senatorial district using the lucky-dip approach. The third stage involved a simple random sampling of three cells in each block using the lucky-dip approach. As a last stage, a list of the all households in the study area was obtained from the National Population Commission. This list was based on the Enumeration Areas (EA) used for 2006 census purposes by National Population Commission. Using the random number table, a Simple Random Sampling of 50 rice-consuming households, disaggregated from the list of the Enumeration Areas (EAs) developed for the 2006 population census by National Population Commission as the sample frame for each Block was randomly sampled from each Cell, making up a total of 300 households from each state and a total of (900) households. To achieve this last stage, a pilot questionnaire was created to specifically target the study area population. Participants were asked to name the foods frequently served/consumed in their homes. Based on the participant's responses, a list of ten foods commonly served/consumed was generated. If six or more

participants reported having been served/consumed a particular food, it was selected to be used in the final questionnaire. However, only households which had rice among the food served were finally sampled.

Data collected were subjected to both descriptive and inferential statistics. The descriptive statistics used were frequency counts, percentages and mean scores while the inferential statistics employed the multiple regression analysis.

To estimate the complete demand functions for rice and the selected food commodities and their elasticities: the consumers were assumed to allocate their expenditure in two stages. In the first stage, the consumer decided how much to spend on each broad category of goods and services such as food, housing, clothing, transport, to mention but a few. Allocation of expenditure on individual groups was determined by consumer's total income and group price index (Heien and Pompelli, 1989). In the second stage which assumed weak separability of the direct utility function (Fan *et al*., 1995), the group expenditure was allocated among the various commodities in that group. The Linear Approximate Almost Ideal Demand System (LA/AIDS) of Deaton and Muellbauer (1980) was employed to model the demand for rice in the second stage. The model used, in generic budget share form is given as:

$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{X}{P}\right) + \varepsilon_i$$

The explicit budget share form used in the study is given as:

$$\omega_1 = \alpha_{11} + \gamma_{11}\ln p_1 + \gamma_{12}\ln p_2 + \gamma_{13}\ln p_3 + \gamma_{14}\ln p_4 + \gamma_{15}\ln p_5 + \gamma_{16}\ln p_6 + \gamma_{17}\ln p_7 + \gamma_{18}\ln p_8 + \gamma_{19}\ln p_9 + \gamma_{1,10}\ln p_{10} + \beta_1 \ln\left(\frac{X}{P}\right)$$

$$\omega_2 = \alpha_{21} + \gamma_{21}\ln p_1 + \gamma_{22}\ln p_2 + \gamma_{23}\ln p_3 + \gamma_{24}\ln p_4 + \gamma_{25}\ln p_5 + \gamma_{26}\ln p_6 + \gamma_{27}\ln p_7 + \gamma_{28}\ln p_8 + \gamma_{29}\ln p_9 + \gamma_{2,10}\ln p_{10} + \beta_2 \ln\left(\frac{X}{P}\right)$$

$$\omega_3 = \alpha_{31} + \gamma_{31}\ln p_1 + \gamma_{32}\ln p_2 + \gamma_{33}\ln p_3 + \gamma_{34}\ln p_4 + \gamma_{35}\ln p_5 + \gamma_{36}\ln p_6 + \gamma_{37}\ln p_7 + \gamma_{38}\ln p_8 + \gamma_{39}\ln p_9 + \gamma_{3,10}\ln p_{10} + \beta_3 \ln\left(\frac{X}{P}\right)$$

$$\omega_4 = \alpha_{41} + \gamma_{41}\ln p_1 + \gamma_{42}\ln p_2 + \gamma_{43}\ln p_3 + \gamma_{44}\ln p_4 + \gamma_{45}\ln p_5 + \gamma_{46}\ln p_6 + \gamma_{47}\ln p_7 + \gamma_{48}\ln p_8 + \gamma_{49}\ln p_9 + \gamma_{4,10}\ln p_{10} + \beta_4 \ln\left(\frac{X}{P}\right)$$

$$\omega_5 = \alpha_{51} + \gamma_{51}\ln p_1 + \gamma_{52}\ln p_2 + \gamma_{53}\ln p_3 + \gamma_{54}\ln p_4 + \gamma_{55}\ln p_5 + \gamma_{56}\ln p_6 + \gamma_{57}\ln p_7 + \gamma_{58}\ln p_8 + \gamma_{59}\ln p_9 + \gamma_{5,10}\ln p_{10} + \beta_5 \ln\left(\frac{X}{P}\right)$$

$$\omega_6 = \alpha_{61} + \gamma_{61}\ln p_1 + \gamma_{62}\ln p_2 + \gamma_{63}\ln p_3 + \gamma_{64}\ln p_4 + \gamma_{65}\ln p_5 + \gamma_{66}\ln p_6 + \gamma_{67}\ln p_7 + \gamma_{68}\ln p_8 + \gamma_{69}\ln p_9 + \gamma_{6,10}\ln p_{10} + \beta_6 \ln\left(\frac{X}{P}\right)$$

$$\omega_7 = \alpha_{71} + \gamma_{71}\ln p_1 + \gamma_{72}\ln p_2 + \gamma_{73}\ln p_3 + \gamma_{74}\ln p_4 + \gamma_{75}\ln p_5 + \gamma_{76}\ln p_6 + \gamma_{77}\ln p_7 + \gamma_{78}\ln p_8 + \gamma_{79}\ln p_9 + \gamma_{7,10}\ln p_{10} + \beta_7 \ln\left(\frac{X}{P}\right)$$

$$\omega_8 = \alpha_{81} + \gamma_{81}\ln p_1 + \gamma_{82}\ln p_2 + \gamma_{83}\ln p_3 + \gamma_{84}\ln p_4 + \gamma_{85}\ln p_5 + \gamma_{86}\ln p_6 + \gamma_{87}\ln p_7 + \gamma_{88}\ln p_8 + \gamma_{89}\ln p_9 + \gamma_{8,10}\ln p_{10} + \beta_8 \ln\left(\frac{X}{P}\right)$$

$$\omega_9 = \alpha_{91} + \gamma_{91}\ln p_1 + \gamma_{92}\ln p_2 + \gamma_{93}\ln p_3 + \gamma_{94}\ln p_4 + \gamma_{95}\ln p_5 + \gamma_{96}\ln p_6 + \gamma_{97}\ln p_7 + \gamma_{98}\ln p_8 + \gamma_{99}\ln p_9 + \gamma_{9,10}\ln p_{10} + \beta_9 \ln\left(\frac{X}{P}\right)$$

$$\omega_{10} = \alpha_{10,1} + \gamma_{10,1}\ln p_1 + \gamma_{10,2}\ln p_2 + \gamma_{10,3}\ln p_3 + \gamma_{10,4}\ln p_4 + \gamma_{10,5}\ln p_5 + \gamma_{10,6}\ln p_6 + \gamma_{10,7}\ln p_7 + \gamma_{10,8}\ln p_8 + \gamma_{10,9}\ln p_9 + \gamma_{10,10}\ln p_{10} + \beta_{10} \ln\left(\frac{X}{P}\right) \quad (1)$$

Where:

P_1-P_{10} = Scaled up market prices of rice, maize, other cereals, beans, yam, garri, plantain, meat/fish, fruits/vegetable and potatoes, respectively

α = The constant coefficient in the share equation representing the value of the budget share in the absence of income and price effects

ω = The budget share of the commodity

γ = The price coefficients or the slope coefficient associated with any commodity in any other commodity's share equation

β = The expenditure coefficient of commodity

X = The total expenditure on all commodities

P = The price index defined as

$$\ln p = \sum_{i=1}^{n} \omega_i \ln p_i \quad (2)$$

where, p_i is the price of the ith commodity. The system of share equations provides a seemingly regression model that was used to estimate the parameters of the model. The Marshallian demand elasticities were computed using:

$$\varepsilon_{ij}^{m} = -\delta_{ij} + \frac{\gamma_{ij}}{\omega_i} - \frac{\beta_i \omega_j}{\omega_i} \quad (3)$$

where, δ_{ij} is the Kronecker delta ($\delta_{ij} = 1$ for $i = j$ and $\delta_{ij} = 0$ for $i \neq j$) while the Hicksian demand elasticities were computed similarly using:

$$\varepsilon_{ij}^{H} = -\delta_{ij} + \frac{\gamma_{ij}}{\omega_i} - \frac{\omega_i \omega_j}{\omega_i} \quad (4)$$

and the expenditure elasticities, computed using:

$$\eta_i = 1 + \frac{\beta_i}{\omega_i} \quad (5)$$

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents: The distribution of households according to the socio-economic characteristics of households is shown in Table 1. The results showed that the area had more of the male-headed households (89.2%) than female-headed households (10.3%) with more male-headed households (93.5%) in the urban centres of the study area. Among the 56.5% of the male-headed households among the urban respondents, 21.8, 20.9 and 20.3% were respectively in the urban centres of Delta, Edo and Lagos states. This suggests that there is a higher consumption of rice by the male-headed households in urban Delta, Lagos and Edo in particular and the entire sample in general than the rural centres. However, there was higher rice consumption in rural Delta among the female-headed households than in other areas of the study area.

The study area had a younger population who were mainly children and teenagers with a large proportion of them in the urban centres than rural centres. This is supported by the large proportion (79.2%) of children and teenagers with 49.4% (representing 64.1% of the total children and teenagers) of them in the urban centres. This implies that rice consumption in the study area is mainly by children and teenagers. However, youths consumed rice more in urban Edo (16.9%) and Delta (20.1%) while rice consumption was more in urban Lagos (66.8%) and Delta (20.0%) by adults in the study area. In the study generally, rice was a function of the average age of household (family age structure) and decreased with increase in the age of a member.

Rice consumption/demand was mostly among the married (67.4%) and was higher in the urban centre than

Table 1: Summary statistics of socio-economic characteristics of households

	Entire sample							Lagos				Deltab				Edo			
	Rural		Urban		Total			Rural		Urban		Rural		Urban		Rural		Urban	
Characteristics	Freq.	%	Freq	%	Freq	%	Mean	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Urbanization	321	39.5	491	60.5	812	100.0	-	105	39.8	159	60.2	117	41.1	168	58.9	99	37.6	164	62.4
Sex																			
Male	265	32.6	459	56.5	724	89.2	-	95	36.0	147	55.7	88	30.9	158	55.4	85	32.3	151	57.4
Female	56	6.9	32	3.9	88	10.8	-	10	3.8	12	4.5	29	10.2	10	3.5	14	5.3	13	4.9
Age group (years)																			
Children	2751	22.0	4914	39.3	6425	61.3	11.2	862	21.2	1602	39.4	1062	24.2	1663	37.9	324	20.7	642	40.7
Teenagers	975	7.8	1263	10.1	2238	17.9	15.4	354	8.7	398	9.8	334	7.6	448	10.2	308	7.6	417	10.3
Youth	1075	8.6	1288	10.3	2363	18.9	37.8	317	7.8	354	8.7	386	8.8	478	10.9	385	9.5	462	11.4
Adult	138	1.1	88	0.7	225	1.8	51.3	94	2.3	94	2.3	48	1.1	-	-	-	-	-	-
Marital status																			
Single	82	10.1	111	13.7	195	24.0	-	21	8.0	39	14.8	32	11.2	26	9.1	32	12.2	43	16.3
Married	222	27.3	325	40.0	547	67.4	-	80	30.3	107	40.5	76	26.7	121	42.5	66	25.1	97	36.9
Widowed/widower	15	1.8	27	3.3	42	5.2	-	4	1.5	8	3.0	7	2.5	13	4.6	1	0.4	9	3.4
Separated	2	0.2	28	3.4	30	3.7	-	-	-	5	1.9	2	0.7	8	2.8	-	-	15	5.7
Household size																			
Small (1-5)	556	10.8	1179	22.9	274	33.7	2.54	187	11.2	393	23.5	152	8.4	475	26.3	203	12.2	278	16.7
Medium (6-10)	884	16.4	1580	30.7	382	47.0	7.41	291	17.4	432	25.8	228	12.6	495	27.4	323	19.4	653	39.2
Large (above 10)	633	12.3	355	6.9	156	19.2	10.23	171	10.2	152	9.1	361	20.0	96	5.3	102	6.1	108	6.5
Education																			
Primary education	170	20.9	156	19.2	326	40.1	-	61	23.1	43	16.3	70	24.6	44	15.4	39	14.8	69	26.2
Secondary education	121	14.9	132	16.3	253	31.2	-	32	12.1	54	20.5	44	15.4	35	12.3	45	17.1	43	16.3
Tertiary education	30	3.7	203	25.0	233	28.7	-	12	4.5	62	23.5	3	1.1	39	31.2	15	5.7	52	19.8
Income group (naira)																			
Low (<25 000)	119	54.0	100	46.0	219	27.0	-	401	5.2	43	16.3	50	17.5	44	15.4	29	11.0	13	4.9
Middle (25000-50000)	141	33.0	287	67.0	428	53.0	-	53	20.1	74	28.0	42	14.3	78	27.4	46	17.5	135	51.3
High (above 50000)	61	37.0	104	63.0	165	20.0	-	12	4.5	42	15.9	25	8.8	46	16.1	24	9.1	16	6.1

the rural of the study area. The proportion of widows/widowers was smaller in the rural areas than the urban centres accounting for only 5.2% in the sample. However, the proportion of widow/widower was highest in the urban Delta (31.0%). Rice consumption is likely to increase among widows/widowers in the state in particular and the study area at large if the proportion of this group increases.

The mean household size was 3, 8 and 10 for the small-, medium- and large-household sizes, respectively. However, the sample had a medium-size household range that lived in the urban centres of the study area. This distribution by household size was also shared by the three states in the study area. It not only implied that rice consumption is mainly among the urban population but that consumption is largely among the medium-size households. However, large-size households also consumed rice but the consumption was largely in rural areas. It means that as household size increased, rice consumption/demand shifted from urban to rural.

The education level distribution of household heads was mainly tertiary education and they lived in the urban centres of the study area. Rice consumption was more prominent among the tertiary-education household heads and mainly in the urban centres. This increase was more in urban Delta than in the other states. The implication is that increase in urbanization and improvement in education level of a household head increase demand for rice.

The table showed that over half (53%) of the household heads were in the middle income class and were mainly concentrated (67%) in the urban centres of the study area while only 20% of them were high income earners with 63% of this high income earners in the urban centres. The implication is that the number of rice consumers first increased as income increased but decreased as income increased further. This decrease is probably due to the effects of economies of scale since households will buy rice in bulk as income increases. Also, as income increased, consumption shifted from high in rural to high in urban centres of the study area.

Average income of households, quantity of rice consumed and expenditure share of rice: Table 2 shows a summary of the income, quantity and expenditure shares of households including differences across income groups and rural and urban areas. The households had a mean monthly income of ₦49678.29 k in the study area and ₦13151.98k and ₦39290.17 k, respectively in the rural and urban centres of the area. The mean annual quantity of rice consumed was 32.0 kg per capita represented by 36.3 kg in the urban centres and 25.8 kg in the rural cntres of the study area. The quantity consumed was highest in urban Lagos (32.5 kg) followed by urban Delta (29.3 kg) and closely followed by urban Edo (28.4 kg). Among the rural dwellers, rice consumer in rural Delta had the highest per capita (33.1 kg) and least in rural Edo (23.4 kg). Among the income category, the middle income earners had the highest annual per capita rice consumption (37.5 kg) while the low income earners had the least per capita rice consumption (15.9 kg). This suggests that annual per capita rice consumption increased with increase in income to a certain level of income and then decreased. The average annual per capita rice consumption in the sample of 812 rice-consuming households from the three states can be put at 0.16 million kilograms and a total of 1.12 million metric tonnes for the population of 4872 million in the south-western Nigeria. With the population of Nigeria currently put at 148 million people, the annual per capita rice consumption is 4.74 million metric tones and will be about 5.42 million metric tones besides industrial uses by 2015 if the population growth rate of 2.7% is sustained. The expenditure share of rice increased from 21% in the rural to 24% in the urban with a mean share of 23% in the study area. Rice constituted a larger share of the household total food expenditure, ranging between about 24 and 25% among the high-income and urban household to 28 and 19% among the low-income and urban households. Also, the low-income and rural households spent more of their income on food. However, proportion of income on food reduced as income was raised. The share of rice in the household's budgets was

Table 2: Average income and expenditure share of rice

	Entire sample			Lagos		Delta		Edo		Income		
Variables	Rural	Urban	Mean	Rural	Urban	Rural	Urban	Rural	Urban	Low	Middle	High
Expenditure rice share	0.24	0.21	0.23	0.20	0.25	0.21	0.23	0.19	0.22	0.28	0.25	0.24
Household income (₦)	13151.98	39290.17	49678.29	16308.46	47148.20	16945.42	48326.91	15124.78	46951.73	15952.38	35640.72	55129.07
Household food exp (₦)	5129.27	8643.84	16393.84	5707.96	15087.42	5253.08	17397.69	6352.41	17841.65	12123.81	16751.14	10474.52
% income on food exp. (₦)	39.00	22.00	33.00	35.00	32.00	31.00	36.00	42.00	38.00	76.00	47.00	19.00
Annual quantity of rice consumed (kg)	25.80	36.30	32.00	30.40	32.50	33.10	29.30	23.40	28.40	15.90	37.50	21.50

higher at lower income levels and decreased at high income levels. This suggests that as income increased, the expenditure share of rice decreased in the study area. Also, expenditure share of rice is higher in the urban centres than the rural centres. The decrease in rice expenditure is probably due to preference for less energy source food items as income increased, beside the live in the urban centres.

Marginal expenditure share of food items in the study area: The results of the marginal expenditure for each food items are shown in Table 3. The results indicate that meat/fish had the largest marginal expenditure share (0.2579) followed by rice (0.2031) and least for plantain. The Table 3 also indicates that there would not be any substantial change in the food demand patterns following an increase in future total expenditure on food. However, rice which account for the largest expenditure share (0.23) and is expenditure inelastic (0.8831) will remain more or less at the same level. A slight increase in the consumption of yam and beans will be possible following increase in future total food expenditures.

Table 3: Demand patterns of food items among respondents

Food items	Budget share	Expenditure elasticiy	Marginal expenditure share
Rice	0.23	0.8831	0.2031
Maize	0.06	0.6183	0.0370
Other cereals	0.09	0.6533	0.0587
Beans	0.06	1.1717	0.0703
Yam	0.18	1.0208	0.1837
Garri	0.20	0.7950	0.1590
Plantain	0.02	0.0000	0.0000
Meat/fish	0.10	2.5790	0.2579
Fruit/vegetables	0.05	0.7800	0.0390
Potatoes	0.03	0.6433	0.0192

Demand functions for rice and the selected food items: The results are as shown in Table 4 showing the estimated parameters and associated asymptotic errors of the LA/AIDS models of the food items. The significance of the vast majority of the γ's indicates some degree of sensitivity of the budget shares to prices. In absolute value, the own-price affects are at least as large as the cross-price effects. Besides, the values and signs of the γ's showed that the most of the food items are complements of rice. The demand functions also satisfied the adding-up criterion. As shown in the Table 4 for every unit income and expenditure, rice took the highest average of 0.2125 of the budget share among the food items. This was followed by garri (0.1347), yam (0.1122), potatoes (0.1101), beans (0.1022) and plantain (0.1011) while fruits/vegetables (0.0147) had the least. The own-prices effects of the food items were 0.065, 0.0422, 0.0476, 0.0555, 0.0649, 0.0469, -0.0175, 0.0656, 0.0474 and 0.0283 for rice, maize, other cereals, beans, yam, garri, plantain, meat/fish, fruit/vegetables and potatoes. Rice also had a largest average budget share (0.0650) among the food commodities when all prices and real expenditures are equal to one. The Table 4 shows that the cross-price coefficients were all negative for the food items. Thus unit increase in the prices of other commodities, the budget share for rice decreased for a given real income.

Table 4: Estimated parameters and associated asymptotic errors of the LA/AIDS models

Parameters	Rice i = 1	Maize i = 2	Other cereals i = 3	Beans i = 4	Yam i = 5	Garri i = 6	Plantain i = 7	Meat/fish i = 8	Fruit/veg. i = 9	Potatoes i = 10
α_i	0.2125	0.1009	0.0812	0.1022	0.1122	0.1347	0.1011	0.0304	0.0147	0.1101
	(0.0129)	(0.0134)	(0.0087)	(0.0190)	(0.0118)	(0.0087)	(0.0045)	(0.0148)	(0.0148)	(0.0157)
γ_{1i}	0.0650	-0.0037	-0.0011	-0.0143	-0.0221	-0.0022	-0.0056	-0.0047	-0.0101	-0.0012
	(0.0201)	(0.0012)	(0.0021)	(0.0069)	(0.0015)	(0.0009)	(0.0125)	(0.0031)	(0.0120)	(0.0026)
γ_{2i}	-0.0037	0.0422	-0.0079	-0.0017	-0.0018	-0.0039	0.0005	-0.0057	-0.0090	-0.0070
	(0.0012)	(0.0029)	(0.0190)	(0.0102)	(0.0513)	(0.0163)	(0.0257)	(0.0125)	(0.0412)	(0.0024)
γ_{3i}	-0.0011	-0.0079	0.0476	-0.0028	-0.0109	-0.0034	-0.0010	-0.0119	-0.0071	-0.0015
	(0.0021)	(0.0190)	(0.0107)	(0.0014)	(0.0016)	(0.0198)	(0.0256)	(0.0379)	(0.0012)	(0.0007)
γ_{4i}	-0.0143	-0.0017	-0.0028	0.0555	-0.0210	-0.0014	-0.0016	-0.0091	-0.0013	-0.0052
	(0.0069)	(0.0102)	(0.0014)	(0.0200)	(0.0150)	(0.0014)	(0.0101)	(0.0143)	(0.0600)	(0.0012)
γ_{5i}	-0.0221	-0.00018	-0.0109	-0.0210	0.0649	-0.0020	-0.0043	-0.0055	-0.0023	-0.0019
	(0.0015)	(0.0513)	(0.0016)	(0.0150)	(0.0204)	(0.0061)	(0.0054)	(0.0126)	(0.0342)	(0.0195)
γ_{6i}	-0.0022	-0.0039	-0.0034	-0.0014	-0.0020	0.0469	-0.0007	-0.0139	-0.00067	-0.0040
	(0.0009)	(0.0163)	(0.0198)	(0.0014)	(0.0061)	(0.0103)	(0.0119)	(0.0074)	(0.0512)	(0.0124)
γ_{7i}	-0.0056	-0.0005	-0.0010	-0.0016	-0.0043	-0.0094	-0.0175	-0.0002	-0.0003	-0.0033
	(0.0125)	(0.0257)	(0.0265)	(0.0101)	(0.0054)	(0.0119)	(0.0061)	(0.0128)	(0.0121)	(0.0151)
γ_{8i}	-0.0047	-0.0057	-0.0119	-0.0091	-0.0055	-0.0139	-0.0002	0.0656	-0.0105	-0.0041
	(0.0031)	(0.0125)	(0.0379)	(0.0143)	(0.0126)	(0.0074)	(0.0128)	(0.0013)	(0.0127)	(0.0119)
γ_{9i}	-0.0101	-0.0090	-0.0071	-0.0013	-0.0023	-0.0067	-0.0003	-0.0105	0.0474	-0.0001
	(0.0120)	(0.0412)	(0.0012)	(0.0600)	(0.0342)	(0.0512)	(0.0121)	(0.0127)	(0.0520)	(0.0158)
γ_{10i}	-0.0012	-0.0070	-0.0015	-0.0019	-0.0050	-0.0040	-0.0033	-0.0041	-0.0001	0.0283
	(0.0026)	(0.0024)	(0.0007)	(0.0012)	(0.0195)	(0.0124)	(0.0151)	(0.0199)	(0.0158)	(0.0112)
β_i	-0.0339	-0.0229	-0.0312	0.0103	0.0025	-0.0410	-0.0200	0.0501	-0.0110	-0.0107
	(0.0011)	(0.0098)	(0.0110)	(0.0012)	(0.0005)	(0.0100)	(0.0157)	(0.0016)	(0.0039)	(0.0031)

Values in parenthesis are t-values, γ_{ij} = price effects of other food items on rice, β = expenditure effect on budget share

For example, the budget share of rice of a household decreased by 2.21% for a unit increase in the price of yam for a given real income while the budget share of rice decreased by 1.43% for a unit increase in the price of beans under the same condition. Meat and fish also share this rice-beans rule with rice since a unit increase in the price of meat/fish reduced rice budget share of a household by 0.47% for a given real income while potatoes as shown in the Table 4, decreased rice budget share by 0.12%. The Table 4 also shows that the prices of rice, beans, yam, garri and meat/fish were significantly important in the share (quantity) of rice in household total food expenditure. For instance, the share of rice in the total food expenditure decreased by 0.22% for a unit increase in the price of garri but decreased by 0.47% for a unit increase in the price of meat/fish taken together as a meal.

Similarly, the significance of the β's shows that the budget shares are responsive to real total food expenditure with real income held constant. Rice in this case, *Ceteris paribus* with a percentage increase in total food expenditure the budget share of rice decreased by 3.39%. The expenditure coefficients for rice (-0.0339), maize (-0.0229), garri (-0.0410), other cereals (-0.0312), plantain (-0.0200), fruits/vegetables (-0.0110) and potatoes (-0.0107) were negative (<0) while that for meat/fish (0.0501), yam (0.0025) and beans (0.0103) were positive.

Price of other food items on rice: According to Table 5, most of the uncompensated own price elasticities are negative and <1. In terms of own-price elasticity, the demand for rice (though inelastic) was close to unity (-0.742) implying that it is more necessary in the Nigerian diet than the other food items. This is also true of garri. In absolute terms, the value of elasticity was found to be lowest for fruits/vegetables (-0.0410), followed by those for potatoes and beans. This implies that the demand for beans, fruits/vegetables and the demand for potatoes seem to be the least sensitive to their own-price changes while rice has the highest sensitivity to its own-price change. Of all the food items, rice was the least expensive followed by garri and meat/fish while fruits/vegetables were the most expensive. As such the results can be regarded as expected since the least expensive item is found to have the lowest elasticity. As expected, the cross-elasticities are generally lower in absolute terms value than own-price elasticities, implying that consumers were more responsive to changes in own prices than the price of other products. With cross-price elasticities close to zero most of the food groups seem to be unrelated. Uncompensated cross-price elasticities were mostly negative indicating complementary type of food groups. Also, the cross-price elasticities show some level of substitutability. The consumption of rice showed the highest substitutability response of the price of other cereals (0.0883). The second strongest substitute response is the consumption of rice for the price of potatoes (0.0634) followed by those maize (0.0490), garri (0.0485) and then plantain and other cereals. The expenditure coefficients of yam (0.0025) and meat/fish (0.0501) were positive while those of other food items like rice (-0.0339) and garri (-0.0410) were negative.

Substitution and complementary effect of other food items on rice: The values of Hicksian own-price and cross-price elasticities as shown in Table 6 show that these are all negative. All compensated own-price elasticities are negative but greater than the corresponding uncompensated price elasticities. This suggests that the substitution effect outweighs the income effect. The compensated own-price elasticity for rice (-1.0659) was elastic while garri (-0.9655), yam (-0.5792), other cereals (-0.5611) and meat/fish (-0.4440) were price-inelastic. The elasticity of -1.0659 for rice means that a price increase of

Table 5: Own-price and cross-price elasticities for the studied commodities

	Marshallian/uncompensated price elasticities									
	Rice	Maize	Other cereals	Beans	Yam	Garri	Plantain	Meat/fish	Fruit/veg.	Potatoes
Food items	Food category									
Rice	-0.7420	-0.0057	0.0067	-0.0423	-0.0622	-0.0158	-0.0170	-0.0045	-0.0290	-0.0063
Maize	0.0490	-0.2738	-0.0973	-0.0054	0.0158	0.0113	-0.0007	-0.0568	0.0041	-0.1052
Other cereals	0.0883	-0.0670	-0.4399	-0.0103	-0.0795	0.0316	-0.0042	-0.0976	-0.0616	-0.0063
Beans	-0.2881	-0.0386	-0.0621	-0.0853	-0.3706	-0.0577	-0.0301	-0.1688	-0.0303	-0.0918
Yam	-0.1902	-0.0163	-0.0972	-0.1763	-0.4617	-0.0208	-0.0363	-0.0479	-0.0202	-0.0165
Garri	-0.0485	-0.0072	-0.0015	-0.0053	-0.0146	-0.7245	-0.0006	-0.0490	-0.0233	-0.0139
Plantain	-0.0100	-0.0350	-0.0400	-0.0100	-0.0950	-0.2700	-0.1050	-0.0900	-0.0350	-0.1350
Meat/fish	-0.5050	-0.0665	-0.1332	-0.1857	-0.2445	-0.4548	-0.0336	-0.5019	-0.1840	-0.0884
Fruits/veg	-0.1382	-0.1668	-0.1222	-0.0128	-0.0196	-0.0900	-0.0016	-0.1880	-0.0410	-0.0046
Potatoes	0.0634	-0.2120	-0.0179	-0.0419	-0.1239	-0.0620	-0.1029	-0.1010	-0.0145	-0.0460

Table 6: Own-price and cross-price elasticities for the studied commodities

	Hicksian/compensated price elasticities										
	Rice	Maize	Other cereals	Beans	Yam	Garri	Plantain	Meat/fish	Fruit/veg.	Potatoes	η_i
Food items	Food category										
Rice	-1.0659	-0.0728	-0.0938	-0.1093	-0.1962	-0.2076	-0.0393	-0.1162	-0.0848	-0.0341	0.8831
Maize	-0.3517	-0.3567	-0.2217	-0.0883	-0.0900	-0.2650	-0.0283	-0.1950	-0.2000	-0.1467	0.6183
Other cereals	-0.3022	-0.1478	-0.5611	-0.0911	-0.2411	-0.2378	-0.0311	-0.2322	-0.1289	-0.0467	0.6533
Beans	-0.5283	-0.0883	-0.1367	-0.1350	-0.4900	-0.2233	-0.0467	-0.2517	-0.0717	-0.1167	1.1717
Yam	-0.4742	-0.0750	-0.1808	-0.2350	-0.5792	-0.2167	-0.0558	-0.1458	-0.0692	-0.0458	1.0208
Garri	-0.3010	-0.0795	-0.1070	-0.0670	-0.1300	-0.9655	-0.0235	-0.1695	-0.0835	-0.0500	0.7950
Plantain	-0.5700	-0.0850	-0.1400	-0.1400	-0.3350	-0.6700	-0.1450	-0.1100	-0.0650	-0.1950	0.0000
Meat/fish	-0.3370	-0.1170	-0.2090	-0.1510	-0.1750	-0.3390	-0.0220	-0.4440	-0.1550	-0.0710	2.5790
Fruits/veg	-0.4920	-0.2400	-0.2920	-0.0860	-0.1660	-0.3340	-0.0260	-0.3100	-0.1020	-0.0320	0.7800
Potatoes	-0.3300	-0.2933	-0.1400	-0.1233	-0.2867	-0.2340	-0.1300	-0.2367	-0.0522	-0.0867	0.6433

1% will cause a reduction in the demand for rice of 1.0659%. Increasing the price of rice in the study area will less proportionately decrease the budget share of rice in the food expenditure. Based on the uncompensated own-price elasticity estimates, all food categories are price inelastic. However, when the substitution effect was considered, only rice became price elastic with the compensated own-price elasticity estimate (-1.0659) of greater than unity. This showed that the demand for rice was more responsive to its own price than cross-prices. This also indicates the less substitutability for rice in response to changes in own-price compared to other food items. Own-price elasticity of rice was most elastic followed by those of garri and yam. The estimates of cross-price elasticities being negative show no level of substitutability among the food items but complementarity between beans and rice (-0.5283), bean and yam (-0.4700), plantain and rice (-0.5700), meat/fish and rice (-0.3370) and also between rice and beans (-0.1093) and between rice and yam (-0.1962).

Expenditure effect on rice and other food commodities consumption: Expenditure elasticities, η_i are all positive, implying all ten food categories are normal goods (Table 6). The expenditure elasticities of rice (0.8831), maize (0.6183), other cereals 0.6533), garri (0.7950) and fruits/vegetables (0.7800) are necessities while food items like yam (1.0208), beans (1.1717) and meat/fish (2.579) are luxuries. Thus when household income increases, the expenditure shares of meats, fish, bean and yam will increase while the shares of rice, maize, garri, fruits/vegetables and potatoes (0.6433) decreased. Because the expenditure elasticity of rice had the highest elasticity among the food items considered as necessity, from the result, the importance of rice in the Nigerian diet will increase as economic growth continues. However, rice was expenditure inelastic.

Policy implication: Rice had the highest budget share and average budget share among the food commodities. This implies that a substantial price decline with increased production will benefit the majority of households. Rice demand is not quite responsive to changes in own-price in come, expenditure and household demographics such as household size, sex of household head, average age of household, average education and location. For any food policy to be effective in alleviating the problems of food insecurity and malnutrition, attention must be paid to these factors. Rice was inelastic with respect to its own price and expenditure on food. This implies that in general in come-oriented policies will have a greater effect on rice consumption than price related policies. However, policy should be targeted at reducing the price of rice particularly for the low-income households who still consider food as a means rather than an end of consumption. Rice constitutes the largest share of the household total food expenditure in both rural and urban centres in come does not have much weight in it consumption with less substitutability in response to changes in own-price and has changed from being a luxury to being a necessity and that rice has become a major food staple in the Nigerian economy. This implies that policies towards increased rice production and productivity will have a greater effect on the availability, affordability and accessibility of rice in the Nigerian economy. The expenditure elasticity of rice has the highest elasticity among the food items considered as necessity, from the result, the importance of rice in the Nigerian diet will increase as economic growth continues.

CONCLUSION

The demand for rice in Nigeria is price and expenditure inelastic. Rice constitutes the largest share of the household total food expenditure in both rural and urban centres. Income does not have much weight in it consumption with less substitutability in response to

changes in own-price. Rice is a normal good has changed from being a luxury to being a necessity has become a major food staple in the Nigerian economy. Finally, the importance of rice in the Nigerian diet will increase as economic growth continues.

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