Households' Demand for Fruits and Vegetables in Urban Nigeria

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ABSTRACT

This study investigated households' demand for fruits and vegetables in urban Nigeria using data from 2012/13 Living Standard Measurement Survey-Integrated Survey on Agriculture (LSMS-ISA). The demand for bananas, citrus, pineapples, tomatoes, onions, fresh okra, and pepper was estimated using Quadratic Almost Ideal Demand System (QUAIDS). There was high quantity response to movements in relative prices.

Households' demographic characteristics significantly influenced fruits and vegetables demand. All the fruits and vegetables considered were normal goods. Tomatoes, banana, citrus, and pineapple are luxury items while onion, okra, and pepper are necessities. Nigerian urban households respond more than proportionately to changes in the prices of almost all the fruits and vegetables. There was significant income effect in the responsiveness of all the fruits and vegetables demand to changing fruits and vegetable prices. The Marshallian Cross Price Elasticities revealed a mix of complementary and substitution relationship among the fruits and vegetables. Policy interventions should be geared towards improving production of fruits and vegetables as well as households' income in Nigeria.

(Keywords: fruits, vegetables, expenditure, elasticity, urban, Nigeria, dietary components, food economics)

INTRODUCTION

Nutrition-related challenge is common across the globe. Over 800 million people in the world are undernourished with majority living in developing countries (Food and Agriculture Organization [FAO], 2017). There are high rates of child undernutrition and adult obesity. One out of every four children under the age of five is affected by stunting across the globe. Many African countries are characterized by deteriorating nutrition as 20% of the population is undernourished (FAO, 2015). Furthermore, Africa records the highest prevalence of undernourishment. In sub-Saharan African (SSA), over 23% of the total population (two hundred and ten million) are undernourished and poor nutrition is responsible for 45% of deaths especially in children under five (FAO, 2015).

Fruits and Vegetables (FV) are foods with low energy density. They are good sources of vitamins and minerals. Consumption of FV has many health benefits. According to World Health Organization (WHO), sufficient consumption of FV has the potential to save about 2.2 million lives every year (WHO, 2002). However, in Sub-Saharan Africa, fruits and vegetables consumption is below the WHO/FAO minimum recommendation of 400g/person/day (Ruel et al, 2004). The consumption in this region ranges from 70 to 312g/person/day. Insufficient intake of fruits and vegetables is responsible for around 14% of gastrointestinal cancer deaths, about 31% of heart disease and approximately 11% of stroke deaths (WHO, 2003).

In Nigeria, thirteen million children are said to be suffering from chronic malnutrition, a condition also known as stunting. This makes Nigeria the country with the highest number of the stunted in Africa and second highest in the world. Therefore, in order to achieve the second sustainable development goal of ending hunger, achieving food security and nutrition, it is imperative to examine households' demand of essential food items such as FV at a more disaggregated level, in order to achieve the objectives of nutrition security in Nigeria. Hence, this study investigates households' demand of fruits and vegetables in urban Nigeria.

Several studies have analyzed food demand (whole food basket) in some developing countries (Abdulai and Aubert, 2004; Ecker and Qaim, 2008; Bett et al., 2012); fruits and vegetables demand (Mutuc, 2007; Tey et al., 2009; Bundi et

al., 2013). In the same vein, empirical studies have been conducted on food demand in Nigeria employing double logarithms function, double hurdle, almost ideal demand system and its variants (Oyekale, 2000; Tsegai and Kormawa, 2002; Akinleye, 2009; Ogundari and Arifalo, 2013; Otunaiya and Shittu, 2014); and quadratic almost ideal demand system (Obayelu et al., 2009; Fashogbon and Oni, 2013; Khaliukova , 2013). However, these studies except (Ogundari and Arifalo, 2013; Khaliukova , 2013) considered the whole food basket and treated FV as an aggregate food item in the demand system.

This study, however, complements previous studies on fruits and vegetables demand. It investigates households' demand for fruits and vegetables in urban Nigeria. It provides information on expenditure elasticities, own-price and cross-price elasticities of demand for different fruits and vegetables namely: banana, citrus, pineapple, tomato, pepper, fresh okra and onion in urban Nigeria.

MATERIALS AND METHODS

The Scope of Study

Nigeria is located in West Africa and lies between latitude 40-14^{0}N and latitude 30-14^{0}E. The country shares borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. Its coast in the south lies on the Gulf of Guinea on the Atlantic Ocean. Nigeria comprises of 36 states and its Federal Capital Territory, Abuja. It comprises of 774 Local Government Areas.

Nigeria has over 250 ethnic groups, with varying languages and customs, creating a country of rich ethnic diversity. The three largest and most influential ethnic groups in Nigeria are the Hausa, Igbo and Yoruba. The population of the country was 168.8 million in 2012 (World Bank, 2012). Nigeria is grouped into six geopolitical zones namely: North-West, North-East, North-Central, South-West, South-East, and South-South.

Nature of Data

The study used secondary data from the 2012/13 Living Standard Measurement Survey (LSMS-ISA). The survey had two visits according to the agricultural periods (post-planting, September-November, and post-harvest, February-April). The survey was a national representative. The households' weekly expenditure on purchased food items were reported. The study used data on urban households. The data include households' consumption of FV, households' food expenditure, prices, age, household size, sex, marital status, educational level. The fruits and vegetables considered as contained in the data set are: bananas, orange/tangerine, pineapples, tomatoes, onions, fresh okra and pepper.

Data Analysis

The analytical techniques employed include descriptive statistics and Quadratic Almost Ideal Demand System (QUAIDS). Descriptive statistics was used to analyze the households' consumption and expenditure share of fruits and vegetables.

The QUAIDS Model

The almost ideal demand system (AIDS) of Deaton and Muellbauer (1980) has been a popular functional form to model demand behavior during the past two decades. The AIDS model has budget shares that are linear functions of log total expenditure. AIDS is a member of the Price-Independent Generalized Logarithmic (PIGLOG) class of demand models (Muellbauer, 1976), which are derived from indirect utility functions that are themselves linear in log total expenditure. However, there is a growing body of literature providing evidence on the importance of allowing for non-linearity in the budget share equations (Lewbel, 1991; Banks et al., 1997).

The quadratic almost ideal demand system (QUAIDS) model developed by Banks et al. (1997), which has budget shares that are quadratic in log total expenditure, is an example of the empirical demand systems that have been developed to allow for this expenditure nonlinearity. The QUAIDS model is a generalization of PIGLOG preferences based on the following indirect utility (V) function:

$$\ln V = \left\{ \left[\frac{\ln x - \ln a(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1} \quad \text{.....(1)}$$

Where, x = total expenditure
P = is a vector of prices
a(p) = is a function that is homogenous of degree one in prices
b(p) and λ (p) = functions that are homogeneous of degree zero in prices.

As in the original AIDS model, ln a(p) and ln b(p) are specified as the translog and Cobb-Douglas equations:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{K} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{K} \sum_{j=1}^{K} \gamma_{ij} \ln p_i \ln p_j \text{.....(2)}$$

$$b(p) = \prod_{i=1}^{K} p_i^{\beta_i} \text{.....(3)}$$

Where i=1, ……K denote commodities. The function λ (p) is specified as:

$$\lambda(p) = \sum_{i=1}^{K} \lambda_i \ln p_i \text{.....(4)}$$

Where,

$$\sum_{i=1}^{K} \lambda_i = 0$$

Application of Roy's identity to (1) gives the QUAIDS budget share equations. To control for varying preference structures and heterogeneity across households, demographic variables (**z**) will be incorporated into the QUAIDS model through the linear demographic translating method. This leads to the following empirical specification of the QUAIDS budget share equations:

$$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{x}{a(p)} \right] + \frac{\lambda_i}{b(p)} \left\{ \ln \left[\frac{x}{a(p)} \right] \right\}^2 + \sum_{s=1}^{L} \delta_{is} z_s \text{.....(5)}$$

where $z_s = (z_1, ..., z_L)$ is a set of demographic variables. Formulas for the QUAIDS expenditure and price elasticities are derived by differentiating the budget share equations with respect to ln x and ln pj, respectively.

A probit regression analysis is done in order to estimate the probability that a given household consumes the individual fruit and vegetable in question. This regression is then used to yield the Inverse Mills Ratio for each household in order to correct the possible bias created by the presence of zero consumption (Heien and Wessels, 1990).

$$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{x}{a(p)} \right] + \frac{\lambda_i}{b(p)} \left\{ \ln \left[\frac{x}{a(p)} \right] \right\}^2 + \sum_{s=1}^{L} \delta_{is} z_s \text{.....} + IMR_i \text{(6)}$$

Following Banks *et al*. (1997), the expressions for the elasticity formulas is simplified by using the intermediate results:

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln x} = \beta_i + \frac{2\lambda_i}{b(p)}\left\{\ln\left[\frac{x}{a(p)}\right]\right\} \text{.....(7)}$$

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i\left(\alpha_j + \sum_{l=1}^{K}\gamma_{jl}\ln p_i\right) - \frac{\lambda_i\beta_j}{b(p)}\left\{\ln\left[\frac{x}{a(p)}\right]\right\}^2 \text{.....(8)}$$

In terms of the μ_i, the formula for expenditure elasticities can be written as:

$$e_i = 1 + \frac{\mu_i}{w_i} \text{.....(9)}$$

The expression for the Marshallian or uncompensated price elasticities can be written as:

$$e_i = \frac{\mu_{ij}}{w_i} - \delta_{ij} \text{.....(10)}$$

Where δ_{ij} is the Kronecker delta. The Hicksian or compensated price elasticities are obtained from the Slutsky equation:

$$e_{ij}^c = e_{ij}^u + w_j e_i \text{.....(11)}$$

Explanatory Variables

The independent variables included in the model are prices of tomatoes, pepper, onion, okra, banana, pineapples and citrus; household's expenditure on fruits and vegetables. Other demographic variables included are sex (male-1, female-0) and age of the household head (years), household size (number), educational status of the household head (educated=1,0 otherwise), and the zone (North=1, South=0).

RESULTS AND DISCUSSION

Summary Statistics of Socio-Economic Characteristics of Nigerian Urban Households

This section presents the socioeconomic characteristics of urban households in Nigeria. The male-headed households represent 82.21% of the respondents.

The mean household size was 5 persons while the mean age of the household heads was 48.58 years. Majority of the respondents (84.65%) were educated.

Consumption of Fruits and Vegetables

Table 1 reveals that not every urban household consumed all the fruits and vegetables considered in the study in a 7-day period. There are more households consuming vegetables than fruits. From the results, tomatoes record the highest proportion of households with an average quantity of 1.57kg followed by pepper (0.55kg) while pineapple has the least number of households with mean quantity of 2.12kg.

Table 1: Consumption of Fruits and Vegetables in Nigeria by FV Type.

Fruits and Vegetables	No of Households	Quantity Consumed
Tomatoes	80.21	1.57
Pepper	79.94	0.55
Onion	84.53	0.54
Fresh okra	41.72	0.46
Banana	18.16	1.34
Citrus	27.39	1.90
Pineapple	7.76	2.12

Table 2: Fruits and Vegetables Budget Share.

Fruits and Vegetables	Expenditure Share
Tomatoes	33.66
Pepper	24.98
Onion	18.82
Fresh okra	8.94
Banana	4.38
Citrus	5.38
Pineapple	1.84

Table 3: Expenditure Elasticities.

Fruits and Vegetables	Expenditure Elasticities
Tomatoes	1.0545
Pepper	0.9551
Onion	0.5770
Banana	1.7170
Okra	0.9307
Citrus	1.5361
Pineapple	1.9766

Fruits and Vegetables Budget Share

Vegetables record higher budget share than fruits in urban Nigeria. Tomatoes and pepper are important vegetables in Nigerian urban households' diet. Tomatoes have the highest FV budget share of 33.66%. This is followed by pepper (24.98%) while pineapple recorded the least FV budget share of less than 2% (Table 2).

Expenditure Elasticities of Demand

The expenditure elasticity of demand reflects the relationship between percentage change in income and the percentage change in demand for good. The expenditure elasticities for the different fruits and vegetables are reported in Table 3. All elasticities are positive indicating that all the FV are normal goods. This finding is in line with Fashogbon and Oni (2013) that fruits and vegetables are normal goods in Ondo state, Nigeria. The expenditure elasticities are greater than unity for tomatoes, banana, citrus and pineapple implying that these FV are expenditure elastic while onions, okra and pepper are expenditure inelastic. The large expenditure elasticity indicates that the quantity demanded of the FV will increase more than proportionately to the increase in total expenditure. This implies that tomatoes, banana, citrus and pineapple are luxury items while onion, okra and pepper are necessity items. The high expenditure elasticity for pineapple (1.9766) shows that it is a more expensive fruit. From the results, 10% increase in income will increase demand for pineapple by 19.77%

Estimated Parameters of the QUAIDS Model

Zero expenditure was recorded by a number of the households in the survey. From literature, three main factors could be responsible for zero expenditures in household level data: it is possible for households to be at a corner solution implying that they never consume the commodity

of interest; limited survey periods can record zero consumption of the commodity among some households while some households may fail to report consuming the commodity due to the fact that it is not an optimal decision at a particular time subject to the set of prices they face and income (Meyerhoefer *et al.,* 2005; Tafere *et al.,* 2011).

This problem was solved by employing a two-stage estimation procedure. In the first stage, a probit regression was estimated to represent a decision by household (h) to demand the particular, commodety (i) or not. The estimates of the maximum likelihood were then used to construct the Inverse Mills Ratio (IMR) for each household. In the second stage, the IMR was used as an explanatory variable to incorporate the censoring latent variable in the regression (Heins and Wessels, 1990; Bundi *et al.,* 2013).

The estimated parameters of the QUAIDS model are presented in Table 4. Twenty-four out of the 28 price effects are significant. This indicates high quantity response to movements in relative prices among urban households in Nigeria. This is likely as a result of the disaggregation of the fruits and vegetables which provides a clearer view of households' sensitivity to price changes than when aggregated.

Furthermore, Table 4 revealed the effects of demographic factors on the household's demand of the different fruits and vegetables. Age of the household head has positive and significant influence only on the demand of citrus ($p<0.01$). Household size has negative but significant effect on demand of okra ($p<0.01$) and citrus ($p<0.05$) while its effect is positive on pepper ($p<0.05$).

Table 4: Estimated Parameters of the QUAIDS Model.

Variables	Tomatoes	Pepper	Onion	Banana	Okra	Citrus	Pineapple
Constant	-0.3573* (0.0967)	-0.2955** (0.1224)	0.5659* (0.0839)	0.4959* (0.0985)	-0.3043* (0.0979)	0.4439* (0.1045)	0.4513* (0.0740)
PTOMA	0.1106* (0.0364)						
PPEPR	0.0872* (0.0209)	0.0651* (0.0261)					
PONION	-0.1062* (0.0230)	-0.0659* (0.0197)	0.0673* (0.0209)				
PBANA	-0.0408** (0.0194)	-0.0360** (0.0149)	0.0489* (0.0157)	-0.0369** (0.0221)			
POKRA	0.0569* (0.0180)	0.0209 (0.0129)	-0.0515* (0.0167)	-0.0280** (0.0127)	0.0706* (0.0186)		
PCITRU	-0.0395** (0.0192)	-0.0268** (0.0146)	0.0462* (0.0157)	0.0077 (0.0127)	-0.0375* (0.0121)	0.0615* (0.0176)	
PPINE	-0.0682* (0.0157)	-0.0443* (0.0134)	0.0612*** (0.0122)	0.0851* (0.0151)	-0.0314* (0.0121)	-0.0118 (0.0112)	0.0095 (0.0168)
LNEXP	-0.1894* (0.0224)	-0.0976* (0.0269)	0.1559* (0.0168)	0.0684* (0.0226)	-0.0858* (0.0219)	0.0584* (0.0236)	0.0899* (0.0162)
$LNEXP^2$	-0.0119* (0.0014)	-0.0063* (0.0015)	0.0137* (0.0009)	0.0024*** (0.0013)	-0.0044* (0.0013)	0.0019 (0.0013)	0.0045* (0.0009)
Age	-0.0001 (0.0001)	-0.0002 (0.0001)	-0.0004** (0.0002)	0.0001** (0.0001)	0.0006* (0.0001)	0.0002* (00001)	0.0001 (0.0000)
Sex	-0.0006 (0.0028)	-0.0069* (0.0027)	0.0035 (0.0031)	0.0013 (0.0017)	0.0047* (0.0017)	-0.0015 (0.0017)	-0.0004 (0.0001)
Household size	0.0002 (0.0004)	0.0008** (0.0003)	0.0003 (0.0004)	-0.0002 (0.0002)	-0.0006* (0.0002)	-0.0005** (0.0002)	0.0001 (0.0001)
Educational status	-0.0005 (0.0022)	-0.0009 (0.0001)	0.0032 (0.0023)	-0.0002 (0.0013)	-0.0017 (0.0013)	-0.0004 (0.0014)	0.0006 (0.0008)
Zone	0.0079 (0.0058)	-0.0057 (0.0055)	0.0095 (0.0069)	-0.0019 (0.0037)	-0.0027 (0.0035)	-0.0098* (0.0037)	0.0027 (0.0023)

*,**,*** indicate level of significance at 1%,5% and 10%, respectively. Standard errors are in parenthesis. All prices are in logarithms, PTOMA=price of tomatoes, PPEPR=price of pepper, PONION= price of onion, PBANA=price of banana, POKRA=price of okra, PCITRU= price of citrus, PPINE= price of pineapple. LNEXP= logarithm of total food expenditure,
$LNEXP^2$= square of logarithm of total food expenditure.

This implies that the larger the households, the more the demand for pepper and the less the demand for citrus and okra in urban Nigeria. This is due to the fact that almost all the other food groups are consumed with pepper sauce in Nigeria. However, this contradicts Khaliukova (2013) who opined that the more the household size, the less the consumption of pepper. Being resident in northern Nigeria significantly reduced the demand of citrus in urban Nigeria.

Own- and Cross-Price Elasticities of Fruits and Vegetables in Urban Nigeria

The study also investigates the own and cross price elasticities of fruits and vegetables. Tables 5 and 6 present estimates of the Marshallian (uncompensated) expenditure elasticities and Hicksian (compensated) expenditure elasticities respectively. The estimates on the diagonal represent the own-price elasticities of the different fruits and vegetables. All the own-price elasticities (compensated and uncompensated) are negative, indicating they conform to the demand theory. From the uncompensated price elasticity estimates, the demand for tomatoes, onion, banana and pineapple are own-price elastic. This implies that Nigerian urban households respond more than proportionately to changes in the prices of these fruits and vegetables.

From the results, a 1% increase in the prices of tomatoes, onion, banana and pineapple will lead to 1.0819, 1.1876, 2.4174 and 2.5088 decrease in the quantity demanded, respectively. Furthermore, it could be observed from that the compensated own-price elasticities are smaller in their absolute value than the uncompensated. This implies a significant income effect in the responsiveness of all the fruits and vegetables demand to changing fruits and vegetable prices.

The Marshallian cross price elasticities reveal a mix of complementary and substitution relationship among the fruits and vegetables. From the results, pepper behaves as a complement to tomatoes (-0.0309), that is, 1% increase in the price of tomatoes will decrease the quantity of pepper demanded by 0.0309. Contrary to opinion, onion has a substitution relationship with tomatoes. This indicates that 1% increase in the price of tomatoes will increase the quantity of onions demanded by 0.3331. Okra behaves as a substitute to tomatoes but complements pepper. Citrus is a substitute to banana while it has a complementary relationship with pineapple.

Table 5: The Marshallian/Uncompensated Elasticity of Demand.

FV	Tomatoes	Pepper	Onion	Banana	Okra	Citrus	Pineapple
Tomatoes	**-1.0819**	-0.0039	0.0192	0.0212	0.0072	-0.0025	0.0045
Pepper	-0.0309	**-0.9473**	0.0164	-0.0048	-0.0629	0.0114	0.0012
Onion	0.2114	0.1188	**-1.1876**	0.0949	-0.0166	0.1164	0.0521
Banana	-0.0744	-0.2205	0.2056	**-2.4174**	-0.1690	0.3233	-1.2820
Okro	0.0171	-0.1697	-0.0343	-0.0476	**-0.4938**	-0.1928	-0.0096
Citrus	-0.1637	-0.0939	0.2387	-0.2562	-0.3760	**-0.2045**	-0.6803
Pineapple	-0.4376	-0.2395	0.3155	3.0941	-0.1420	-2.0582	**-2.5088**

Table 6: Hicksian/Compensated Elasticities of Demand.

FV	Tomatoes	Pepper	Onion	Banana	Okro	Citrus	Pineapple
Tomatoes	**-0.7057**	0.2596	0.2180	0.0672	0.0872	0.0591	0.0144
Pepper	0.3717	**-0.7087**	0.1965	0.0369	0.0225	0.0627	0.0184
Onion	0.4174	0.2630	**-1.0788**	0.1202	0.0682	0.1474	0.0625
Banana	0.5381	0.2085	0.5294	**-2.3424**	-0.0154	-0.2311	1.3129
Okra	0.3492	0.0628	0.1412	-0.0069	**-0.4106**	-0.1428	0.0070
Citrus	0.3843	0.2898	0.5283	-0.1891	-0.2386	**-0.1220**	-0.6527
Pineapple	0.2676	0.2542	0.6883	3.1805	0.0348	-1.9521	**-2.4733**

CONCLUSION

The study investigated households' fruits and vegetables demand in urban Nigeria using data from the LSMS-ISA namely 2012/13 data. The quadratic almost ideal demand system was employed in the analysis. Bananas, citrus and pineapples were considered for fruits while the vegetables considered were tomatoes, onions, fresh okra and pepper. Nigerian urban households consumed more of vegetables than fruits. Pineapple and okra recorded the lowest budget share among fruits and vegetables respectively.

All the demographic variables except educational status have significant effect on demand for fruits and vegetables. All the FV considered are normal goods. However, tomatoes, banana, citrus and pineapple are luxury items while onion, okra and pepper are necessity items. There is a mix of complementary and substitution relationship among the fruits and vegetables. There is a significant income effect in the responsiveness of all the fruits and vegetables demand to changing fruits and vegetable prices. The study recommends government investment on storage facilities that could prolong shelf-life in order to reduce seasonal price variation. Policy interventions should be geared towards improving production of fruits and Vegetables as well as increasing households' income in Nigeria.

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