

Linear Approach Almost Ideal Demand System Analysis of Main Vegetables in Lagos State, Nigeria

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Abstract

The World Health Organization estimated that low vegetable intake was a factor enhancing high mortality all over the world. Studies have shown that the level of vegetable intake in Nigeria was low. Despite relatively cheap and abundant sources of micro nutrients found in vegetables, wide spread cases of micro nutrient deficiencies are still common in the study area. Thus, this study examined the demand for main vegetables in Lagos state. The result revealed that the average monthly consumption per household was 21kg and 16kg in urban and rural Lagos respectively. However, the average monthly expenditure per household was ₦2, 905.83 in urban and ₦2, 698.60 in rural areas of Lagos state. The result indicated that the coefficient of determination (R^2) falls between 0.54 and 0.92. In both areas the coefficients of all own price, and cross price parameters and household size are all statistically significant at varying levels of probabilities. Own price elasticity of demand for vegetables indicated that urban and rural areas are elastic and inelastic, respectively. The values of income elasticity of demand are positive and greater than 1, hence the demands for all the vegetables are elastic in nature in both areas. The cross price elasticities for both urban and rural areas have negative signs and are therefore complementary goods. Policies and strategies that would make vegetables available throughout the year should be vigorously pursued. Furthermore, to enhance vegetable consumption in the area, the public should be enlightened on the health benefits of vegetables.

Keywords: Vegetables, micronutrient deficiencies, demands, price elasticity, LA-AIDS

1. Introduction

All over the world, there were 868 million people, who suffered from undernourishment, in the period of 2010-2012 and approximately two billion people had negative health consequences caused by micronutrient deficiencies (FAO, 2012). The demand analyses for food items play a critical role in tackling the undernourishment issue. Nigeria is blessed with good natural resources, in spite of her rich agro-ecological diversity (Oladele *et al.*, 2004). The country has fertile soil that has the potential critically to add to global food security (Ariyo and Mortimore, 2011). However, the country is listed as the 54th poorest country in the world (UNDP, 2007). About 70.0% of the population lives on less than US \$1.25 a day (IFAD, 2012).

The predominant food items in the Nigerian diets are starchy staple foods (rice, gari and yam) and vegetables (okra, tomatoes, onion and pepper). Vegetables are horticultural crops, which are one of the world most important foods consumed by more than half of the world's population (FAO, 2007). It has been an important food commodity for most of the people in sub-Saharan Africa particularly West Africa (FAO, 2012). Vegetables are an important component of healthy human diet. They are good sources of vitamins and minerals, vegetable proteins, protective micronutrients and dietary fibers, which help to prevent constipation (Balasubramanian and Rangunathan, 2012). They are foods with low energy density, i.e. with few calories in relation to the volume of the food consumed, which favors maintenance of healthy body weight (USDA, 2009). Eating vegetables appears to help keep the brain young and may slow the mental decline sometimes associated with growing old (Morris *et al.*, 2006). A diet including mainly spinach can boost memory power and help in cognition and better learning (Vishal, 2014).

There are no fewer than 33 vegetable markets in Lagos and the most prominent is Mile 12. Lagos markets and traders face severe problems and at the same time constitute major challenges to smooth traffic, the environment as well as enforcement of law and order. Mile 12 Market is typically for all fresh food items in Lagos and popular for retailing in farm produce like pepper, tomato, onions, okra and fluted pumpkin, fruits, yam and other edible goods, which are all beautifully stacked in heaps of unending baskets. It is so popular far beyond the South West to the East and North Central states. Vegetables are normally cultivated in the rural areas of Lagos,

while the smallholders bring greater percentages to the state from the northern part of the country.

In spite of the numerous uses of vegetables, literatures have indicated that consumption of vegetables in Africa fall short of the recommended daily intake (Hall *et al.*, 2009). Daily intake of fruit and vegetables in sub-Saharan Africa falls between 70 to 312 g per person per day, far below the WHO/FAO minimum recommendation of 400g per person per day or 146kg per person per year (Ruel *et al.*, 2004). Low vegetable intake is a critical variable influencing malnutrition and deaths all over the world (WHO, 2003). In Nigeria, micronutrient malnutrition is well known as a challenge with negative economic implications (Adish, 2009).

The diets of urban dwellers are generally more diverse than those of their rural counterparts (Smith *et al.*, 2003). It is believed that this is due to a combination of factors including the availability of a wider variety of foods in urban markets, the availability of storage facilities, changes in life styles and cultural patterns. According to Fabiosa and Soliman (2008), urban households show larger differentials in the elasticities for food and non-food items with much smaller elasticities for the food categories. Rural households on the other hand, show higher elasticities in the food categories, especially for meat, fish and dairy. However, urban households are less responsive to income changes than are rural households in the food categories; and more responsive in the non-food category. The main objective of the present study was therefore to examine the demand for vegetables in Lagos state, Nigeria.

2. Hypotheses of the Study

In this study, the following null hypotheses were tested.

- HO₁: there is no significant difference between the consumption of vegetables in urban and rural areas of Lagos state;
- HO₂: the determinants of the consumption of vegetables are not the same in urban and rural areas;
- HO₃: there is no significant difference in the demand elasticities for vegetables in urban and rural areas of state.

3. Justification of the Study

Vegetables consist of myriads of nutrients, which are beneficial to the body and can help prevent diseases and maintain good health conditions if adequately consumed. This could lead to a drastic reduction in the malnourished people in the state. They are relatively cheap sources of essential micronutrients and are therefore cost effective. Studies on demand for vegetables in Lagos state are rare in the literature. This study will broaden the understanding of household level factors that influence the demand for vegetables in urban and rural areas of the state. The result will assist in the promotional efforts to enhance vegetable consumption in the nearest future.

Consumer demand is defined as the various quantities of a particular commodity that an individual consumer is willing and able to buy as the price of that commodity varies with other factors that affect or influence the demand held constant (Tomek and Robinson, 1991). Many factors are known to affect or influence the demand for a product. These factors include own price of the product, prices of other products, consumer's income, tastes and preference (Koutsoyiannis, 1980). Other factors or determinants of demand include distribution of income, total population and its composition, government policy, weather, credit availability, advertising, past levels of demand and habits. According to Pagot (1992), factors like availability of various commodities, eating traditions and relative prices also affect demand.

According to Davis (1982), consumer demand theory investigates the food-expenditure relationships through Engel's demand curve, which is a functional relationship between households in a given period. The slope of Engel's curve measures the expenditure (income) elasticity of demand. A positive, negative, or zero elasticity implies normal, inferior and neutral goods respectively. Engel's curve shows how purchases of food commodities change when income changes. Engel ascertained that the lower the consumer's money income, the greater the proportion of that income spent on food.

4. Materials and Methods

4.1 Area of study

Lagos state was chosen for this study because it is the second populous state in Nigeria next to Kano state with a population of over 21 million people (NPC, 2016) Nigeria. The state was created on 27th May 1967. Lagos state is arguably the most economically important state of the country (Figure 1). It contains twenty Local Governments Areas (LGAs) namely: Agege, Alimosho, Ifako-jaye, Ikeja, Kosofe, Mushin, Oshodi-isolo, Somolu, Apapa, Eti-Osa, Lagos Island, Lagos mainland, Surulere, Ajeromifelodun, Amuwoodofin, Ojo, Badagry, Ikorodu, IbejuLekki, Epe. The urban areas of Lagos includes: Lagos mainland, Ikeja, Surulere, Lekki, Lagos island etc. while the rural areas includes; Epe, Ojo, Badagry, Ijede, Eputu, Ikorodu etc.



Figure 1: Map of Lagos showing the various communities

4.2 Method of data collection

Primary data and secondary information were used for this study. The primary data were collected with the use of a structured questionnaire for information on quantity of vegetables consumed, households' income, and total expenditure per kilogram of each commodity consumed among others.

4.3 Sampling methods

A three-stage sampling techniques was used in the selection of respondents. The first stage involved random selection of 2 LGAs each of rural and urban areas of Lagos state. This was followed by random selection of 2 communities each from the selected LGAs in both rural and urban Lagos. Thirdly, 15 households were randomly selected in each community to make up a sample size of 120 respondents each for both rural and urban areas of Lagos.

4.4 Analytical framework

Descriptive statistical tools such as mean, frequency distribution and percentages were used to describe the socioeconomic characteristics of the respondents. Following Deaton and Muellbauer (1980) and Afrif *et al.* (2014), Linear Approach Almost Ideal Demand System (LA-AIDS) was used to examine the demand for vegetables as well as their elasticities. The model is given as:

$$w_{i=} \alpha i + \sum_j \gamma_{ij} \log P_j + \beta i \log \left[\frac{X}{p^*} \right] + \theta \log Art + \delta \log Edu + \varepsilon \log Xpd$$

Where:

- $w_{i=}$ budget share (expenditure proportion) of i community group with I = 1, 2, 3.....n
- α, β, γ = regression parameter for intercept, vegetable expenditure (with the weighing price) and aggregate price from each commodity
- $\theta, \delta, \varepsilon$ = regression parameter for the number of household member, education level of household head and total expenditure of household
- P_j = aggregate price of j^{th} commodity
- X/p^* = vegetable expenditure is divided by the index weighing price
- Art = household size
- Edu = education level of household's head
- Xpd = total expenditure of household

The formula used for calculating the demand elasticities from the model are:

Own price elasticity: $e_{ii=} = \frac{\gamma_{ii}}{w_i} - 1$

Cross price elasticity: $e_{ij} = \frac{\gamma_{ij}}{w_i}$ ($i \neq j$)

Income elasticity: $e_{ii} = 1 + \frac{\beta_i}{w_i}$

5. Results and Discussion

5.1 Socioeconomic characteristics of the respondents

Majority (82.5% and 81.7%) of the respondents in urban and rural areas of Lagos respectively, are male headed households. The average age of the respondents is 48 and 43 years in urban and rural Lagos respectively. The average household size is 8 and 7 persons in the urban and rural areas respectively. It is expected that the higher the household size the higher the demand for vegetables (Table 1).

Table 1: Socio economic characteristics of respondents

Variable	Urban				Rural			
	Minimum	Maximum	Mean	Standard deviation	Minimum	Maximum	Mean	Standard deviation
Age	19	60	48.01	11.504	19	60	43.18	10.586
Household Size	3	15	8	2.486	6	10	7	1.166
Years of education	6	17	9.6	4.408	6	17	9.23	4.201
Income (₦)	60,000	300,000	107716	59279	40,000	250,00	90199	47121

Source: Field Survey 2017

The educational status of the household head was based on the numbers of years spent in school. The average years of education are 9.6 years and 9.23 years in urban and rural areas of Lagos, respectively. *Ceteris paribus*, the more the numbers of years spent in school the higher the income. Furthermore, the average households' income in rural is low (₦=90,199) when compared with ₦=107,716 earned by the urban households. This could play an important role in stimulating vegetable consumption in the area.

5.2 Consumption level of five vegetable commodities in urban and rural areas of Lagos

Table 2 reveals that all the households (100%) consumed vegetables. They consumed on the average 21 kg in urban and 16 kg in rural areas of Lagos. On the average, every household spends on monthly basis ₦=2,905.83 and ₦=2,698.60 on vegetables in urban and rural areas respectively.

Table 2: Estimated vegetable consumption in urban and rural areas of Lagos

	Urban area	Rural area
Percentage of household which consume vegetables	100	100
(kg/capita/month)	21	16
Total expenditure per capita (₦/capita/month)	74,700	36,517
Vegetable expenditure per capital (₦/capita/month)	2905.83	2698.60
Vegetable expenditure as a percentage of the total expenditure	3.89	7.39

Source: Data Analysis, 2017

Note: The official *naira* to *dollar exchange rate* was pegged at ₦301 per \$1 while the black market rate was pegged at ₦360 per \$1. On the other hand, 1EUR is ₦325 and ₦400 at the official and black market rates, respectively

5.3 Estimation of the model of complete demand of vegetables

Table 3 shows that the value of the coefficient of determination (R^2) falls between 0.54 and 0.92.

Table 3: Estimates of LA-AIDS in urban areas of Lagos

	Tomatoes	Onion	Pepper	Okra	Fluted pumpk.
Intercept	8.34154 *** (0.480346)	12.5293 ** * (1.50603)	13.4378 *** (1.41676)	14.2083*** (2.16067)	14.2580 *** (1.11455)
Ln(price of tomatoes)	0.0081*** (0.0000)	-1.20125*** (0.160261)	-1.19678 ** * (0.158972)	-1.33176*** (0.228408)	-1.59679 *** (0.0965315)
Ln (price of onion)	-0.279758 *** (0.037323)	0.00175*** (0.0000)	-0.365694*** (0.0876689)	-0.429687 *** (0.119196)	-0.530363 *** (0.0706090)
Ln (price of pepper)	-0.282427 *** (0.0375157)	-0.370563 *** (0.0888362)	0.00162*** (0.000002)	-0.356811 *** (0.122210)	-0.426415*** (0.0773418)
Ln (price of okra)	-0.176054 *** (0.0301948)	-0.243908 *** (0.0676603)	-0.199879 *** (0.0684599)	0.00175*** (0.000003)	-0.255804 *** (0.0606547)
Ln (price of Fluted pumpkin)	-0.445524 *** (0.0269334)	-0.635401 *** (0.0845930)	-0.504153 *** (0.0914417)	-0.539894 *** (0.128016)	0.00154** (0.000002)
Ln(household size)	0.0586281 (0.0522906)	0.0663392 (0.108785)	0.214375 ** (0.106319)	0.0157076 (0.144622)	0.0500097 (0.0994405)
Ln(education)	-0.0410254 (0.104411)	0.208563 (0.215601)	-0.317992 (0.212952)	0.548599 * (0.282610)	0.213960 (0.196759)
Ln(income)	-0.0333527 (0.0413330)	-0.0793321 (0.0855692)	-0.0629889 (0.0851240)	-0.244550 ** (0.111626)	-0.123114 (0.0776045)
Ln (stone price index)	2.33344 *** (0.0847274)	3.55509*** (0.357203)	3.30010 ** * (0.374391)	3.55813 *** (0.557952)	4.14702 *** (0.215884)

Source: Data Analysis, 2017. Values in parentheses are the standard errors

The parameters are positive and significant at different levels ranging from 90%-99%. The assumption of own price parameter is all significant at the level of 1% for both urban and rural Lagos. This is in accordance with previous studies. The variables with positive signs suggest a direct relationship between the price of another commodity and the commodity expenditure. Most of the cross price parameters are negative and influences the proportion of vegetable expenditure at 1% level. This implies that all the commodities have the opposing relation between the expenditure proportions of one commodity with the price of another vegetable commodity. The higher the price of another commodity the lower is the proportion of

commodity expenditure. Most of the coefficients of household size were not significant except for the coefficient of pepper, which is positively signed and statistically significant at 5% level of probability. The positive sign implies that an increase in household size *ceteris paribus* would lead to an increase in budget share.

Also, the coefficients of education were not significant except for the coefficient of okra which is positively signed and significant at 10% level of probability. This means education is not an important variable as far as budget share is concerned. On the other hand, most of the coefficients of income were negatively signed but not significant except for the coefficient of okra, which is significant at 5% level of probability. The negative signs suggest as income increases, the proportion of income spent on consumption decreases (Engel's law).

In the rural areas of Lagos, the signs on the coefficients on all own price parameters are also positive and significant at 1% level of probability. Most of the cross price parameters are negative and important at 1% level of probability (Table 4).

Table 4: Estimates of LA-AIDS in rural areas of Lagos

	Tomatoes	Onion	Pepper	Okra	Fluted pump
Intercept	8.88782*** (0.770357)	14.9338 ** * (1.7333)	11.4328 ** * (1.09423)	26.4045 *** (3.21987)	13.7220 *** (1.30277)
Ln(price of tomatoes)	0.0068*** (0.00002)	-0.824222 *** (0.168788)	-1.00903*** (0.0849777)	-2.43185 *** (0.248285)	-1.28208 ** * (0.0928288)
Ln (price of onion)	-0.214549 *** (0.0439362)	(0.00065)** (0.0000)	-0.213305 ** (0.0621083)	-0.585159 *** (0.163800)	-0.364175 *** (0.0700210)
Ln (price of pepper)	-0.554505 *** (0.0466989)	-0.450320*** (0.131120)	(0.00043)*** (0.0000)	-1.23014 *** (0.222537)	-0.783294 *** (0.0857077)
Ln (price of okra)	-0.190635 *** (0.0194633)	-0.176221 *** (0.0493286)	-0.175476 *** (0.031744)	(0.00038)*** (0.0000)	-0.232928 *** (0.0367091)
Ln (price of Fluted pumpkin)	-0.493063*** (0.0357003)	-0.538045 *** (0.103451)	-0.548167 *** (0.0599801)	-1.14273 *** (0.180093)	0.00035** (0.0000)
Ln(household size)	-0.105481 ** (0.0521692)	-0.177287 * (0.102749)	0.0297328 (0.0716028)	-0.416961 ** (0.185556)	-0.170558 ** (0.0841154)
Ln(education)	-0.0409277 ** (0.0338308)	0.0351208 (0.0666612)	-0.0265628 (0.0458670)	-0.324411*** (0.117663)	-0.0202504 (0.0548776)
Ln(income)	-0.0409277 (0.0338308)	-0.375484 *** (0.129662)	0.0545426 (0.0924033)	-0.0650103 (0.244962)	0.110962 (0.110128)
Ln (stone price index)	2.28736 *** (0.0966933)	2.97302 *** (0.370630)	2.63052 *** (0.201112)	6.03736 *** (0.626241)	3.38825 * ** (0.208441)

Source: Data Analysis, 2017. Values in parentheses are the standard errors

Most of the coefficients of household size were negative and important of at 5% and 10% levels of probability. The negative signs imply that as the household size increases budget share on vegetables also decreases. Few of the coefficients of education were negative and significant at 1% and 5% levels. This means education is an important variable influencing the budget share in the rural areas of Lagos. On the other hand, most of the coefficients of income were negatively signed, but not significant except for the coefficient of onion, which is important of at 1%.

5.4 Elasticity

Elasticity measures the responsiveness of quantity (demand or supply) to changes in the factors that affect the demand or supply. Elasticity of demand is the responsiveness of quantity demanded of a commodity to changes in the factors that cause the change in the demand. The important elasticities of demand are: price, income and cross elasticity of demand (Table 5).

Table 5: Value of own price elasticity in rural and urban areas of Lagos

Area	Tomatoes	Onion	Pepper	Okra	Fluted pumpkin
Urban area	-0.87084	-0.56395	-0.76473	-0.56849	-0.74415
Rural area	-0.81512	-0.23215	-0.70004	-0.67125	-0.63918

Source: Field Survey 2017

The own price elasticities for each commodity are negative for both the urban and rural areas. This is in line with the law of demand, which states that the higher the price, the lower the quantity demanded. Another notable characteristic is that all the price elasticities are less than 1. This signifies that, the percentage change in quantity of each commodity is smaller than the percentage change in price in both urban and rural Lagos. The elasticities values of all the vegetables are higher in the urban than in the rural areas. This shows that the demand for vegetables in urban and rural is elastic and inelastic respectively.

The income elasticity of demand is the proportionate change in the quantity demanded of a commodity resulting from a proportionate change in the income of the consumer (Table 6). For all the vegetables, the values are positive and greater than 1, hence the demand for all the

vegetables is elastic in nature. Income elasticity of demand is used to classify goods into luxuries, necessities and inferior goods. Luxuries have income elasticity that is greater than 1, necessities have income elasticity that is between 0 and 1 and inferior goods have income elasticity that is less than 0. A good may not be superior or inferior every time, it depends on the income level of the consumers (Engel's law).

Table 6: Value of income elasticity in urban and rural areas of Lagos

Area	Tomatoes	Onion	Pepper	Okra	Fluted pumpkin
Urban area	1.505202	1.101812	1.153883	1.039816	1.199287
Rural area	1.436373	1.097128	1.212468	1.060899	1.203133

Source: Field Survey 2017

Cross elasticity is the proportionate change in the quantity demanded of a commodity (X) resulting from a proportionate change in the price of another commodity (Y). Table 7a and Table 7b showed that the cross price elasticity for both urban and rural areas have negative signs. It is normally used to classify goods as complementary and substitute goods. Complementary goods have negative cross elasticity. On the other hand, substitutes have positive cross elasticity. The higher the value of the cross elasticity, the stronger is the degree of substitutability or complementarity of commodities X and Y.

Table 7a: Effects of cross price changes towards the demand for vegetables in urban Lagos

Price	Tomatoes	Onion	Pepper	Okra	Fluted pumpkin
Tomatoes	-	-0.043	-0.060	-0.097	-0.027
Onion	0.0218	-	-0.087	-0.027	-0.080
Pepper	-0.020	-0.058	-	-0.103	-0.087
Okra	-0.024	-0.071	-0.096	-	-0.094
Fluted pumpkin	-0.068	-0.039	-0.082	-0.062	-

Source: Field Survey 2017

Table 7b: Effects of cross price changes towards the demand for vegetables in rural Lagos

Price	Tomatoes	Onion	Pepper	Okra	Fluted pumpkin
Tomatoes	-	-0.040	-0.081	-0.163	-0.090
Onion	0.193	-	-0.062	-0.023	-0.024
Pepper	-0.021	-0.073	-	-0.021	-0.042
Okra	-0.032	-0.062	-0.021	-	-0.024
Fluted pumpkin	-0.090	-0.026	-0.063	-0.071	-

Source: Field Survey 2017

6. Conclusion

The study analyzed the demand for main vegetables in urban and rural areas of the Lagos state. The result revealed that people in the urban areas consumed more vegetables when compared to those in the rural areas. This could be due to the wide gap between their income levels. Furthermore, the average monthly consumption per household was 21 kg and 16 kg in urban and rural Lagos respectively. However, the average monthly expenditure per household was ₦2,905.83 in urban and ₦2,698.60 in rural areas of Lagos. The average total expenditure of households was ₦74,700 and ₦36,517, while the vegetable expenditure as a percentage of the total expenditure were 3.89 and 7.39 in urban and rural areas of Lagos respectively. In both areas the coefficients on all own price parameter, cross price parameter and household size are all important at varying levels of probabilities. Own price elasticity indicated that the demand for vegetables in urban and rural areas are more elastic and inelastic respectively. The values of income elasticity of demand are positive and greater than 1. Hence, the demands for all the vegetables are elastic in nature in both areas. The cross price elasticities for both urban and rural areas have negative signs and are therefore said to be complementary goods. Policies and strategies that would make vegetables available throughout the year by reducing post-harvest losses should be vigorously pursued. Furthermore, the public should be well educated on the health benefits of vegetables.

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