Journal of Research in Forestry, Wildlife & Environment Vol. 12(3) September, 2020
E-mail: jrfwe2019@gmail.com; jfewr@yahoo.com
http://www.ajol.info/index.php/jrfwe
jfewr ©2020 - jfewr Publications
ISBN: 2141 – 1778
Ojogho and Imade, 2020

HOUSEHOLDS FOOD CONSUMPTION PATTERN IN EDO STATE, NIGERIA: APPLICATION OF ALTERNATIVE DEMAND MODEL

Ojogho, O. and Imade, O. S.

Department of Agricultural Economics and Extension Services, Faculty of Agriculture, University of Benin, Benin City, Nigeria,

***Correspondent Author:** *o.ojogho@uniben.edu; igomercy@yahoo.com*

ABSTRACT

The concern of food demand analyst is not to model food demand only but to obtain accurate estimates of price and income elasticities for predicting household behaviour. To satisfy that, the study estimated a complete food demand system and estimated the price and conditional income elasticites of food demand on micro-data obtained from 252 household in Edo State using the Quadratic Almost Ideal Demand System (QUAIDS) model. The results show that households, in Edo state, spend more than half (57%) of their conditional food expenditure on starchy staple foods. The remaining 43% of household food expenditure is spent on other common food commodities with beans, meat and fish accounting for 11%, 16% and 12% respectively. The budget share for plantain, fufu, garri and yam respectively declines with rising conditional food expenditure while the budget share for rice, potatoes, bean and meat increases with increase in conditional food expenditure. The results show no strong complementarity and substitutability among majority of the food commodities in the State. Potatoes (1.101), and meat (1.156) are luxury food commodities in Edo state.

Keyword: food, household, budget-share, price- elasticity, income- elasticity

INTRODUCTION

Variations in household food expenditures in Nigeria have been attributed to income of households and prices of food commodities. High prices are a barrier to eating more organically produced meat (McEachern and Schröder 2001), fish (Cassady *et al*. 2007; Verbeke and Vackier 2005) or fruits and vegetables (Ard *et al.* 2007). While the importance of low food prices to the low-income families is clear, the relationship between income level and food demand has been of concern (Drewnowski *et al.,* 2004; Andrieu *et al.* 2006; Bowman 2006; Cassady *et al.* 2007; Ard *et al.* 2007). The concern of food demand analyst is not to model food demand only but to obtain accurate estimates of price and income elasticities.

Some studies in Nigeria (Ogunniyi *et al.,* 2012; Rattiya *et al.,* 2010; Marie *et al.,* 2004; Adebamiji and Omotola, 2009; Agbola *et al.,* 2002) have used demand systems model specifications to measure behaviour of household food demand with the assumption of monotonic relationship between income and budget share. Others (Naanwaab and Yeboah, 2012; Ogundari and Arifalo, 2013) have analysed food demand without the use of a structured budgeting system. Such methods introduce a complexity factor and pose a huge problem in determining the price and income elasticities (Crawford *et al.,* 2003; Mergenthaler *et al.,* 2007; Chen, 2007; Claro *et al.,* 2007; Janda *et al.,* 2009; Anwarul Huq and Arshad, 2010; Dallongeville *et al.,* 2011; Niu and Wohlgenant, 2013). However effective a linear relationship between expenditure and budget share is in approximating consumer behaviour, it does not completely satisfy Engel's law of demand of a decline in budget share with a rise in income (Banks *et al.*, 1997). Banks *et al.* (1997) argues that commonly used models of consumer behavior such as Almost Ideal Demand System (AIDS), Linear Approximate Almost Ideal Demand System (LA/AIDS) and Linear Expenditure System (LES) display the mentioned low Engel curve flexibility on the assumption that expenditure shares are implicitly monotonic functions of disposable income.

In an effort to provide as realistic an empirical analysis as possible, this study estimated a complete food demand system using the Quadratic Almost Ideal Demand System (QUAIDS) model, estimated the price and conditional income elasticites of food demand using micro-data.

MATERIALS AND METHODS

Study Area

The study was conducted in Edo State, Nigeria. It lies within Latitudes 4° 45´ and 7° 40' North of the Equator and Longitudes 5° and 6° 45' East of Greenwich meridian. It has boundaries with Kogi in the North, Delta in the South, Ondo in the West and, Anambra in the East. It occupies a total land area of 19,794 Km^2 with a population of 3,218,332 million people (National Population Commission, NPC, 2006). The State has 18 Local Government Areas delineated into three senatorial districts. The traditional cuisine in Edo State is fairly representative of what obtains in most southern States of Nigeria. Pounded yam or *eba* are eaten with vegetable, melon or okra soups cooked with bush meat, beef or fish. The target population for the study was household food consumers who live in the urban centres. The study spanned through the period of November 2017- April 2018. The study considered the same food commodities as in Ojogho and Ojo (2017b).

Experimental Design

A multistage sampling procedure was employed for the study. The first stage involved simple random sample of one Local Government Area (LGA) from each of the three senatorial district of the state. The LGAs were Oredo in Edo-south, Esan-west in Edo central and Etsako-west in Edo-north. The second stage involved a purposive sample of a headquarters of the LGA as proxy for urban centres with Benin City for Oredo, Ekpoma for Esan-west and Auchi for Etsako-west. The third stage involved a simple random sample of two wards each from the headquarters. The sample size for the study in each ward was determined using the sample-size estimator as used by Ojogho and Ojo (2017a), given estimates of the expenditure variance for each ward, from a pilot survey, at 95% confidence interval and a 0.03 margin of error. The sample-size estimator is given as:

$$n_i = \frac{z^2_{\alpha/2} s^2_i}{e^2 + \frac{z^2_{\alpha/2} s^2_i}{N_i}} \quad \text{......... [1]}$$

Where:

$z_{0.025} = 1.96$, s^2_i is the expenditure variance of the i^{th} ward, N_i is the target population of the i^{th} ward and $e = 0.03$.

A simple random sample of households in each ward was then taken from the list of the target population in the region developed from the pilot survey. Using the estimator, 100 households were sampled from Edo-south, 75 households from Edo-central and 84 households from Edo-north out of a target population of 120, 80 and 100 households respectively. However, 252 households provided useful information for the analysis as only data from 6 or more in 10 respondents who consumed food commodities under study were used in the final analysis in order to avoid inclusion of household with zero consumption. The prices of food commodities were measured as the sum of the transactions costs incurred by a household and the retail prices in ₦/Kg, while the quantity consumed of food commodities by a household was the quantities purchased at market price per Kg as at 2018.

Model Specification

The study used the Quadratic Almost Ideal Demand System (QUAIDS) of Banks *et al.* (1997) to estimate a complete food demand system in the study area. The QUAIDS model is given, in its budget share form, as:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_j \left[\ln \frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)} \left[\ln \frac{m}{a(p)}\right]^2 \quad \text{......[2]}$$

Where w_i is the share of expenditure, m is total expenditure, p_j is price of j^{th} commodity, $a(p)$ is a price index, homogenous of degree one in prices, defined as $\ln a(p) = \alpha_0 + \sum_{i=1}^{k} \alpha_i \ln p_i + \frac{1}{2}\sum_{i=1}^{k}\sum_{i=1}^{k} \gamma_{ij} \ln p_i \ln p_j$, $b(p)$ defined as $b(p) = \prod_{i=1}^{k} p_i^{\beta_i}$ is a function that is homogenous of degree zero in prices, n is the number of goods entering the demand model, p is a vector of prices and α, β and λ are parameters to be estimated.

An error term ϵ_i was added to the right-hand side of [2] for estimation purposes. In addition, $\epsilon \equiv [\epsilon_1, \epsilon_2, ..., \epsilon_k]$ was assumed to have a multivariate normal distribution with covariance matrix Σ. However, the adding-up condition implies that Σ is singular. Therefore, one of the *K*-demand equations is dropped from the system with the remaining (*K*−1) equations estimated by maximum likelihood, while the parameters of the dropped equation are recovered using the regularity conditions. There are several conditions which have to hold for the model to be consistent.

The regularity conditions of adding-up, homogeneity and symmetry were imposed so that the resulting model agrees with the theory of utility maximization.

Adding up

$\sum_{i=1}^{k} \alpha_i = 1$, $\sum_{i=1}^{k} \beta_i = 0$, $\sum_{i=1}^{k} \lambda_i = 0$, and $\sum_{i=1}^{k} \gamma_{ij} = 0, \ \forall j$

Homogeneity

$\sum_{j=1}^{k} \gamma_{ij} = 0, \forall j$

Slutsky symmetry

$\gamma_{ij} = \gamma_{ji}, \forall i,j$

The study assumes prices to be fixed, implying that prices are not dependent on the total quantity demanded. This implies that the model is limited from being used on prediction of supply-demand interactions on a market. Furthermore, the study assumed the weak separability between goods included in the model. The study argues that the decision making process on the side of demand is not done by individuals but rather by the household as a whole. This can be a single person in case of single households but usually it is done by one of the parents or one of the couple hereafter called household head. Moreover, household is considered to be the best option of a unit for demand analysis. The study assumes that there is an additive zero-mean error term associated with each of the *k* expenditure share equations.

The raw estimated parameters are very hard to interpret. Thus, income and price elasticities are reported. To achieve this, the geometric means of the price and expenditure variables were first computed and then the elasticities of the price and conditional income elasticities were computed at their geometric means. The uncompensated own- and cross-price elasticites were estimated using:

$\varepsilon_{ij}^{m} = -\partial_{ij} + \frac{\mu_{ij}}{w_i}$ …….. [3]

Compensated own- and cross-price elasticites were estimated using:

$\varepsilon_{ij}^{h} = \varepsilon_{ij}^{m} + w_j \mu_i$ ……… [4]

Expenditure elasticites were estimated using:

$e_i = 1 + \frac{\mu_i}{w_i}$ …….. [5]

$\mu_i = \beta_i + \frac{2\lambda_i}{b(p)} . \ln\left(\frac{m}{a(p)}\right)$ …… [6]

Where: δ_{ij} is the Kronecker delta, $a(p)$ and $b(p)$ are as defined above, p_k is the price of the *k*th commodity. A commodity was then considered substitute if $\varepsilon_{ij}^{m} > 0, \forall i \neq j$ and complement if $\varepsilon_{ij}^{h} < 0, \forall i \neq j$.

The sensitivity of expenditure share with conditional income was determined using:

$\frac{d\omega_i}{dm} = \left(\frac{\omega_i}{m}\right)[\eta_i - 1]$ .... [8]

RESULTS

Table 1 presents the summary statistics of the variables used in the QUAIDS model. Table 1 also contains the food budget shares, and the proportions of total consumption devoted to food. The results show that in the broad categories of household expenditure, the monthly per *capita* expenditure on food was highest, representing 35% of the total monthly per *capita* expenditure of the household heads in Edo state. The per *capita* expenditure on education was highest after food, followed by *others*, housing, clothing and then health with respective budget share of 0.21, 0.15, 0.12, 0.11 and 0.07. The budget share of the total expenditure on food allocated to the eleven (11) food items consumed by households in the study area, including expenditure per *capita* on each food item is also presented in Table 1. Result shows that, of all the food items, rice has the highest budget share

(0.19) with average expenditure of ₦ 1182.47 followed by meat (0.16) and fish (0.12) at average expenditures of ₦ 995.76 and ₦ 746.82 respectively. Of the expenditure on food, 57% was expended on starchy staples with rice having the highest budget share (0.19) representing 0.12 of the total expenditure on food. This is closely followed by yam (0.06) and *garri* (0.06) and least with potatoes. Households expend 39% of the total food expenditure on meat, fish and bean representing 0.14, 0.11, 0.10 of the total food expenditure. Tomatoes and pepper representing 24% and 12% respectively of the total expenditure on food, considered as vegetables, had about 12% of the total food expenditure by households in Edo State.

Table 1: Summary Statistics of Variables in the QUAIDS Model

Household Commodities			**Food Expenditure Pattern**			**Food commodities**	
Variables	**Expenditure (₦)**	**Budget share (ω)**	**Variables**	**Expenditure (₦)**	**Budget share (ω)**	**Variables**	**Mean**
Food	6223.51	0.35	Plantain	435.65	0.07	Lnppl	4.68
Education	4390.04	0.21	*Garri*	622.35	0.10	Lnpg	5.43
Housing	2370.89	0.12	Rice	1182.47	0.19	lnpr	5.94
Health	1294.02	0.07	Yam	622.35	0.10	Lnpy	5.17
Clothing	2169.14	0.11	Potato	248.94	0.04	Lnppot	4.77
Others	3129.04	0.15	*Fufu*	435.65	0.07	Lnpfu	6.04
			Tomato	497.88	0.08	Lnpb	6.04
			Pepper	248.94	0.04	lnpto	5.21
			Meat	995.76	0.16	lnppe	6.40
			Fish	746.82	0.12	Lnpme	7.13
			Beans	684.59	0.11	Lnpfi	6.64

The resulting coefficients and their associated standard error from the last iteration of the QUAIDS model are presented in Table 2. The squared log expenditure coefficient are very low for all the equations especially *fufu* where it is below 0.0003 with the highest but still low value of 0.012 and 0.014 ended up for *garri* and meat respectively. The coefficients of at most seven of the variables are statistically significant for at least one food commodity equation. The price variables are less statistically significant then the income variables. Also, own-prices effects are statistically significant for only one commodity. The non-squared term of the log expenditure is significant for three of the commodities. The squared term is also significant for three commodities, *garri*, yam and meat. The resulting Engle curves of *garri*, yam and meat are, therefore, non-linear. Only meat exhibits the inverse hump-shaped Engle curve as the coefficient at the log expenditure squared is negative, the other two exhibit hump-shaped Engle curve as their share increase more with more conditional income.

Table 2: Parameter Estimates of the QUAIDS Model and Associated Standard Errors

Parameter	Plantain i =1	Garri i =2	Rice i =3	Yam i =4	Potatoe i =5	Fufu i =6	Beans i =7	Tomatoe i =8	Pepper i =9	Meat i =10	Fish i =11
α_i	0.130	0.386***	0.107	-0.322***	0.104	0.026	0.117	0.008	-0.028	0.496**	-0.024
	(0.121)	(0.135)	(0.182)	(0.073)	(0.092)	(0.148)	(0.163)	(0.133)	(0.065)	(0.125)	(0.188)
β_i	0.021	0.121**	-0.020	-0.177***	0.021	-0.008	0.015	-0.031	-0.023	0.144***	-0.063
	(0.049)	(0.052)	(0.076)	(0.025)	(0.038)	(0.063)	(0.069)	(0.056)	(0.028)	(0.054)	(0.076)
λ_i	0.003	0.012**	-0.003	-0.018***	0.002	0.0002	0.001	-0.002	-0.002	0.014**	-0.007
	(0.005)	(0.005)	(0.008)	(0.003)	(0.004)	(0.007)	(0.007)	(0.006)	(0.003)	(0.006)	(0.008)
γ_{1i}	0.011	0.008	-0.010	-0.010	0.003	0.001	-0.007	0.004	-0.006	0.005	0.001
	(0.010)	(0.017)	(0.009)	(0.025)	(0.005)	(0.006)	(0.008)	(0.007)	(0.004)	(0.019)	(0.012)
γ_{2i}	0.008	0.036	0.004	-0.060**	0.007	-0.001	0.006	-0.007	-0.011	0.040*	-0.015
	(0.017)	(0.038)	(0.028)	(0.029)	(0.014)	(0.022)	(0.025)	(0.021)	(0.010)	(0.025)	(0.030)
γ_{3i}	-0.010	-0.004	-0.003	-0.001	0.004	0.016**	0.009	-0.016*	-0.003	0.001	0.007
	(0.009)	(0.028)	(0.015)	(0.039)	(0.007)	(0.008)	(0.010)	(0.010)	(0.006)	(0.031)	(0.025)
γ_{4i}	-0.010	-0.060**	-0.001	0.087***	-0.009	0.001	-0.001	0.016	0.011	-0.074***	0.040
	(0.025)	(0.029)	(0.039)	(0.030)	(0.020)	(0.032)	(0.036)	(0.030)	(0.015)	(0.028)	(0.039)
γ_{5i}	0.003	0.007	0.004	-0.009	0.002	0.002	-0.014**	0.006	0.002	0.005	-0.008
	(0.005)	(0.014)	(0.007)	(0.020)	(0.007)	(0.005)	(0.007)	(0.007)	(0.004)	(0.015)	(0.010)
γ_{6i}	0.001	-0.001	0.016**	0.001	0.002	-0.011	-0.008	0.001	0.002	0.002	-0.004
	(0.006)	(0.022)	(0.008)	(0.032)	(0.005)	(0.008)	(0.007)	(0.007)	(0.005)	(0.025)	(0.013)
γ_{7i}	-0.007	0.006	0.009	-0.001	-0.014^{5}	-0.008	0.016	-0.001	0.001	0.011	-0.013
	(0.008)	(0.025)	(0.010)	(0.036)	(0.007)	(0.007)	(0.014)	(0.010)	(0.006)	(0.027)	(0.016)
γ_{8i}	0.004	-0.007	-0.016*	0.016	0.006	0.001	-0.001	0.006	0.008	-0.021	0.005
	(0.007)	(0.021)	(0.010)	(0.030)	(0.007)	(0.007)	(0.010)	(0.012)	(0.006)	(0.023)	(0.013)
γ_{9i}	-0.006	-0.011	-0.003	0.011	0.002	0.002	0.001	0.008	0.003	-0.011	0.004
	(0.004)	(0.010)	(0.006)	(0.015)	(0.004)	(0.005)	(0.006)	(0.006)	(0.004)	(0.012)	(0.007)
γ_{10i}	0.005	0.040*	0.001	-0.074***	0.005	0.002	0.011	-0.021	-0.011	0.059	-0.017
	(0.019)	(0.025)	(0.031)	(0.028)	(0.015)	(0.025)	(0.027)	(0.023)	(0.012)	(0.043)	(0.032)
γ_{11i}	0.001	-0.015	0.007	0.040	-0.008	-0.004	-0.013	0.005	0.004	-0.017	-0.001
	(0.012)	(0.030)	(0.025)	(0.039)	(0.010)	(0.013)	(0.016)	(0.013)	(0.007)	(0.032)	(0.029)

****significant at 1%, **significant at 5%, *significant at 10%*

The resulting income elasticities can be seen in Table 3. All conditional income elasticities are significant at 1% level of significance. The conditional income elasticities of plantain, yam, *fufu*, tomatoes, pepper and fish were less than 1 with *fufu* being the least elastic. The expenditure coefficient for plantain, yam *fufu*, tomatoes, pepper and fish indicate that 1% increase in all expenditure leads to a rise in demand for plantain, yam, *fufu*, tomatoes, pepper and fish by about 0.0.942%, 0.902%, 0.827%, 0.865%, 0.832%, and 0.973% respectively on average. The demand for plantain, yam, *fufu*, tomatoes, pepper and fish has negative sensitivity with income. Beans and meat had expenditure elasticities of 1.020 and meat 1.156 respectively in the protein food category in the study area with meat having the highest elasticity. Similarly, potatoes (1.101), *garri* (1.087) and rice (1.027) had expenditure elasticities of 1.101, 1.087 and 1.027 respectively in the study area with potatoes having the highest elasticities among the carbohydrate food commodities. *Garri*, potatoes, rice, beans and meat budget share were positively sensitive to expenditure.

Table 3: Expenditure Elasticity Coefficient Estimates and Share-Expenditure Sensitivity for a typical Household in Edo State

Variable	Elasticity	Standard error	Minimum	Maximum	Expenditure	Budget share	Share-expenditure sensitivity
Plantain	0.942	0.047	0.719	1.061	435.65	0.07	-
Garri	1.087	0.134	0.691	1.762	622.35	0.10	+
Rice	1.027	0.016	0.988	1.125	1182.47	0.19	+
Yam	0.902	0.183	0.141	1.691	622.35	0.10	-
Potatoes	1.101	0.066	0.957	1.329	248.94	0.04	+
Fufu	0.827	0.089	0.233	0.970	435.65	0.07	-
Beans	1.020	0.016	0.987	1.119	684.59	0.11	+
Tomatoes	0.865	0.067	0.549	0.969	497.88	0.08	-
Pepper	0.832	0.101	0.363	0.984	248.94	0.04	-
Meat	1.156	0.111	0.913	1.852	995.76	0.16	+
Fish	0.973	0.054	0.794	1.186	746.82	0.12	-

$^{+}$ *increasing budget share with rising conditional income,* $^{-}$ *increasing budget share with rising conditional income*

The results of the Mashellian own- and cross-price elasticities are presented in Table 4. The own-price elasticities of the demand for *garri*, rice, *fufu*, meat and fish were -1.041, -1.029, 1.174, 1.007 and fish 1.085. The second set of parameter in Table 4 is the uncompensated cross-price elasticity coefficients. Complementary dependence was observed between plantain and bean (-0.102), plantain and beans (-0.102), rice and tomatoes (-0.102), beans and potatoes (-0.144), beans and fish (-0.103), and potatoes and fish (-0.126). Similarly, strong substitute relation was observed between *fufu* and rice (0.275) in the State.

Table 4: Uncompensated Own- and Cross-price Elasticity Coefficient Estimates for a typical Household in Edo State

Food item	Plantain	Garri	Rice	Yam	Potatoe	Fufu	Beans	Tomatoe	Pepper	Meat	Fish
Plantain	-0.860	0.022	-0.112	0.016	0.023	0.017	-0.102	0.085	-0.063	-0.041	0.065
Garri	0.008	-1.041	0.010	-0.036	0.005	0.017	0.004	0.030	-0.039	-0.088	0.056
Rice	-0.048	0.009	-1.029	-0.058	0.026	0.088	0.052	-0.102	-0.027	0.044	0.018
Yam	0.015	-0.020	-0.089	-0.961	0.014	-0.029	0.069	0.014	0.002	-0.041	0.118
Potatoes	0.034	0.012	0.120	0.019	-0.987	0.050	-0.411	0.201	0.089	-0.087	-0.126
Fufu	0.025	0.043	0.275	-0.037	0.036	-1.174	-0.106	0.017	0.024	0.097	-0.062
Beans	-0.074	0.009	0.093	0.053	-0.144	-0.077	-0.854	0.006	0.022	0.050	-0.103
Tomatoes	0.087	0.056	-0.230	0.021	0.110	0.014	0.023	-0.946	0.085	-0.106	0.007
Pepper	-0.120	-0.083	-0.108	0.010	0.102	0.044	0.081	0.176	-0.942	-0.022	0.003
Meat	-0.032	-0.060	0.033	-0.048	-0.023	0.025	0.022	-0.070	-0.015	-1.007	0.035
Fish	0.038	0.054	0.038	0.092	-0.036	-0.043	-0.088	-0.003	-0.003	0.070	-1.095

Table 5 shows the compensated own- and cross-price elasticities of a typical household in Edo State based on the QUAIDS model. The own-price elasticity coefficient for plantain, *garri*, rice, yam, potatoes, beans, tomatoes, pepper, meat and fish were respectively -0.795, -0.943, -0.846, -0.876, -0.948, -0.751, -0.883, -0.912, -0.838, and -0.985 while that of *fufu* was -1,118. Only for *fufu* was the elasticity coefficient greater than one in absolute term.

Table 5: Compensated Own- and Cross-price Elasticity Coefficient Estimates for a typical Household in Edo State

Food item	Plantain	Garri	Rice	Yam	Potatoe	Fufu	Beans	Tomatoe	Pepper	Meat	Fish
Plantain	-0.795	0.109	0.058	0.105	0.057	0.078	-0.005	0.153	-0.030	0.099	0.172
Garri	0.082	-0.943	0.201	0.065	0.044	0.086	0.113	0.106	-0.002	0.070	0.177
Rice	0.022	0.103	-0.846	0.038	0.064	0.154	0.156	-0.029	0.009	0.195	0.134
Yam	0.077	0.063	0.073	-0.876	0.047	0.030	0.161	0.078	0.033	0.093	0.221
Potatoes	0.109	0.111	0.314	0.121	-0.948	0.119	-0.301	0.278	0.127	0.073	-0.003
Fufu	0.084	0.122	0.429	0.043	0.067	-1.118	-0.018	0.079	0.053	0.224	0.035
Beans	-0.004	0.101	0.275	0.149	-0.107	-0.012	-0.751	0.079	0.057	0.200	0.012
Tomatoes	0.148	0.136	-0.073	0.103	0.142	0.071	0.112	-0.883	0.115	0.023	0.106
Pepper	-0.061	-0.005	0.046	0.090	0.133	0.100	0.169	0.237	-0.912	0.104	0.100
Meat	0.046	0.043	0.237	0.059	0.018	0.098	0.138	0.011	0.024	-0.838	0.164
Fish	0.105	0.143	0.212	0.183	-0.001	0.020	0.011	0.067	0.031	0.214	-0.985

DISCUSSION

The results in Table 1 showed that food category takes the largest share in the expenditure of a typical household in Edo State. The important food items in the food budget of households in the region are rice, *garri*, and potatoes in the carbohydrate category, meat, fish and beans in the protein category, tomatoes and pepper considered as vegetables. Thus, in this sense, the budgets of the households tend to be food-intensive. Relatedly, within the food budget, starchy foods such as rice, potatoes, and *garri* are predominant for the households, suggesting less nutritious, less diversified diets.

The resulting coefficients and their associated standard error of the QUAIDS model presented in Table 2 showed that the squared log expenditure coefficient are very low for all the equations especially *fufu*, *garri* and meat. The price variables are less statistically significant than the income variables, which imply low variations in food prices during the study period. The squared term of the log expenditure is significant for three commodities while the resulting Engle curves of *garri*, yam and meat are non-linear. These results support the use of the QUAIDS model against the AIDS. Only meat exhibits the inverse hump-shaped Engle curve as the coefficient at the log expenditure squared is negative, the other two exhibit hump-shaped Engle curve as their share increase more with more conditional expenditure. This implies that these food commodities can change from being necessities (luxury) to luxury food commodities (necessities) with increase (decrease) in conditional food expenditure.

The results of income elasticities are presented in Table 3. The expenditure coefficients for plantain, yam, *fufu*, tomatoe, pepper and fish indicate that a 1% increase in all expenditure leads to a less than proportionate rise in demand for plantain, yam, *fufu*, tomatoe, pepper and fish on average, *ceteris paribus*. Plantain, yam, *fufu*, tomatoe, pepper and fish are, thus, considered normal necessary food commodities in the state. This implies that the demand for Plantain, yam, *fufu*, tomatoe, pepper and fish increases with income, but their budget share decreases with increase in income. None of the food commodities turn out to be inferior good (negative income elasticity). Potatoes and meat are luxury food commodities in the study area. Also, the demand for beans and meat is highly sensitive to any change in income with their budget shares increasing with income. Contrary to expectation, potatoe, *garri* and rice are luxury food commodities among the carbohydrate food commodities. The results differ slightly from Ojogho and Ojo (2017b).

The difference may be due to the included quadratic term of the log expenditure square that allows the hump-shaped relationships observed for certain goods, including several food items. This is different from the built-in assumption in AIDS, LA/AIDS and LES used in previous studies (Ojogho & Alufohai, 2010; Ojogho & Ojo, 2017 a, b), where the hump-shaped relationships observed for certain goods, including several food items, are ruled out. However, it should be noted that those studies also built models for other households, and any comparisons warrant caution.

The results of the Mashellian own- and cross-price elasticities are presented in Table 4. The results show that the own-price elasticities of food commodities in the State are negative for all commodities, as expected. Based on the size of the own-price elasticities, the demand for *garri*, rice, *fufu*, meat and fish are among the most affected by changes in their own prices while plantain is the least affected by change in its own price in the area. The second set of parameter in Table 4 is the uncompensated cross-price elasticity coefficients. Most of the uncompensated cross-price elasticity coefficients were small. This implies that there is no strong dependence among majority of the food commodities in Edo State. However, complementary dependence was observed between plantain and bean, plantain and rice, rice and tomatoes, tomatoes and fish, *fufu* and beans, bean and potatoes, beans and fish. Households in Edo state take any of plantain and bean, plantain and rice, rice and tomatoes, tomatoes and fish, *fufu* and beans, bean and potatoes, beans and fish in a meal containing either of the pair of food commodities. In contrast, a substitute relation was also observed only between *fufu* and rice in the State.

Table 5 shows the compensated own- and cross-price elasticities of a typical household in Edo State based on the QUAIDS model. The results show that the compensated own-price elasticities for all food commodities are non-positive which is in line with economic theory. The own-price elasticity coefficient for all food commodities were less than one in absolute term, except for *fufu*. This means that demand for these food commodities was inelastic For *fufu*, the elasticity coefficient was greater than one in absolute term, which means that the demand was elastic. One percent increase in the price of *fufu* causes a drop in demand by 1.118% on average (*ceteris paribus*). The second set of parameter in Table 5 is the compensated cross-price elasticity coefficients. Most of the compensated cross-price elasticity coefficients analyzed were small, which means that there is no strong dependence between the food commodities. However, complementary dependence was observed among tomatoe and rice, pepper and plantain, pepper and *garri*, bean and *fufu*, beans and potatoe, fish and potatoe, and tomatoe and fish. In contrast, a substitute relation was observed between other pairs of food commodities in the State.

CONCLUSION

The study estimated a complete food demand system and estimated the price and conditional income elasticites of food demand on micro-data from 252 household using the Quadratic Almost Ideal Demand System (QUAIDS) model. Households spend more than half of their conditional expenditure on starchy staple foods which are price inelastic, having inverse relationship with price but with no strong complementarity and substitutability among the food commodities in Edo State. The demand for some food commodities, like plantain, yam, tomatoes, pepper, fish and *garri*, in Edo State follows the 'hump-shaped' demand-income relationship.

REFERENCES

Adebamiji A. and Omotola O. (2009) Economic analysis of consumption of fresh and processed fruit in Bowen University Iwo, Osun State, Nigeria. *International NGO Journal* Vol. 4 (6), pp. 318-323, June, 2009

Agbola, F. W., Maitra, P., and McLaren, K. R. (2002). *The Analysis Of Consumer Demand For Food In South Africa Using An Almost Ideal Demand System: Some Preliminary Results.* No 125047, 2002 Conference (46th), February 13-15, 2002, Canberra, Australia from Australian Agricultural and Resource Economics Society

Andrieu, E., Darmon, N. and Drewnowski, A. (2006). Low-cost Diets: More Energy, Fewer Nutrients. *European Journal of Clinical Nutrition,* 60:434-436.

Anwarul Huq, A. S. M., and Arshad, F. M. (2010). Supply response of potato in Bangladesh: A vector error correction approach. *Journal of Applied Sciences* 10*(11)*: 895-902.

Ard, J. D., Fitzpatrick, S., Desmond, R. A., Sutton, B. S., Pisu, M., Allison, D. B., Franklin, F. and Baskin, M. L. (2007). The Impact of Cost on the Availability of Fruits and Vegetables in the Homes of Schoolchildren in Birmingham, Alabama. *American Journal of Public Health*, 97*(2)*: 367-372.

Banks, J., Blundell, R and Lewbel. A (1997). Quadratic Engel curves and Consumer Demand. *Review of Economics and Statistics* 69: 527–539.

Bowman, S. A. (2006). A Comparison of the Socioeconomic Characteristics, Dietary Practices, and Health Status of Women Food Shoppers with Different Food Price Attitudes. *Nutrition Research*, 26:318-324.

Cassady, D., Jetter, K. M. and Culp, J. (2007). Is Price a Barrier to Eating more Fruits and Vegetables for Low-income Families? *Journal of American Dietic Association*, 107: 1909-1915.

Chen, M. F. (2007). Consumer Attitudes and Purchase Intentions in Relation to Organic Foods in Taiwan: Moderating Effects of Food-related Personality Traits. *Food Quality and Preference*, 18:1008-1021.

Claro, R. M., Carmo, H. C. E., Machado, F. M. S., and Monteiro, C. A. (2007). Income, food prices, and participation of fruit and vegetables in the diet. *Revista de Saúde Pública*, 41*(4):* 557-564.

Crawford, I., Laisney, F., and Preston, I. (2003): Estimation of Household Demand Systems with Theoretically Compatible Engel Curves and Unit Value Specifications. *Journal of Econometrics*, 114 *(2)*:221–241.

Dallongeville J, Dauchet L, de Mouzon O, Réquillart V, and Soler L. G. (2011). Increasing fruit and vegetable consumption: a cost-effectiveness analysis of public policies. *European Journal of Public Health*, 21*(1)*:69-73.

Drewnowski, A., Darmon, N. and Briend, A. (2004). Replacing Fats and Sweets with Vegetables and Fruits – A Question of Cots. *American Journal of Public Health*, 94 *(9)*: 1555-1559.

Janda, K., Mikol´A SEK, J., and Netuka, M. (2009): The Estimation of Complete Almost Ideal Demand System from Czech Household Budget Survey Data." Working Papers IES 2009/31, Charles University Prague, Faculty of Social Sciences, Institute of Economic Studies.

Marie, T., Ruel, Nicholas, M., and Lisa, S. (2004). Pattern and determinants of fruit and vegetable consumption in sub saharan Africa. Background paper for the joint FAO/WHO workshop on fruit and vegetables for health 1-3 September 2004, kobe, Japan.

McEachern, M. G. and Schröder, M. J. A. (2002). The Role of Lifestock Production Ethics in Consumer Values towards Meat. *Journal of Agricultural and Environmental Ethics*, 15*(2)*: 221-237.

Mergenthaler, Marcus and Weinberger, Katinka & Qaim, Matin. (2009). Consumer Valuation of Food Quality and Food Safety Attributes in Vietnam. *Review of Agricultural Economics*. 31. 266-283. 10.2307/30224861. Naanwaab and Yeboah (2012), Demand for Fresh Vegetables in the United States: 1970-2010. *Hindawi Publishing Corporation Economics Research International*.

National Population Commission (NPC), (2006). Provisional Results, Abuja, Nigeria.http://www.Population.gov.ng/index .php? Option=com_content& view =article & id= 89.

Niu, L., and Wohlgenant, M. K. (2013). *Subsidizing Fruits and Vegetables by Income Group: A Two-Stage Budgeting Approach.*Agricultural and Applied Economics Association (AAEA) > 2013 Annual Meeting, August 4-6, 2013, Washington, D.C.

Ogundari and Arifalo (2013). Determinants of Household Demand for Fresh Fruit and

Vegetable in Nigeria: A Double Hurdle Approach. *Quarterly Journal of International Agriculture* 52 (3), 199-216.

Ogunniyi, L.T., Oladejo, J.A. and Olawuyi, S.O (2012) Households Demand Analysis for Processed Fruits In Abeokuta Metropolis of Ogun State, Nigeria. *Production Agriculture and Technology* December, 2012; 8 (2): 25-36

Ojogho, O. and Alufohai, G. O. (2010). Impact of Price and Total Expenditure on Food Demand in South-western Nigeria, *African Journal of Food, Agriculture, Nutrition and Development,* 10*(11)*: 4350-4363

Ojogho, O. and Ojo, M. P. (2017a). Impact of Food Prices on the Welfare of Rural Households in South-Eastern Nigeria, *Applied Tropical Agriculture,* 22*(1)*: 142-148.

Ojogho, O. and Ojo, M. P. (2017b). Linear Approximate Almost Ideal Demand System of Food Consumers Behaviour towards Price and Income in South-eastern Nigeria. *International Journal of Agricultural Economics and Rural Development*, 9*(1)*: 33-40

Rattiya Suddeephong Lippe, Somporn Isvilanonda, Holger Seeben and Matin Qaim. (2010). Food Demand Elasticities among Urban Households in Thailand. *Thammasat Economic Journal*, 28(2).

Verbeke, W. and Vackier, I. (2005). Individual Determinants of Fish Consumption: Application of the Theory of Planned Behaviour. *Appetite*, 44:67-82.