Determinants of Household Demand for Fresh Fruit and Vegetable in Nigeria: A Double Hurdle Approach

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Abstract

The study investigates separately demand characteristics of consuming healthy food such as fresh fruit and vegetable (FV) based on the 2003/2004 Nigeria Living Standard Survey (NLSS) data. It uses the double-hurdle model that allows the analysis of both the decisions to consume and the demand for FV to differ. The empirical results show that an average household in the sample considered the demand for FV to be luxury good. But a closer look at the results across income groups show that households in the low and high-income groups considered the demand for fresh fruit to be necessity and luxury goods, respectively, while all households irrespective of which income groups they belong considered the demand for fresh vegetable to be luxury good in the study. Our results also imply that the demand for FV is higher among households with younger members, compared to households with older members. Regional differences in the demand for FV are also evident in the study.

Keywords: fruits, vegetable, double hurdle model, income elasticity, income groups, Nigeria
JEL: Q50, D11, D12, Q18

1 Introduction

The consumption of fruits and vegetables are not only rich in vitamins, minerals, and dietary fiber, they are also low in calorie required for the normal functioning of human body (UUSIKU et al., 2010). The micronutrients supply by fruits and vegetables are also vital for the optimal functioning of the gastro-intestinal tract as they also enable the body to use other nutrients required for its normal function like energy from fats and carbohydrate (NAYGA, 1995; BANWAT et al., 2012). However, increase in consumption of these food items have been associated with reduced risk of health conditions/

non-communicable diseases such as obesity, diabetes, cancer, and cardiovascular disease globally (WHO, 2004; BAZZANO, 2006; TOHILL et al., 2004; ISHDORG et al., 2013).

As pointed out by BANWAT et al. (2012) and MENG et al. (2013), the scientific linkage between food consume and human health is well establish in the literature. For example, the worldwide mortality attributable to insufficient fruit and vegetable intake is estimated at about 2.7 million per year and from chronic diseases is about 11% (KAMGA et al., 2013). Likewise, the high prevalence of micronutrient deficiencies in developing countries has been attributed to the low knowledge of nutritional value of the fruits and vegetables as well as their low consumption (BANWAT et al., 2012). Given this, the consumption of food rich in low fat content and high fiber contents such as fruits and vegetables with regular exercises has been recommended as important step to maintain healthy living in the literature.

Most of the published studies on the determinants of food demand have always focused on the role of income and prices across the globe (GALLET, 2010), while a very few has investigated specifically the demand characteristics (including economic and non-economic factors) of healthy food such as fruit and vegetable (see; MENG et al., 2013; NIU and WOHLGENANT, 2013; DUNN et al., 2012; and DURHAM and EALES, 2006). The implication of this observation is that there are limited number of studies that have investigated or shed light on demand characteristics of household consumption of fresh fruits and vegetables globally and in particular sub Saharan Africa (SSA). Given the importance of fruit and vegetable to human survival, the present study extends the frontier of literature on household food demand by investigating separately the determinants of household demand for fresh fruit and fresh vegetable in Nigeria.

In Nigeria, consumption of fruits such as banana, apples, orange, grape, pear and lemon and vegetables such as tomato, pepper, eggplant, lettuce, cucumber, garlic, carrot and cabbage are undoubtedly common in the household food basket. As noted by KAMGA et al. (2013), Nigeria is the largest consumer of vegetable in SSA with about 61.31g/capita/day. Nevertheless, there is discussion in some quarters that consumption of fruit and vegetable is still below dietary recommendation in the country. For example, BANWAT et al. (2012) based on WHO recommendation observe that adequate fruit and vegetable entails a consumption of at least 400g of fruits and vegetables per day per capita globally. Given this, a good knowledge of household demand characteristics of fruit and vegetable consumption may help policy makers address the concern of low consumption of these food items in Nigeria. However, this is very important because without a clear understanding of defining characteristics of poor and malnourished in Nigeria, studies have shown that the country will be unable to achieve the Millennium Development Goals of reducing poverty and food insecurity (see for detail; IFPRI, 2008). This observation also motivated the present study.

The rest of the paper is organized as follows. Section 2 describes the data and sources of zero expenditure problem in the survey data. Conceptual framework and empirical model is presented in section 3. Section 4 contains results and discussion, while summary and conclusions are presented in section 5.

2 The Data and Sources of Zero Expenditure in Survey Data

The data used in the present study were obtained from the 2003/2004 Nigeria Living Standards Survey (NLSS) conducted by the Nigeria Bureau of Statistics (NBS). A two-stage stratified random sampling technique was used in the NLSS to sample the households. In the first-stage, a cluster of housing units called the Enumeration Area (EA) was selected, while the second-stage involved the random selection of housing units within the clusters.

The households were interviewed through questionnaire that gathered information on households' demographic variables and expenditure on different food items including fresh fruits and vegetables. Non-food expenditures such as clothing, education, health, housing, e.t.c., were also collected. Thus, there were seven interviewers visit to each selected household at a minimum of four-day interval in a cycle of 30 days. Although, the NLSS data contains information on 19,158 households, we employed 18,883, as 275 households were deleted as a result of incomplete information. Detail definition and summary statistics of the variables from the NLSS data are provided in Table 1.

However, a major challenge associated with using survey data to analyze household demand is the fact that a nontrivial portion of the data often reports zero expenditures. In this case, we observe that about 66% and 10% of the expenditure on fruit and vegetable, respectively is censored. The implication of this is that using Ordinary Least Square (OLS) techniques, which only takes into account positive expenditure values for the analysis, while neglecting the zero outcomes can lead to bias results (MADDALA, 1983). Thus, we employ a double hurdle model, to accounts for the censoring of the data by correcting for selection bias associated with the zero expenditure.

3 Theoretical Framework and Empirical Model

3.1 Theoretical Framework

Given the censored nature of the data, the study is designed to employ discrete random utility theory (PUDNEY, 1989), such that household is assumed to maximize the random utility (U) subject to a budget constraint m as

(1a) $$U = \underset{\max\ c_f,\, c_{nf}}{u} \left(\left(D_{c_f}, C_{nf}; Z \right) \middle| m \right)$$

But $m = P_f'.C_f + C_{nf}$

where $C_f = \left[C_{f1}, ...C_{fn} \right]'$ is the vector of food consumed with positive prices $P_f = \left[P_{f1}, ...P_{fn} \right]'$, C_{nf} is a composite non-food commodity in the household budget with price normalized at unity, Z is a vector of household demographic variables, $D = diag\left(d_1, ...d_n \right)$ is diagonal matrix with each binary variable d_n indicating if an household in the sample is a consumer of C_f .

Furthermore, it is necessary to assume that $u\left(D_{c_f}, C_{nf}; Z \right)$ is a regular strictly quasi-concave w.r.t positive element of D_{c_f} and C_{nf}. Given this, optimization of equation 1a gives optimal demand C_f^* without a non-negative constraint, which motivate specification of household demand for food as

(1b) $$C_f^* = Z'\beta + \nu_i$$

where, Z' is the household socio-economic variable, which also include dummy representing the sector (i.e., rural vs. urban) and regions in the country, β is the parameters to be estimated and ν_i is the error term for the regression.[1]

But in case the household is a potential consumer of C_f and due to economic reason could not consume the item, then optimum demand C_f^* occurs in the interior of the choice set that corresponds to $d_n = 1$ and $C_f = 0$ when $d_n = 0$ since price P_f is assumed to be positive. In this case, censoring in C_f is governed by sample selection mechanism (LIU et al., 2013). In addition, TAFERE et al. (2010) identified other sources of zero consumption in household survey, which include permanent zero consumption (or non-consumers) and zero consumption during the survey period. Permanent zero consumption may arise due to non-economic reasons that includes religious beliefs, health considerations and perhaps non-smokers in the case of

[1] It is important to mention here that part of the regional and seasonal variations in expenditure on fresh fruits and vegetables may be associated with price differentials as noted by NAYGA (1995). Unfortunately, prices were not included in the NLSS data. Given this, equation 1b is estimated using Engel curve specification where the price is assumed to be constant.

tobacco. The zero consumption during the survey could be linked to frequency with which households consume the commodities in question such that the survey period is not long enough to capture it. Guided by the suggestion of JONES (1996), we believe censoring in household expenditure on fresh fruit and vegetable is likely to occur other than sample selection bias. And based on this, the study employ CRAGG'S (1971) double hurdle model for the empirical analysis because the methodology by construction is capable of accommodating other sources of zeros other than sample selection bias.

3.2 Empirical Model: *Double Hurdle Model*

The earlier model for estimating censored dependent variable models is the Tobit model originally proposed by TOBIN (1958). CRAGG (1971) argue that Tobit model is restrictive because it assumes the decisions to purchase fruit and vegetable and how much to spend on these food items (i.e., actual consumption) are governed by the same process, which eliminate the assumption that the decisions are made jointly. In realization of the argument that decisions to purchase and how much fruit and vegetable to consume are not governed by the same process; CRAGG proposed a double hurdle (DH) model.

However, a similar model known also as sample selection model was proposed by HECKMAN (1979) and designed for incidental truncation where zero consumption is simply assumed to be unobserved due to selection problem. A typical example of sample selection problem arises when respondents are consumer of a specific product and have zero purchase because they could not purchase the product at current price and income level.

Given this, YEN and JONES (1996), argue that DH model, allows for the possibility of zero observations in the second stage unlike Heckman's selection model by recognizing the fact that zero expenditures is observed and could be due to any or combination of the following factors: (1) random effect (or data reporting problem), (2) the fact that the respondents are simply not interested in consuming fruits/ vegetables or (3) when the survey period is too short to allow consumers to report any purchase of a specific product (infrequency of purchase of products). These observations motivated the use of DH model as against Heckman's selection model for the present study.

A search in literature shows that the methodology has been applied widely in the demand analysis. For example, ASTERI et al. (2005), GROUND and KOCH (2007), and MOSHOESHOE (2012) employed DH in the analysis of demand for beverages. Likewise, GARCIA and LABEAGE (1996) and YEN and JONES (1996) for cigarette

demand, KEELER et al. (2006) and BAI et al. (2012) for food demand and DURHAM and EALES (2006) for the demand for fruit.

Thus, the underlying data generating process (DGP) for DH model specified for the demand for fruit and vegetable in the study can be described using the following two equations:

$$(2) \qquad d_i^* = m_k'\delta + \zeta_i \qquad d_i = \begin{cases} 1 & if \quad d_i^* > 0 \\ 0 & if \quad otherwise \end{cases}$$

$$(3) \qquad e_i^* = x_j'\beta + \tau_i \qquad e_i = \begin{cases} e_i^* & if \quad d_i^* > 0 \; and \; e_i^* > 0 \\ 0 & if \quad otherwise \end{cases}$$

Note: $C_f^* = e_i^*$ and $C_f^* = \left\{Fruit_{\exp}, Vegetable_{\exp}\right\}'$,while $Z = m_k' \,\&\, x_j'$

where, equation 2 represents what CRAGG (1971) refers to as first hurdle model. It relates the individual decision to consume fresh fruit / fresh vegetable denoted by a dummy variable (d) to a vector of exogenous variable m_k', which include household income (proxied by real total expenditure), education of household head, household size, gender and occupation of household head, households within certain age cohorts and locations viz. rural and regions. The d_i^* is the unobserved latent variable which describes whether household consumed fresh fruit/fresh vegetable or not, while d_i is the correspondent observed variable. ζ_i is the error term for equation 2. Equation 3 is the Cragg's second hurdle, where e_i^* is the unobserved latent variable describing household expenditure on fresh fruit/fresh vegetable, while e_i is the corresponding observed expenditure on fresh fruit/fresh vegetable consumed by the households. The x_j' is a vector of determinants of household expenditure on fresh fruit/fresh vegetable similar to m_k' mentioned earlier and τ_i is the error term for the equation 3.[2]

Therefore, the log likelihood for estimating double hurdle with independent error terms for equation 2 and 3 is based on the work of JONES (1992) and this is specified below

$$(4) \qquad LL = \sum_0 \ln\left[1 - \Phi(z\delta)\phi\left(\frac{z'\beta}{\sigma}\right)\right] + \sum_+ \ln\left[\Phi(z\delta)\frac{1}{\sigma}\phi\left(\frac{e_i - z'\beta}{\sigma}\right)\right]$$

[2] The vectors m_k' and x_j' for equations 2 and 3, respectively, are also listed on the first column of Table 1.

where; Φ is the conditional cumulative distribution function *cdf*, ϕ is the probability density function *pdf* and σ representing the standard error of (τ_i) from the second hurdle.

The first part of equation 4 denotes the contribution of all the zero observations. For example, $1-\Phi(z'\delta)$ describes the zero values associated with the first hurdle which can be due to any of the sources of zeros outline in the text. Also, $\phi\left(\frac{z'\beta}{\sigma}\right)$ reflects zeros values that might possibly occur in the second hurdle, which makes double hurdle model different from Heckman's selection model. The second part of equation 4 corresponds to the contribution of all the values indicating positive income.

Estimating average partial effects (APE) of the explanatory variables

Despite its advantages, a major limitation of the DH model is the problem of decomposing the effects of the first hurdle on the second hurdle, when interpreting the results (YEN et al., 1996; GARCIA and LABEAGE, 1996; YEN and JONES, 1996). However, BURKE (2009) shows that one way to understand the overall effect of the explanatory variables in the first and second hurdles is to incorporate the likelihood function and the partial effects of both hurdles, by calculating the average partial effects (APE) of these variables. The modification suggested by BURKE (2009), which can be found in STATA as craggit command, with bootstrapping standard errors, is used in the present study and subsequently discuss below.

From the first hurdle, the probability that the respondents consume fresh fruit (fresh vegetable) or not is represented by

$$(5) \qquad Pr(e_i > 0) = \Phi(m_k'\delta)$$

From the second hurdle, the conditional mean of household expenditure on fruit or vegetable given that the respondents consume these food items is represented by

$$(6) \qquad E(e_i | e_i > 0) = x_j'\beta + \sigma(x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)$$

where, $\phi(m_k'\delta)/\Phi(m_k'\delta)$ is the inverse mills ratio and other parameters are as earlier defined.

Also, from the second hurdle, the unconditional mean of household demand for fruit or vegetable is represented by

$$(7) \qquad E(e_i) = \Phi(m_k'\delta)\left[x_j'\beta + \sigma(x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\right]$$

However, differentiating Equations 5-7 gives the average partial effects (APE) on probability, conditional mean, and unconditional mean of a common element of m_k and x_j (i.e., $m_k = x_j$) defined below:

$$(8) \qquad \partial Pr(e_i > 0)/\partial x_j = \phi(m_k'\delta)\delta_k$$

$$(9) \qquad \partial E(e_i | e_i > 0)/\partial x_j = \beta_j\left[1 - (x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\left\{x_j'\beta/\sigma + (x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\right\}\right]$$

$$(10) \qquad \partial E(e_i)/\partial x_j = \phi(m_k'\delta)\delta_k\left\{x_j'\beta/\sigma + (x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\right\} + \Phi(m_k'\delta)\beta_j\left[1 - (x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\left\{x_j'\beta/\sigma + (x_j'\beta/\sigma)\left(\frac{\phi(m_k'\delta)}{\Phi(m_k'\delta)}\right)\right\}\right]$$

4 Results and Discussion

Before we discuss the empirical results in detail, it is important to mention that we are aware of endogeneity problem of total expenditure taken as a proxy for household income in the study. To this end, we correct the endogeneity problem using income of the household head as instrument following the suggestion of BOPAPE (2006) that income is the best instrument for expenditure.[3] Thus, we regress the income and other variables in Table 1 of the appendix on total expenditure as first stage.[4] Thereafter, we conducted a test to confirm the relevance of the instrument and the result was found to be highly significance with p-value of 0.000. Hence, the predicted fitted value of the instrumented-total expenditure is then used in the final analysis as a proxy for household income in the subsequent analysis.

However, presented in Tables 2A and 2B are the results of the APE of the explanatory variables represented by equations 8, 9, and 10. Because APE of the explanatory variables is viewed as marginal effect, the generalized results of the first and second

[3] The NLSS contains detail information on income of household head as information on income of other members of the households is not provided.

[4] For brevity the result of the first stage regression is not presented and this could be requested from the correspondent author.

hurdles represented by equations 2 and 3, respectively from which the results of the APE were computed are not presented in the interest of brevity in the study. These results can be made available upon request from the correspondent author. Furthermore, it is also important to mention that the conditional and unconditional estimates of the APE for the second hurdle are given in the third and fourth columns of Tables 2A and 2B. But, we focus the discussion on the unconditional estimates, since they take into account the effect of both the decisions stages (i.e., decisions to consume and the demand for fresh fruit or fresh vegetable) in the study. Besides, a number of empirical studies on the application of double hurdle model have based their discussion on this (see for detail; YEN and JONES, 1996; ANGULO et al., 2001).

4.1 Demand Characteristics of Household Consumption of Fresh Fruit in Nigeria

Presented in columns two and four of Table 2A are the results of the APE of the explanatory variables representing determinants of probability of consuming fresh fruit and the demand for fresh fruit (or determinants of consuming fresh fruit), respectively. To this end, the empirical results show that household income measured in terms of *real* total expenditure increases the probability of purchasing (i.e., first hurdle) and the demand for fresh fruit (i.e., second hurdle) in the study. As for the later, which represents income elasticity of demand for fresh fruit, the estimates shows that a 10% increase in household income increases the demand for fresh fruit by about 14%. This implies that an average household in the sample considered the demand for fruit to be luxury good. A search in literature shows that the demand for fruit was found to be necessity by NAYGA (1995), NIU and WOHLGENANT (2013) and MENG et al. (2013).

However, in a highly stratified socioeconomic setting as Nigeria, household demand for fresh fruit in response to income could vary by income groups. Based on this, we take a step further to disaggregate estimated income elasticity of demand for fruit across identified income groups to shed light on how household income influences the demand for fruit in the study. Consequently, second row of Table 3 presents the mean APE of income on the demand for fresh fruit by different income groups. And the results show that households in the lower tail of the income distribution (i.e., poorest) considered the demand for fruit to be necessity good, while households in higher income groups considered the demand for fruit to be luxury good. Thus, it is apparent from the findings that income differential play a significant influence in household consumption of fresh fruit, as wealthier households appear to respond fast to the demand for fruit than poorer households in the sample. This observation lends support to DURHAM and EALES (2006) and POWEL et al. (2009) argument in literature that fruits and vegetables are often not easily accessible to low income households because of high price and most importantly less disposable income.

The results of other determinants show that household size, educational level of household head and having male as head of the family decrease the probability and the demand for fresh fruit in the study. Of these variables, only household size is significantly different from zero, while the result contradicts the findings of NAYGA (1995). Nevertheless, the significance of household size perhaps signify existence of scale economies since larger household are better off due to economies of scale that accrue from sharing public goods such as food, at any given level of per capita resources. Education increases probability of consuming fruit in the study conducted by DUNN et al. (2012), which contradict the findings in the present paper. Other findings also show that households with farming as the main occupation of the head have higher probability of consuming fruit as well as increase the demand for fresh fruit in the sample.

Households with younger members have higher likelihood and increase the demand for fresh fruit, compared to households with members within the age cohort >59 years of age in the sample. Specifically, the results show that households with younger members, within the ranges of 25-39 years of age spend significantly more on healthy food such as fruit, compared to those with older members. This is absolutely strange since one would expect households with older members for health reason to spend more/demand for more fruits relative to those with younger members. As noted by LEONARD (1982), healthy eaters tend to shift to eating foods, which help prevent heart disease and cancer.

Our findings also provide insight into whether sector (rural vs. urban) or regional differences exist in consumption of fresh fruit in Nigeria. Based on this, the empirical findings show that households in the rural areas have lower likelihood of consuming fresh fruit and decrease the demand for fruit, compared to households in urban areas. These results are significantly not different from zero. But the results of the regional effect seems to suggest that the probability of consuming and the demand for fruit increase significantly among households in the south south, south east, and north east regions, compared to households in the south west region taken as the base category. Likewise, households in the north central region have higher probability and increase the demand for fresh fruit, compared to those in southwest region, but this estimate is significantly not different from zero. This means regional differences is evident in consumption of fresh fruits in Nigeria.

4.2 Demand Characteristics of Household Consumption of Fresh Vegetable in Nigeria

Presented in columns two and four of Table 2B are the results of the APE of the explanatory variables representing determinants of probability of consuming fresh vegetable and the demand for fresh vegetable (or determinants of consuming fresh

vegetable), respectively. Given this, the empirical results show that household income measured in terms of instrumented total expenditure increase the probability of consuming fresh vegetable (i.e., first hurdle) and the demand for fresh vegetable (i.e., second hurdle) in the sample. Since the later is considered income elasticity of demand for vegetable in literature, the estimates thus suggest that 10% increase in household income increases the demand for fresh vegetable by about 17%. This implies that an average household in the sample considered the demand for fresh vegetable to be luxury good. Furthermore, since Nigeria has a highly stratified socioeconomic setting, household demand for vegetable in response to income could vary across income groups. Based on this, we disaggregate estimated income elasticity of demand for vegetable across identified income groups in the study. To this end, third row of Table 3 presents the result of the mean APE of household income on the demand for fresh vegetable by different income group in the study. And the results show that households in the different income groups considered the demand for vegetable to luxury good. Given the magnitude of the estimated elasticities, the results also show that households in the lower tail of the income distribution (i.e., poorest) respond faster to the demand for vegetable than households in the upper tail of income distribution (i.e., wealthier). However, a search in literature shows that our result contradicts the finding by NAYGA (1995), DUNN et al. (2012), NIU and WOHLGENANT (2013) and MENG et al. (2013), where these studies considered the demand for vegetable to be necessity. Nevertheless, we find that our result conforms with the findings of TIFFIN and ARNOULT (2010), where the authors considered the demand for fresh fruit and vegetable to be luxury good.

The results of other determinants show that the probability of consuming and the demand for vegetable decrease significantly with household size, educational level of head, and among households headed male. In contrast, it increases among households with farming as the main occupation of the head. A search in literature shows that the result of the coefficient of household size in the study contradict the finding of NAYGA (1995). The estimates for the age cohorts also reveal that households with younger members are more likely to consume and demand for more vegetable compared to households with members within >59 years of age. This observation contradicts the argument of NAYGA (1995) that households with older members are expected to influence their household consumption patterns by purchasing more of fruit and vegetable for health reasons. Also, households in the rural areas have significant higher probability of consuming and demand for fresh vegetable, compared to households in urban areas of the country. This result probably aligns with the previous finding that households headed by farmers are likely to consume more vegetable in the study. Given this, one may argue that being a farmer and living in the rural area help the respondents to have access to cheap vegetable or perhaps being a farmer, the respondents could grow their own vegetable which supplement their demand or consumption of vegetable in the study.

Our findings also provide insight into regional differences in the demand for fresh vegetable in the study. Based on this, the empirical results of the regional effects show that households in the south south, south east, north east, and north west regions of the country have higher probability of consuming and the demand for vegetable, while households in the north central region have lower probability of consuming and the demand for vegetable, compared to households in the south west region (reference). The implication of these findings is that both sector and regional differences do exist in the demand for vegetable in Nigeria.

5 Summary and Conclusions

The study investigates separately demand characteristics of household consumption of fruit and vegetable (FV) based on the 2003/2004 Nigerian Living Standard Survey (NLSS) data. It uses the double hurdle model that allows the analysis of both the decisions to consume and the demand for FV to differ. However, the empirical results show that household socioeconomic determinant of the probability of consuming and the demand for FV are identical with exception of few variables. For example, our results show that income increases the demand and probability of consuming fresh fruit and vegetable and thus considered the demand for FV to be luxury good. But when the elasticity was disaggregated across income groups, the results show that household in the low-income and high-income groups considered the demand for fruit to be necessity and luxury goods, respectively. In contrast, households in all income groups considered the demand for vegetable to be luxury. Apparently from these findings, the demand for fruit responds slowly to rise in income among low-income households in Nigeria.

We also find that household size and occupation of the household head (farming) affect the consumption of FV in the study. In addition, our results show that households with younger members consume more FV than households with older members. The findings also provide insight into regional differences in the demand for FV in the country.

Given this, the aspect of the results, which is important in a policy context, is the fact that the demand for fresh fruit responds slowly to rise in income among low-income households, while households with older members demand for less FV, compared to households with younger members. Thus, we believe the results of this study will be useful for designing food policy program that specifically target low-income households and households with aging or older members in an attempt to increase the consumption of FV and perhaps food security among these groups of households in the country. Consequently, this observation emphasize the role of income or policies that would enhance income earning capacity of these groups of households to be able

to benefit from what market could provid to eliminate food insecurity and perhaps increase in consumption of healthy food such as fruit and vegetable in the country.

The future challenge, which is associated with data limitation in the present study, is to be able to consider the role of price of fruit, vegetable and other food items in analysis of household fruit and vegetable demand in Nigeria. Nevertheless, we believe the results obtained are still of policy relevance in the country.

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Appendix

Table 1. Summary statistics of the variables for the regressions

Variables	Description	Mean	S.D
Total Expenditure	*Real* total expenditure on food and non-food	117509.20	117672.20
Fruit_expenditure	*Real* total expenditure on Fruit	2888.54	7609.24
Vegetable_expenditure	*Real* total expenditure on Vegetable	7832.60	13069.01
EDUCATION	Years of schooling of household head	7.3620	7.1659
HHSIZE	Household size	4.8468	2.9069
D_GENDER_Head	Equal to 1 if HH head is male	0.8562	
D_OCCUPATION_Head	Equal 1 if HH head occupation is farming	0.6255	
D_Age<25	Equal 1 if HH has member within <25years	0.0221	
D_Age25-29	Equal 1 if HH has members within 25-29years	0.0659	
D_Age30-34	Equal 1 if HH has members within 30-34years	0.1042	
D_Age35-39	Equal 1 if HH has members within 35-39years	0.1225	
D_Age40-44	Equal 1 if HH has members within 40-44years	0.1320	
D_Age45-49	Equal 1 if HH has members within 45-49years	0.1272	
D_Age50-54	Equal 1 if HH has members within 50-54years	0.1178	
D_Age55-59	Equal 1 if HH has members within 55-59years	0.0797	
D_Rural	Equal 1 if household is located in the Rural area	0.7610	
D_Southsouth	Equal 1 if household is located in the SS	0.1513	
D_Southeast	Equal 1 if household is located in the SE	0.1421	
D_Northeast	Equal 1 if household is located in the NE	0.1768	
D_Northcentral	Equal 1 if household is located in the NC	0.1697	
D_Northwest	Equal 1 if household is located in the NW	0.2014	

All expenditure are expressed in naira which is the Nigerian currency unit-1US$=133 naira as at the time of the survey.

Source: NLSS 2003/2004 data

Table 2A. Average partial effects (APE) of the explanatory variables of demand for fresh fruit

Variables	First Hurdle Probability	Second Hurdle	
		Conditional	Unconditional
LOG (*Real* Total Expenditure)	0.1722***(0.0052)	0.6363***(0.0267)	1.4201***(0.0360)
LOG (Household Size)	-0.0561***(0.0059)	0.0225 (0.0304)	-0.3836***(0.0450)
LOG (Household Head's Education)	-0.0049 (0.0032)	0.0191 (0.0119)	-0.0282 (0.0187)
Gender (Household Head) #	-0.0147 (0.0097)	0.0241 (0.0416)	-0.0939 (0.0739)
Occupation (Household Head)#	0.0168** (0.0086)	0.1401***(0.0342)	0.1655***(0.0601)
Households with AGE<25 yrs#	-0.0233 (0.0264)	-0.1286 (0.0974)	-0.2074 (0.1862)
Households with AGE25-29 yrs#	0.0333** (0.0146)	-0.0572 (0.0698)	0.2128** (0.1081)
Households with AGE30-34 yrs#	0.0425***(0.0126)	-0.0017 (0.0504)	0.2957***(0.0914)
Households with AGE35-39 yrs#	0.0490***(0.0109)	-0.0973* (0.0538)	0.3085***(0.0878)
Households with AGE40-44 yrs#	0.0155 (0.0124)	-0.0477 (0.0567)	0.0914 (0.0858)
Households with AGE45-49 yrs#	0.0225* (0.0126)	-0.0598 (0.0462)	0.1365 (0.0858)
Households with AGE50-54 yrs#	0.0342***(0.0118)	-0.1004** (0.0511)	0.2040** (0.0851)
Households with AGE55-59 yrs#	0.0261* (0.0136)	-0.0977* (0.0545)	0.1484 (0.1015)
Households in RURAL#	-0.0074 (0.0106)	0.0603 (0.0379)	-0.0305 (0.0693)
Households in Southsouth#	0.1997***(0.0125)	0.1617***(0.0550)	1.4487***(0.0873)
Households in Southeast#	0.2715***(0.0127)	0.4821***(0.0561)	2.0598***(0.0876)
Households in Northcentral#	0.0623***(0.0120)	0.2571***(0.0561)	0.5230***(0.0841)
Households in Northeast#	0.1495***(0.0116)	0.1658***(0.0535)	1.0995***(0.0789)
Households in Northwest#	0.0121 (0.0113)	0.1269** (0.0636)	0.1279 (0.0853)

#Effect of the binary variables (dy/dx) are computed for discrete change of dummy from 0 to 1 ; ***, **,* implies that the estimated parameters are significantly different from zero at 1%, 5%, and 10% significance level, respectively. Figure in parenthesis is the standard error.

Source: estimated by the authors from NLSS 2003/2004 data using Stata

Table 2B. Average partial effects (APE) of the explanatory variables of demand for fresh vegetable

Variables	First Hurdle Probability	Second Hurdle	
		Conditional	Unconditional
LOG(*Real* total Expenditure)	0.1287***(0.0020)	0.7377***(0.0131)	1.7079***(0.0248)
LOG(Household Size)	-0.0331***(0.0031)	0.0786***(0.0145)	-0.1987***(0.0268)
LOG(Household Head's Education)	-0.0046***(0.0017)	0.0141***(0.0053)	-0.0248* (0.0142)
Gender (Household Head) #	-0.0249***(0.0061)	-0.1287***(0.0196)	-0.3181***(0.0534)
Occupation (Household Head)#	0.0613***(0.0043)	0.0539***(0.0165)	0.5467***(0.0397)
Households with AGE<25 yrs#	0.0061 (0.0116)	-0.1121** (0.0512)	-0.0511 (0.1128)
Households with AGE25-29 yrs#	0.0108 (0.0078)	-0.0192 (0.0319)	0.0706 (0.0658)
Households with AGE30-34 yrs#	0.0291***(0.0071)	-0.0129 (0.0250)	0.2246***(0.0608)
Households with AGE35-39 yrs#	0.0229***(0.0075)	-0.0074 (0.0219)	0.1797***(0.0616)
Households with AGE40-44 yrs#	0.0073 (0.0066)	-0.0079 (0.0179)	0.0519 (0.0569)
Households with AGE45-49 yrs#	0.0028 (0.0070)	-0.0164 (0.0238)	0.0082 (0.0569)
Households with AGE50-54 yrs#	0.0039 (0.0068)	-0.0196 (0.0198)	0.0138 (0.0541)
Households with AGE55-59 yrs#	-0.0175** (0.0083)	-0.0035 (0.0252)	-0.1454** (0.0667)
Households in RURAL#	0.0556***(0.0041)	-0.0032 (0.0159)	0.4493***(0.0381)
Households in Southsouth#	0.0682***(0.0082)	-0.3629***(0.0168)	0.2289***(0.0651)
Households in Southeast#	0.0583***(0.0089)	-0.0785***(0.0215)	0.4031***(0.0709)
Households in Northcentral#	-0.0976***(0.0059)	0.0103 (0.0267)	-0.7844***(0.0475)
Households in Northeast#	0.0415***(0.0074)	0.2368***(0.0231)	0.5497***(0.0664)
Households in Northwest#	0.0086 (0.0063)	0.0664***(0.0206)	0.1294***(0.0487)

#Effect of the binary variables (dy/dx) are computed for discrete change of dummy from 0 to 1 ; ***, **,* implies that the estimated parameters are significantly different from zero at 1%, 5%, and 10% significance level, respectively. Figure in parenthesis is the standard error.

Source: estimated by the authors from NLSS 2003/2004 data using Stata

Table 3. Estimated income elasticity of demand for fruit and vegetable by income groups

Quintile	Q_1 (Poorest)	Q_2	Q_3	Q_4	Q_5 (Wealthiest)
Fruit_Elasticties	0.9488	1.2714	1.4314	1.5413	1.6389
Vegetable_Elasticities	2.4336	1.9420	1.7056	1.5413	1.3440

Source: estimated by the authors from NLSS 2003/2004 data using Stata