Nutrient elasticities among Nigerian households differentiated by income

SO Akinleye[1] & MAY Rahji[2]

Abstract

Food calorie intake has been found to have a strong empirical linkage with both human health and productivity. In a study to determine the probable influence of price and income changes on the availability of food nutrients to Nigerian households segmented by income, demand elasticities were obtained for survey respondents and the nutritional effects of changes arising from changes in income and prices were computed using both the AIDS methodology and a technique developed by Huang. The findings show that guinea corn is the food that would have the greatest implications for the nutrient status of low income households. Millet, guinea corn and maize and rice, beans and maize respectively are the food items of note for the households whose heads earn average and high incomes. The study concludes with the implications of the findings on the different income groups and the likely applications of the methodology used to derive nutrient elasticities.

Keywords: Food demand; income; almost ideal demand system (AIDS); Nigeria

1. Introduction

Economic analysis of calorie consumption by households derives from the important role calories play in the definition of important welfare concepts such as health and labour productivity. Thus, food in adequate quantity is mostly defined with emphasis on calories taken relative to the requirements for an active, healthy life as against simple survival (Skoufias, 2004).

Food calorie intake has been found to have a strong empirical linkage with both human health and productivity. The human body needs energy to maintain normal body function (basic metabolic rate), engage in required minimal activity related to good health and hygiene (standard minimum requirement), and carry out productive activities to sustain the supply of

[1] *Department of Agricultural Economics, Olabisi Onabanjo University, Ago Iwoye, Nigeria. E-mail: diran_1011@yahoo.com. Postal Address: Department of Agricultural Economics, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria 111011.*
[2] *Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.*

energy and other required nutrients to the body. The level of calorie intake (both stock and flow) by an individual should therefore be adequate to sustain these functions over his expected lifetime. When this lifetime calorie consumption pattern falls short of a minimum threshold, the individual is at a health risk. Secondly, whenever there is a persistent short fall in the flow of calorie intake relative to the amount required for optimal productive activity, the inflow of other nutrient intakes is likely to be affected since the resources required to acquire these nutrients is obtained from productive work.

This situation is especially true in populations where the major income-earning asset is human labour efforts – as in agrarian societies like Nigeria. Such populations are made up of poor households where non-earned income forms an insignificant component of total income. In these populations, increased calorie intake may imply increased productivity, increased income and thus improved overall nutrition. Increased nutrition is associated with sustained increments in productivity and thus sustained access to food energy intake.

Engel's Law, one of the most consistent patterns found in economics, states that as income rises, the share of the budget spent on food tends to decline (Deaton & Muellbauer, 1980). A related pattern is Bennett's Law, which states that, as income rises, consumers reallocate their food budget away from starchy staples, such as rice and maize that are inexpensive sources of calories, towards higher-cost sources of calories such as fruits, vegetables, and animal products. Several studies (Bouis & Haddad, 1992; Subramanian & Deaton, 1996; Grimard, 1996 and Aromolaran, 2004) have provided evidence that the level of per capita calorie intake has a strong relationship with household income, after controlling for household and demographic variables. Differences in food demand across income categories at a point in time can provide clues to the changes in demand that could result from sustained economic growth. In particular, household survey data can be used to identify the effect of price and income on the demand for different commodities (Deaton, 1997).

Nigeria, with an estimated 120 million citizens, is Africa's most populous country. It boasts an abundance of natural and human resources but the country's per capita income of US$350 is one of the lowest in the world. With the economic restructuring of the mid 1980's, Nigerian households experienced large increases in the prices of food and non-food products. Such price increases led to a decrease in household purchasing power and a relative price effect that induced households to seek substitutes for more expensive, and in many instances, nutritionally poorer, foods. Yet there is a paucity of studies to show the effect of falls in real income and increases in food expenditure on nutrient availability. The concern about the impact of the crisis on the quantity and quality of food available in poor households is the primary purpose for writing this paper and to achieve this, the authors set out to determine the effect of food prices and household income on nutrient availability to Nigerian households.

2. Methodology

2.1 The study area

The study area is Nigeria, which covers an area of 923,768 square kilometers on the shores of the Gulf of Guinea, with Benin to the west, Niger to the north, Chad to the north-east and Cameroon to the south and south-east. The population exceeds 120 million. The climate is characterised by relatively high temperatures throughout the year, with average annual maximum temperature varying from 35^0C in the north to 31^0C in the south, average annual minimum temperature between 23^0C in the south and 14^0C in the north. Annual total rainfall ranges from over 3800mm at Forcados on the coast to under 650mm at Maiduguri in the north east. The length of the rainy season ranges from almost 12 months in the south to under 5 months in the north. Cattle, goats and sheep constitute important animal resources with poultry and pigs growing in importance. Fish are caught in inland lakes and rivers, and lagoons, creeks and distributaries along the coast. The major crops cultivated are maize, cowpea, cassava, yam, sorghum, fruits, cocoa, vegetables, timber and rubber (Mabogunje, 2000).

The data used for this study was the dataset of the National Consumer Survey (NCS) of the Federal Office of Statistics (FOS), Nigeria. This is the most comprehensive household level survey to date in Nigeria. A two-stage stratified random sampling technique was used in sample design. As a first stage, a list of all Nigerian households was obtained from the National Population Commission (NpopC). This list is based on the enumeration areas (EA) used for census purposes. Within each EA, five household units (HU) were chosen randomly using a table of random numbers.

The data for this analysis are the portions dealing with the household characteristics and household food consumption behaviour in the 1996/1997 NCS which were targeted at all households in Nigeria. The data set provides detailed records on the money value, quantity and the types of food purchased by the households over a one-week period.

2.2 Method of data analysis

A model of household demand for the different food items which compete for the household budget allocation requires a complete demand system framework. Arising from its theoretical consistency with the postulate that households maximise utility (minimise cost) in their consumption decision making process, and its flexibility to encompass broad ranges of behaviour, the 'almost ideal demand system' (AIDS) was selected for modelling household behaviour. The basis for the AIDS approach comes from the minimisation of a cost or expenditure function (Deaton & Muellbauer, 1980).

However, the true AIDS model is non-linear and is thus difficult to estimate. The model estimated in this study is a linear approximation of the strict AIDS model (LA-AIDS) and it corresponds to those used by Savadogo and Brandt (1988), Fulponi (1989), Mergos and Donatos (1989) and Soe *et al*. (1994). The model hypothesises that the portion of total expenditure that accrues to a particular commodity (or budget share) is related to prices and income as follows:

$$w_i = a^* + b_i \log(M / P^*) + \sum_{j}^{n} c_{ij} \log p_j \qquad [1]$$

Where i = 1,..., n
n = number of food items
w_i = average budget share of commodity i
M = total nominal expenditure on all goods
p_j = price of the jth good
P* is a price index defined as:

$$\log P^* = a_0^* + a_k^* \log P_k + \tfrac{1}{2} \sum_{k}^{n} \sum_{j}^{n} c_{kj} \log p_k \log p_j \qquad [2]$$

Equation (2) allows the AIDS flexibility but complicates the estimation procedure of eq. (1) which is nonlinear in the parameters. In empirical work, the following geometric price index is often used instead:

$$\log P = w_j \log P_j \qquad [3]$$

where w_j is the budget share of food item j. Deaton and Muellbauer (1980) found in their application that Stones index P closely approximates P*. This results in the following linear (in the parameters) demand system:

$$w_i = a_i + b_i \log(M / P) + \sum_{j}^{n} c_{ij} \log p_j \qquad [4]$$

Adding a disturbance term completes the equation.

$$w_{ih} = a_i + b_i \log m + \sum c_{ij} \log p_j + U_{ih} \qquad [5]$$

i = 1, ….,n

where i indexes commodity prices; m = M/P is real income and u is the random error.

The parameter a_i represents the average value of the budget share in the absence of price and income effects. The parameters b_i and c_{ij} represent the effects on the expenditure share of good i of a 1 per cent change in real income of price of good j. A positive (negative) b_i indicates that the good has an income elasticity greater (less) than unity. Similarly, a good for which c_{ij} is negative (positive) has an own price elasticity greater (less) than 1 in absolute value. When c_{ij} is positive (negative), the goods are considered substitutes (complements). The model is estimated using the SURE regression function in LIMDEP econometric software.

The formulae and procedures for the computation of elasticities after Beggs (1988) and Green and Alston (1990) are:

income elasticities

$$\varsigma_{iy} = 1 + b_i / w_i \qquad [6]$$

own-price elasticities

$$\varsigma_{ii} = c_{ii} / w_{ii} - (1 + b_i) \qquad [7]$$

cross-price elasticities

$$\varsigma_{ih} = c_{ih} / w_i - b_i w_h / w_i \qquad [8]$$

The second stage of the analysis is the use of a technique developed by Huang (1996) to explore the linkage of the demand model to nutrient availability. To do this, information about the nutrient values of each food consumed is needed. Let a_{ki} be the amount of the *k*th nutrient obtained from a unit of the *i*th food. The total amount of that nutrient obtained from various foods, say Φ_k may be expressed as

$$\Phi_k = \Sigma_i\, a_{ki}\, q_i \qquad [9]$$

This is referred to by Huang (1996) as the consumption technology of consumer behaviour. The values of a_{ki}*'s* for non-foods will be assigned zero, thus the terms associated with non-foods will disappear. This equation, including all foods consumed, plays a central role in the transformation of food demands into nutrient availability. By substituting a demand equation for the quantity variable of equation (9), changes in consumer nutrient availability become

$$d\Phi_k = \Sigma_i\, a_{ki}\, [\Sigma_j(\delta q_i / \delta p_i)dp_i + (\delta q_i / \delta m)dm] \qquad (10)$$

Furthermore, the relative changes of consumer nutrient availability can be expressed as functions of the relative changes in food prices and per capita income as follows:

$$d\Phi_k \,/\, d\Phi = \Sigma_j\, (\Sigma_i e_{ij} a_{ki} q_i / \Phi k) dp_j p_j + (\Sigma_i \eta_i a_{ki} q_i / \Phi k) dm/m = \Sigma_j \Pi_{kj} dp_j / p_j + \rho_k dm/m \qquad (11)$$

where $\Pi_{kj} = \Sigma_i e_{ij} a_{ki} q_i / \Phi_k$ is a price elasticity measure relating the effect of the jth food price on the availability of the kth nutrient, and ρ_k represents the effect of income on the availability of that nutrient.

Obviously, the measurement represents the weighted average of all own- and cross-price elasticities (e_{ij}'s) in response to the jth price with each weight expressed as the share of each food's contribution to the kth nutrient ($a_{ki}q_i/\Phi_k$'s). Similarly, the measurement of ρ_k represents the weighted average of all income elasticities (η_i's) with each weight again expressed as the share of each food's contribution to the kth nutrient. Thus the general calculation of nutrient elasticity matrix, say N, for the case of ℓ nutrients and n foods can be obtained as a product of multiplying matrix S by matrix D as follows:

$$N = S^* D \qquad [12]$$

where N is the ℓ x (n+1) matrix of nutrient elasticities in response to changes of food prices and income, S is the ℓ x n matrix with entries of each row indicating a food's share of a particular nutrient, and D is the n x (n + 1) matrix of demand elasticities. From these nutrient elasticity measurements, a change in a particular food price or per capita income will affect all food quantities demanded through the interdependent demand relationships and thus cause the levels of consumer nutrient availability to change simultaneously. The

MMULT option of the Excel worksheet was used to compute the nutrient elasticities.

3. Results and discussion

3.1 Socioeconomic characteristics of respondents

Table 1 presents the breakdown of the socioeconomic characteristics of the respondents. This distribution is shown according to income class delineations. Respondents with average incomes constitute more than 75 per cent of all respondents. The proportion of high-income earning respondents is fairly even across regions but relative to the other regions, there is a high proportion of low-income earners in the north east and the north west regions. The results also show that for all income groups, there is a reduction in the proportion of respondents with higher levels of education. Expectedly, low-income earners are in higher proportion in the rural areas. The age group 45-54 has the largest number of people in all income categories.

Comparing these results with national data show some differences. Expectedly, the distribution of the respondents according to the geopolitical regions is little different between the two data sets; as this was the basis for the sampling in the first place. However, the distribution of the Nigerian population by sex is fairly even across the sexes as against the male-favouring skew of the survey data. This is to be expected, given the fact that the NCS was directed principally at households and household heads. The same is true for the difference in the distribution of the respondents by marital status and the age of the household heads. The distribution of respondents by sector of residence and major occupation of the household head favours the rural-farming group of respondents. This could be attributable to the non-inclusion of recent migration data and trends in the sampling procedure for the NCS.

Table 1: Socioeconomic characteristics of respondents

Socioeconomic Characteristics	Low Income		Average Income		High Income		Total	National Avg. (%)
	Number	% of Total	Number	% of Total	Number	% of Total		
Region of Residence								
North East	649	4.34	1780	11.91	101	1.68	2530	17
North West	980	6.55	1720	11.50	63	0.42	2763	14
North Central	334	2.23	2823	18.88	226	1.51	3383	23
South East	79	0.53	1601	10.71	171	1.14	1851	15
South West	177	1.18	1652	11.05	178	1.19	2007	19
South South	205	1.37	2028	13.56	184	1.23	2417	12
Sex (of Household Head)								
Male	2085	13.95	9954	66.58	840	5.62	12879	49
Female	339	2.27	1650	11.04	83	0.56	2072	51
Marital Status (of Household Head)								
Married	1940	12.98	9108	60.92	790	5.28	11838	13
Non-married	484	3.24	2496	16.69	133	0.89	3113	87
Sector of Residence								
Urban	195	1.30	2532	16.94	379	2.53	3106	48
Rural	2229	14.91	9072	60.68	544	3.64	11845	52
Age (of Household Head) in Years								
Less than 34	73	0.49	316	2.11	14	0.01	403	69
35-44	521	3.48	2332	16.60	153	1.02	3006	10
45-54	1306	8.74	6251	41.81	551	3.69	8108	9
More than 54	524	3.50	2705	18.09	205	1.37	3434	12
Level of Educational Attainment (of Household Head)								
None	2004	13.40	6728	45.00	342	2.29	9074	30
Primary	253	1.69	2624	17.55	269	1.80	3146	56
Secondary	139	0.93	1661	11.11	185	1.24	1985	18
Tertiary	28	0.19	591	3.95	127	0.85	746	8
Family Size								
Less than 2	348	2.33	1526	10.21	92	0.62	1966	16
2-4	1167	7.81	5030	33.64	330	2.21	6257	28
5-9	836	5.59	4501	30.11	416	2.78	5753	48
More than 9	73	0.49	547	3.66	85	0.57	705	8
Occupation (of Household Head)								
Farming	2077	13.89	7535	50.40	415	2.78	10027	55
Other Occup.	347	2.32	4069	27.22	508	3.40	4924	45
Total	**2424**	**16.21**	**11604**	**77.61**	**1923**	**12.86**	**14951**	**100**

Sources: Result of Analysis, 2004; National Population Commission (NpopC), 1996.
Note: () Parentheses in the sub-titles are used to denote the differences between the survey data and national data.

3.2 Food demand elasticities for survey households

Income elasticities for all households are as seen in Table 2. The values show rice and yam to be the luxury food items for low-income households. Computed results for own price elasticities show that guinea corn, millet and beans are the price elastic food items while other food items are price inelastic. Cross price relationships show that beans is complemented by other food items except yam; millet is a substitute for rice, guinea corn, yam and maize and maize is a substitute for millet, guinea corn, garri and beans.

For mid-income earning households in Nigeria, rice, yam and millet are the luxury food items while guinea corn and maize are the essential foods. The inferior foods are garri and beans. Guinea corn is price elastic and other food items are price inelastic. For average-income earning households, rice would substitute millet, yam and maize, guinea corn would complement rice, millet, garri, beans and maize and maize is a substitute for rice, millet, guinea corn and garri.

Income elasticities for high income earning households as seen from Table 2 show garri, beans and maize to be inferior foods. The other food items are essential foods. Guinea corn is price elastic while the other food items are price inelastic. Cross price relationships show that beans would substitute guinea corn, yam and maize; millet would substitute guinea corn, yam and maize and yam would substitute every other food item.

3.3 Nutritive value of foods consumed in Nigeria

Table 3 shows the nutritive values per kilogramme for selected food items in the raw form. Rice has the least energy content of the food items but yam has the highest moisture content. Beans have the highest protein value and garri the least. Rice has the least carbohydrate content and beans the highest calcium content. Beans also have the highest phosphorous content but the least iron content. Further details on the nutrient contents of the different foods are as seen in Table 3.

Table 2: Income and price elasticities for Nigerian households by income class

Food Items	Income Elasticities	Price Elasticities						
		Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
Low Income-earning Households								
Rice	2.56	0.24	0.19	-0.16	-0.09	0.16	0.03	-0.19
Millet	0.21	-0.54	-1.19	-0.12	0.94	0.63	0.36	0.97
G. Corn	0.42	1.16	0.49	-2.70	-0.72	-0.49	0.83	0.90
Yam	1.12	0.13	0.07	-0.05	-0.69	0.16	-0.27	-0.14
Garri	0.46	-0.67	-0.45	-0.09	-0.51	0.27	0.12	0.67
Beans	0.14	0.33	-0.38	-0.36	-0.05	-0.85	-1.38	0.20
Maize	0.38	0.43	0.73	-0.02	0.50	0.94	0.51	-0.43
Average Income-earning Households								
Rice	1.21	0.25	-0.23	-0.05	-0.48	0.27	0.34	0.17
Millet	1.21	1.21	-0.85	-0.27	0.60	0.77	0.70	0.01
G. Corn	0.86	-0.13	1.09	-2.41	1.00	0.21	1.36	1.04
Yam	1.01	0.53	0.07	0.16	-0.34	-0.17	0.25	-0.09
Garri	-0.12	-0.69	0.08	-0.03	0.05	-0.35	-0.32	0.53
Beans	-0.31	-0.05	0.62	-0.12	-0.73	-1.46	-0.13	-1.10
Maize	0.49	0.64	-0.54	-0.41	0.30	0.28	0.41	-0.57
High Income-earning households								
Rice	0.82	-0.06	-0.27	0.01	0.48	-0.64	0.33	-0.42
Millet	0.21	-0.32	-0.37	0.10	0.29	0.52	1.02	-0.48
G. Corn	0.21	-1.25	1.43	2.70	0.63	-1.12	-0.59	-0.41
Yam	0.56	0.37	0.12	-0.01	0.40	-0.20	-0.06	-0.20
Garri	-0.04	-0.41	-0.10	0.05	0.34	-0.12	0.38	-0.43
Beans	-0.12	0.95	-1.01	-0.52	0.18	0.41	0.61	-1.22
Maize	-0.23	-0.14	0.20	0.12	0.98	0.50	-0.52	-0.33

Source: Result of Analysis, 2004.

Table 3: Nutritive value of food per kilogram and average food consumption

Nutrients	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
Energy (Kcal)	0.001	414	394	373	384	338	410
Moisture (%)	6	11	12	76	14	11	10
Protein (g)	12.5	9	15	7.3	1.2	22.5	10.7
Fat (g)	0.2	5	3.2	0.6	0.4	1.4	4
Carbohydrate (g)	0.2	83	76	86	94	61	83
Calcium (mg)	12	50	26	10.4	45	104	60
Phosphorous (mg)	290	350	330	41.2	79	416	300
Iron (mg)	2	9	10.6	0.6	1.6	0.001	2.5
Thiamine (mg)	0.3	0.31	0.3	0.09	0.08	0.1	0.38
Riboflavin (mg)	0.05	0.04	0.2	0.03	0.03	0.1	0.11
Niacin (mg)	4.6	4.6	3.3	0.001	0.001	4	2
Food LIH (kg)	11.945	54.15	40.19	117.30	220.28	10.87	4845.54
Food AIH (kg)	35.89	66.83	88.38	292.59	384.56	25.74	1009.09
Food HIH (kg)	121.78	92.66	102.76	549.18	414.12	38.48	1718.18

Source: Oguntona & Akinyele, 1995; Central Bank of Nigeria, 1998.

In addition to the unit nutritive value of the food items, the amount of food consumed is another factor determining the level of nutrients available to consumers. Averages of food consumption over the study period were obtained from the Central Bank of Nigeria, 1998. Table 3 presents the average food consumption per household per year segregated by the income group of the respondents. Maize is the food item consumed in the greatest quantity by Nigerian households and beans is consumed in the least quantity.

In Table 4, maize consumption is the most important source of nutrients to all households involved in the survey regardless of income class. Conversely, rice contributes the least amount of all nutrients. Yam and garri are the other major sources of nutrients to low income households. Average income-earning households derive additional nutrients principally from millet, guinea corn, yam and garri. The situation is little different for high-income-earning households. The reason that could be adduced for the relative importance of maize in nutrient provision is its peculiar nature; it is a major component of major staples in the Nigerian diet such as *tuwo*, *eko*, *ogi/akamu* and *sapala* and it is consumed nationwide by all ethnic groups and tribes. Rice, on the other hand, as consumed by the Nigeria population, is long-grained and polished, with a lot of its nutrients lost in the processing. Table 4 presents the source of nutrients and is the first step for obtaining nutrient elasticities for the food items.

3.4 Nutrient elasticities of foods consumed by Nigerian households

A unit percentage increase in income would lead to percentage increases in the amount of nutrients from the foods consumed by households whose heads earn low incomes. This increase has a mean value of 40 per cent. A similar change in the price of guinea corn would however have an opposite effect. Interestingly, the greatest increases, as much as 90 per cent in some instances, would come from *garri*, popularly referred to as the food of the poor. Relative increases in the diet arising form a change in the price of millet are also high. Details are provided in Table 5.

Table 5 also shows the nutrient elasticities for households whose heads earn average incomes. Millet and guinea corn are the danger food items for this group of consumers. A percentage increase in the prices of these food items would lead to a reduction in the percentage nutrient availability to the households. Increasing incomes would however lead to increased nutrient availability to the food items by as much as 71 per cent in an instance.

Table 4: Food share of nutrients based on average food consumption

Nutrients	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize	Total
Percentages for Low Income-earning Households								
Energy	0.01	1.04	0.73	2.03	3.91	0.17	92.11	100
Moisture	0.12	0.97	0.78	14.44	5.45	0.19	78.05	100
Protein	0.27	0.9	1.11	1.57	0.48	0.45	95.22	100
Fat	0.01	1.36	0.64	0.35	0.44	0.08	97.12	100
Carbohydrate	0.01	1.02	0.69	2.28	4.69	0.15	91.16	100
Calcium	0.05	0.88	0.34	0.40	3.23	0.37	94.73	100
Phosphorous	0.23	1.25	0.87	0.32	1.15	0.30	95.88	100
Iron	0.18	3.62	3.16	0.52	2.60	0.01	89.91	100
Thiamine	0.19	0.88	0.63	0.55	0.93	0.06	96.76	100
Riboflavin	0.11	0.39	1.45	0.63	1.19	0.20	96.03	100
Niacin	0.54	2.45	1.3	0.01	0.01	0.41	95.28	100
Percentages for Average Income-earning Households								
Energy	0.01	3.73	4.69	14.71	19.91	1.17	55.78	100
Moisture	0.54	1.84	2.65	55.58	13.46	0.71	25.22	100
Protein	2.74	3.68	8.11	13.06	2.82	3.54	66.05	100
Fat	0.14	6.65	5.63	3.49	3.06	0.72	80.31	100
Carbohydrate	0.01	3.49	4.23	15.83	22.75	0.99	52.7	100
Calcium	0.48	3.73	2.56	3.39	19.31	2.99	67.54	100
Phosphorous	2.49	5.58	6.96	2.88	7.25	2.56	72.28	100
Iron	1.46	12.22	19.03	3.57	12.5	0.01	51.21	100
Thiamine	2.15	4.13	5.29	5.24	6.14	0.51	76.54	100
Riboflavin	1.15	1.71	11.33	5.63	7.39	1.65	71.14	100
Niacin	5.72	10.65	10.11	0.11	0.01	3.57	69.83	100
Percentages for High Income-earning Households								
Energy	0.01	3.31	3.49	17.99	13.71	1.12	60.72	100
Moisture	10.7	1.5	1.81	61.27	8.51	0.62	25.12	100
Protein	5.5	3.02	5.57	14.5	1.8	3.13	66.48	100
Fat	0.3	5.63	3.99	4.00	2.01	0.65	83.42	100
Carbohydrate	0.01	3.12	3.17	19.15	15.78	0.95	57.82	100
Calcium	1.04	3.3	1.91	4.07	13.29	2.85	73.53	100
Phosphorous	5.13	4.71	4.93	3.29	4.75	2.33	74.87	100
Iron	3.27	11.09	14.61	4.52	8.89	0.01	57.62	100
Thiamine	4.37	3.44	3.7	5.92	3.97	0.46	78.15	100
Riboflavin	2.42	1.47	8.15	6.54	4.93	1.53	74.97	100
Niacin	11.39	8.67	6.9	0.01	0.01	3.13	69.89	100

Source: Result of Analysis, 2004.

Increasing the income of respondents in the high income group has the effect of reducing nutrient availability to the households in the group. This could be attributed to the predilection of household decision makers to spend extra incomes on exotic foods of poor nutritional value viz fast foods. For households in the high income group, the foods most likely to affect the nutrition status of these households if the prices are increased are rice, beans and maize. Increasing the prices of other food items would however have a net effect of increasing the nutrients available to the households.

Table 5: Nutrient elasticities for foods consumed by Nigerian households

Nutrients	Income	Rice	Millet	G. Corn	Yam	Garri	Beans	Maize
Nutrient Elasticities for Foods Consumed in Households with Low Income-earning Heads								
Energy	39.6484	37.5952	64.6803	-4.4542	43.1028	88.1185	47.6432	39.6484
Moisture	49.2039	32.2597	54.7133	-5.0835	26.6118	77.2355	37.2987	49.2039
Protein	39.5722	41.842	68.7577	-5.3363	46.2819	89.5714	48.8283	39.5722
Fat	38.0912	41.5491	69.3908	-3.9211	48.9068	91.9444	50.4002	38.0912
Carbohydrate	39.9024	36.6544	63.6651	-4.4003	42.0685	87.5001	47.172	39.9024
Calcium	38.4386	38.6751	66.7157	-3.3701	46.0011	90.0636	48.6818	38.4386
Phosphorous	38.5805	40.9879	68.3658	-4.6809	47.6456	90.6319	49.7154	38.5805
Iron	38.4938	38.7442	61.7717	-11.057	44.3811	86.0531	49.9433	38.4938
Thiamine	38.7568	41.3762	69.5296	-3.905	47.8797	91.5186	50.0733	38.7568
Riboflavin	38.7449	42.1413	69.8018	-6.1106	46.2761	90.0731	50.0192	38.7449
Niacin	38.7225	41.4149	67.2189	-5.945	48.9259	90.2119	50.0027	38.7225
Nutrient Elasticities for Foods Consumed in Households with Average Income-earning Heads								
Energy	47.9962	33.6052	-24.834	-33.5644	18.7972	8.3007	29.0168	47.9962
Moisture	71.8171	38.2922	-7.0109	-8.8467	-7.6817	-6.0155	24.9113	71.8171
Protein	58.8621	51.1545	-27.2507	-46.176	21.9342	15.3949	43.5201	58.8621
Fat	55.3441	58.4503	-41.9799	-47.9177	32.0866	26.1119	45.0862	55.3441
Carbohydrate	46.6472	30.0464	-23.2742	-31.0126	17.1618	6.2353	26.355	46.6472
Calcium	40.5701	35.8494	-33.3262	-35.2878	22.4598	10.7503	28.2268	40.5701
Phosphorous	52.4127	49.1246	-34.3917	-48.1034	28.3113	19.9042	41.9202	52.4127
Iron	60.1141	38.7183	-16.3774	-70.0358	40.4281	23.1422	52.8185	60.1141
Thiamine	54.0503	52.3478	-38.3963	-44.7599	27.8511	22.5183	41.4767	54.0503
Riboflavin	52.351	44.2156	-25.7756	-56.5108	30.3968	17.9731	44.9924	52.351
Niacin	61.7222	57.5663	-34.8345	-56.568	32.0604	26.186	51.3399	61.7222
Nutrient Elasticities for Foods Consumed in Households with High Income-earning Heads								
Energy	-3.1378	-11.8239	15.5639	16.9637	74.728	23.382	-25.4404	-3.1378
Moisture	37.5879	12.8685	10.0435	7.6488	58.8419	-8.5562	-9.1335	37.5879
Protein	-1.3041	-9.9656	17.0574	21.691	79.1507	23.2193	-31.2372	-1.3041
Fat	-14.8388	-17.2125	19.8481	21.0719	88.4424	39.2021	-38.9706	-14.8388
Carbohydrate	-1.9907	-11.5381	14.7005	15.913	72.7665	21.6415	-23.3241	-1.9907
Calcium	-13.5594	-15.0356	12.2164	13.4628	81.3785	34.4359	-29.1088	-13.5594
Phosphorous	-9.6163	-16.976	16.4626	21.8107	83.6572	30.8067	-32.3151	-9.6163
Iron	-2.9998	-32.0373	27.0734	47.8972	75.29	14.1541	-23.0783	-2.9998
Thiamine	-9.7905	-15.9293	18.3171	19.6558	85.8138	32.4512	-36.4361	-9.7905
Riboflavin	-9.9569	-19.4469	24.1977	30.5581	84.7606	26.3003	-39.0806	-9.9569
Niacin	-3.8356	-18.8943	14.4007	26.3705	81.3915	25.7159	-25.8992	-3.8356

Source: Result of Analysis, 2004.

5. Conclusion

There is an increasing realisation that food demand studies should go beyond the realm of being mere academic exercises to having an impact on the livelihood of people who consume the foods. This study has attempted to do this by examining the changes in nutrient availability arising from price and income changes in Nigerian households segmented by sector of income.

The study found out that relative income increases for low- and average-income earning households led to increases in nutrient availability to these households. The reverse was the case for high income households where the quality of nutrient intake declined, probably as a result of their spending the extra income on more exotic, but less nutritious, meals. The foods most affected by price increases are millet and guinea corn, for low- and average-income earning households and rice, beans and maize for high income-earning households. It is thus obvious from the findings of the study that different sets of policy interventions are required for the different income classes.

Using demand elasticities from traditional demand studies, the study was able to show the intervening relationship between nutrient changes arising from changes in economic factors. The major policy implications of the study are that it provides a means to derive a nexus between economic planning and the (nutritional) well being of the citizens of the nation. With this tool, therefore, it is possible to foretell the non-immediate effects of food policies vis import restrictions, farm subsidies and associated government legislation on food nutrient status.

References

Aromolaran AB (2004). *Intra-household redistribution of income and calorie consumption in Southwestern Nigeria*. Center Discussion Paper No 890, Economic Growth Center, Yale University, New Haven, Connecticut.

Beggs JJ (1988). Diagnostic testing in applied econometrics. *Economic Record* 64:82-98.

Boius H & Haddad L (1992). Are estimates of calorie-income elasticities too high?: A recalibration of the plausible range. *Journal of Development Economics* 39(2):333-364.

Central Bank of Nigeria (1998). *Annual Report and Statement of Accounts*. CBN, Abuja, Nigeria.

Deaton A (1997). *The analysis of household surveys: A microeconometric approach to development policy*. The Johns Hopkins University Press, Baltimore, MD.

Deaton AS & Muellbauer J (1980). *Economics and consumer behaviour*. Cambridge University Press, Cambridge.

Deaton AS & Muellbauer J (1980). An almost ideal demand system. *American Economic Review* 70:312-326.

Fulponi L (1989). The almost ideal demand system: An application to food and meat groups for France. *Journal of Agricultural Economics* 40:89-92.

Green R & Alston JM (1990). Elasticities in AIDS models. *American Journal of Agricultural Economics* 72:442-445.

Grimard F (1996). Does the poor's consumption of calorie respond to changes in income?: Evidence from Pakistan. *The Pakistan Development Review* 35 (3):257-283.

Huang KS (1996). Nutrient demand elasticities in a complete food demand system. *American Journal of Agricultural Economics* 78:21-29.

Mabogunje AL (2000). *Nigeria: Physical and social geography in Africa south of the Sahara 2000.* Twenty-ninth Edition. Europa Publications.

Mergos GJ & Donatos GS (1989). Demand for food in Greece: An almost ideal demand system analysis. *Journal of Agricultural Economics* 40:178-184.

NpopC (National Population Commission) (1996). *Report of the National Population Census.* NPC, Garki, Abuja.

Oguntona EB & Akinyele IO (1995). *Nutrients composition of commonly eaten foods in Nigeria – raw, processed and prepared*. Food Basket Foundation Publication Series, Ibadan, Nigeria.

Savadogo K & Brandt JA (1988). Household food demand in Burkina Faso: Implications for food policy. *Agricultural Economics* 2:345-364.

Skoufias E (2004). *The sensitivity of calorie-income demand elasticity to price changes: Evidence from Indonesia*. Discussion Paper 141, International Food Policy Research Institute, Washington DC, USA.

Soe T, Batterham RL & Drynan RG (1994). Demand for food in Myanmar (Burma). *Agricultural Economics* 11:2-3, 207–217.

Subramanian S & Deaton A (1996). The demand for food and calories. *Journal of Political Economy* 104(1):133-162.