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Nutritional Implications of Food Demand in Rural Nigeria

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Abstract: This study determines the influence of price and income changes on the availability of food nutrients to rural households in Nigeria. Demand elasticities were obtained. The nutritional effects of changes arising from changes in income and prices were computed using both the AIDS model and a nutrient availability measure developed by Huang. The findings show that foods in the bread/confectionary group are the foods that have the greatest implications for the nutrient status of households resident in rural areas. Increasing the prices of these food items by 1% would lead to reduced intake of some nutrients by as much as 10%. There study recommends policies that ensure sustainability in the supply of materials in the confectionary industry.

Key words: Food demand, almost ideal demand system, rural, Nigeria

INTRODUCTION

Nigeria is Africa's most populous country with a population of 125 million. Agriculture is the most important sector of the economy. It is the main source of food for most of the population. It provides the means of livelihood for over 70% of the population; is a major source of raw materials for the agro-allied industries and a potent source of much-needed foreign exchange[1,2]. The agricultural sector in the periods immediately after independence performed creditably the roles highlighted above to such an extent that the regional development witnessed during these period were linked directly to the sector. It once contributed over 60% of gross domestic product[3].

However, over the years, the sector has witnessed a tremendous decline in its contribution to national development. The decline is attributed to the boom in the petroleum sector and the growth of the industrial sector. These two have contributed to the mass exodus of able-bodied youths from the rural areas. The percentage of the economically active population involved in agriculture had dropped to 52% in the late 1990s. The result has been Nigeria becoming an increasingly urbanised society. The urban population grew from 11% of the total population in 1952 to 46% in 2002. Nigeria also has the largest number of people residing in urban areas in Sub-Saharan Africa[3].

The performance of agriculture in Nigeria has been able to match the expectation ascribed to the sector in the development process. At independence, agriculture sustained the Nigeria economy and held the promise of a vibrant agrarian economy[4]. In fact, according to Adedipe[5], agriculture contributed 67% of the Gross Domestic Product (GDP) in the 1960/1961 period. In the 1999/2000 period, the sector contributed 40% of the GDP. The Civil War (1967-70) and the emergence of petroleum in the early 1970s scuttled the production foundation of agriculture through lack of visionary planning for sustainable development. The sector is yet to regain its central role in the economy. The misfortune is that, on the basis of the human, material and financial resources expended on agriculture in the last 40 years, the country ought to have performed better. In fact, the present economic situation in Nigeria has been attributed to the poor performance of the agricultural sector. The near eclipse of the sector in the era of oil boom (1972-1975), inconsistent performance and unfocused government policies have been described as the fatal perturbations that rocked the boat of food security in Nigeria.

Small-scale farmers inundate the agricultural landscape, producing about 85% of the total output[6]. These resource poor farmers are characterised by a strong dependence on agricultural labour market, little or no savings or storage facilities and labour intensive cultural practices. The socioeconomic and production characteristics of the farmers, inconsistent and unfocussed government policies and the poor infrastructural base all interact to asphyxiate the sector, resulting in low production, high prices of food items, inflation, underdevelopment and concomitant poverty.

Economic deregulation in Nigeria has in a very short time brought about a reduction in household income levels and to this effect, the livelihood patterns of most rural households have remained more deplorable[7]. On the national level, per capita growth of production of major foods in Nigeria has not been sufficient to satisfy the demands of an increasing population[8]. The result is a big gap between national supply and national demand for food. Progress in the agricultural sector has also remained

unsatisfactory[9]. Common staples in most Nigerian homes are insufficient and do not provide a balanced diet, as such, malnutrition is prevalent in most homes. This has led to massive importation of foods and massive foreign debt[10-12].

Yet, food is a basic human need and the major source of nutrients needed for human existence. Food security indicates the availability of and access to food[13-17]. The place of agriculture in an agrarian society cannot be overemphasized given its importance in the life of human sbeings. Agriculture is expected to ensure adequate supply of food to the people. Globally, there is enough food for all, but more than 780 million people are chronically undernourished[18]. Millions of people in the developing world simply cannot obtain the food they need for a healthy and productive life.

Over 90% of total agricultural production is used for domestic consumption and less than 3% of the quantity of food consumed is imported[19]. However, the influence of urban demand for food and labour is unevenly spread in the country. Increase in food demand generated by the growth of cities and expansion of transport capacity is a major driving force of agricultural production and modernisation through the 1990s. The rural areas are thus left with a demographically unbalanced population of women, younger children and older people. This study intends to examine the demand for food in Nigeria and the nutritional implications of existing food consumption patterns on rural consumers in Nigeria.

MATERIALS AND METHODS

The study area is Nigeria. It 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 is projected to be more than 120 million[20]. The climate is characterised by relatively high temperatures throughout the year, with average annual maximum temperature varying from 35°C in the north to 31°C in the south, average annual minimum temperature between 23°C in the south and 14°C in the north. Annual total rainfall ranges from over 3800 mm at Forcados on the coast to under 650 mm 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[21].

The data used for this study were a subset of the 2003/2004 National Living Standards Survey (NLSS) of the Federal Office of Statistics (FOS), Nigeria. This is the most comprehensive household level survey to date in Nigeria, with data on almost 100, 000 Nigerians. A two-stage sampling technique was used in sample design for the NLSS. As a first stage, a list of all Nigerian households was obtained from the National Population Commission[22]. This list is based on the Enumeration Areas (EA) used for census purposes. The second stage involved the selection of five Household Units (HU) from each EA. These were chosen randomly using a table of random numbers. The different data available in the NLSS are data on household socioeconomic characteristics such as age, sex, educational and marital status, household income, etc. Other data in the NLSS are detailed records of the money value, quantity and the types of food purchased by the households over a defined period of time.

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. Because of 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[23].

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[24], Fulponi[25], Mergos and Donatos[26] and Soe *et al.*[27]. 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 goodP* 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:

$$\log P = w_j \log P_j \tag{3}$$

where w_j is the budget share of food item j. Deaton and Muellbauer[23] found in their application that Stones index P closely approximates P*. This results in the following linear (in the parameters) demand system:

$$w_i = a_i + b_i \log(M/P) + \sum_j^n c_{ij} \log p_j \tag{4}$$

Adding a disturbance term completes the equation.

$$w_{ih} = a_i + b_i \log m + \sum c_{ij} \log p_j + U_{ih} \qquad i = 1, ...,n \tag{5}$$

where i indexes commodity prices; m = M/P is real income and u 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_j and c_{ij} represent the effects on the expenditure share of good i of a 1% 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[28] and Green and Alston[29] are: income elasticities

$$\varsigma_{iy} = 1 + b_i / w_i \tag{6}$$

own-price elasticities

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

cross-price elasticities

$$\varsigma_{ih} = c_{ih} / w_i - b_i w_h / w_i \tag{8}$$

The second stage of the analysis is the use of a technique developed by Huang[30] 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 kth nutrient obtained from a unit of the ith food. The total amount of that nutrient obtained from various foods, say Φ_k may be expressed as

$$\Phi_k = \Sigma_i \, a_{ki} \, q_i \tag{9}$$

This is referred to by Huang[30] 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 Eq. 9, changes in consumer nutrient availability become

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

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:

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

where $Ð_{kj} = \Sigma_i e_{ij} a_{ki} q_i / \Phi_k$ 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:

$$N = S^* D \tag{12}$$

where N is the ℓ x (n+1) matrix of nutrient elasticities in response to changes of food prices and income, S is the $\ell \times n$ matrix with entries of each row indicating a food's share of a particular nutrient and D is the $n \times (n+1)$ 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

Table 1: Income and price elasticities for food items in rural households

Food items	Income elasticities	Price elasticities							
		Bread	Meat	Fish	Dairy	Fat	Fruit	Vegetable	Beverage
Bread	0.03	-0.01	1.30	0.01	0.19	1.37	1.36	1.36	1.40
Meat	0.40	-0.01	-0.40	0.01	0.01	0.44	0.50	0.44	0.40
Fish	0.50	0.19	0.10	0.01	0.02	0.15	0.15	0.15	0.14
Dairy	1.20	-0.01	0.01	0.01	-0.01	0.09	0.09	0.01	0.01
Fat	0.01	-0.01	0.20	0.01	0.01	-0.24	0.24	0.24	0.24
Fruit	0.30	0.12	0.20	0.01	0.01	0.19	0.19	0.19	0.19
Vegetable	0.08	-0.01	-0.01	-0.01	0.02	0.13	0.13	-0.13	0.13
Beverage	1.30	0.19	1.40	0.42	0.19	1.38	1.38	1.38	1.38

Source: Result of Analysis, 2006

Table 2: Nutritive value of food per kilogramme and average food consumption/head

Nutrients	Bread	Meat	Fish	Dairy	Fat	Fruit	Vegetable	Beverage
Moisture (%)	39	63	47	69	16	88	85	5
Energy (kcal)	233	237	138	158	730	53	43	273
Protein (g)	7.8	18.2	15.7	8.6	0.1	1	4	16.5
Fat (g)	1.7	17.7	8.3	9	81	0.7	0.9	20.8
Carbohydrate (g)	50	0	0.001	11	0	12	7	52
Calcium (mg)	100	11	21	280	53	28	506	130
Iron (mg)	1.7	3.6	0.9	0.2	0.4	0.1	1.7	10.5
Phosphorous (mg)	97	194	200	280	52	17	62	660
Potassium (mg)	100	0.001	310	390	59	150	0.001	1500
Sodium (mg)	540	0.001	110	180	0.001	2	0.001	950
Thiamine (mg)	0.2	0.001	0.07	0.06	0.01	0.02	0.001	0.16
Riboflavin (mg)	0.03	0.001	0.28	0.5	0.08	0.03	0.01	0.06
Niacin (mg)	1.4	0.001	6.4	0.28	0.1	0.2	0.001	1.7
Food (kg)	158.01	4.2	8.46	4	4.46	9.26	40.72	0.04

Source: Oguntona and Akinyele, 1995. United States Department of Agriculture, 1981

Table 3: Food share of nutrients based on average consumption of food/head

Nutrients	Bread	Meat	Fish	Dairy	Fat	Fruit	Vegetable	Beverage	Total
Moisture	53.828	2.311	3.473	2.411	0.623	7.118	30.233	0.002	100
Energy	81.597	2.206	2.588	1.401	7.216	1.088	3.881	0.024	100
Protein	74.723	4.634	8.053	2.086	0.027	0.561	9.875	0.040	100
Fat	31.439	8.701	8.218	4.213	42.282	0.759	4.289	0.097	100
Carbohydrate	94.699	0.001	0.001	0.527	0.001	1.332	3.417	0.025	100
Calcium	41.310	0.121	0.464	2.928	0.618	0.678	53.867	0.014	100
Iron	73.694	4.148	2.089	0.219	0.489	0.254	18.991	0.115	100
Phosphorous	70.005	3.722	7.728	5.116	1.059	0.719	11.531	0.121	100
Potassium	72.830	0.001	12.088	7.190	1.213	6.402	0.001	0.277	100
Sodium	98.038	0.001	1.069	0.827	0.001	0.021	0.001	0.044	100
Thiamine	96.597	0.013	1.810	0.734	0.136	0.566	0.124	0.020	100
Riboflavin	46.668	0.041	23.321	19.690	3.513	2.735	4.009	0.024	100
Niacin	79.320	0.002	19.414	0.402	0.160	0.664	0.015	0.024	100

Source: Result of Analysis, 2004

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.

RESULTS AND DISCUSSION

Food demand elasticities: The elasticity computations for the households are as seen in Table 1. For these households, the luxury food items are dairy and beverages. The other food items are essentials. Beverage is the only price elastic food item. Meat would substitute all other food items except vegetables. Beverage would substitute all other food items.

Nutritive value of foods consumed in Nigeria: Table 2 shows the nutritive values per kilogramme for selected food items. Vegetables and fruits have the least energy content of the food items, but the highest moisture content. Meat and fish have the highest protein value while fats and fruits have the least. Meat has no carbohydrate content and vegetables the highest calcium content. Beverage has the highest phosphorous content while fruits has the least iron content.

In addition to the unit nutritive value of the study 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 data. Bread is the

Table 4: Nutrient elasticities for foods consumed by households resident in rural areas

Nutrients	Income	Bread	Meat	Fish	Dairy	Fat	Fruit	Vegetable	Beverage
Percentages									
Moisture	11.732	0.620	70.672	0.396	10.978	80.635	80.535	72.343	82.229
Energy	7.045	-0.336	107.122	0.932	15.728	112.286	115.066	113.812	117.971
Protein	11.635	0.692	96.188	0.819	14.595	107.245	106.789	103.776	109.067
Fat	14.709	0.762	46.956	0.954	6.717	39.201	59.704	57.730	59.672
Carbohydrate	4.180	-0.822	123.381	0.942	18.074	130.517	129.570	128.640	133.316
Calcium	9.570	-0.816	53.470	-0.072	8.923	63.983	63.874	49.626	65.275
Iron	6.928	-0.526	94.474	0.667	14.492	105.677	105.424	100.220	107.919
Phosphorous	14.897	0.663	90.751	0.819	13.713	100.712	100.743	97.113	102.685
Potassium	19.150	2.305	97.869	1.113	14.136	103.545	103.399	102.823	105.616
Sodium	4.532	-0.775	127.630	1.018	18.649	134.612	133.632	133.566	137.477
Thiamine	4.895	-0.560	125.926	1.006	18.396	132.799	131.899	131.807	135.685
Riboflavin	37.912	4.024	64.423	0.930	9.284	69.454	70.676	68.056	70.730
Niacin	12.803	2.974	105.259	1.010	15.468	111.740	111.024	110.988	113.970

Source: Result of Analysis, 2004

food item consumed in the greatest quantity by Nigerian households and beverage is consumed in the least quantity.

Consumption of bread accounts for more than 80% of all energy consumption. Also, bread is a major source of almost all other food nutrients, that is, all other nutrients except fat. The fat food group expectedly has the biggest fat content of all food items. Table 3 presents the source of nutrients and is the first step for obtaining nutrient elasticities for the selected food items.

Food nutrient elasticities: Table 4 shows that bread is the food that would have the greatest implications for the nutrient status of households resident in rural areas. Increasing the prices of these food items by one% would lead to reduced intake of some nutrients. Increasing the income of the respondents would however increase nutrient availability to all the rural households involved in the study.

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 rural households in Nigerian.

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 a vis import restrictions, farm subsidies and associated government legislation on food nutrient status.

On the basis of the findings of this study, therefore, it is recommended that there be especially concerted effort to ensure sustainability in the production of and supply of flour and associated raw materials to, the bread group of products (confectionaries) which have been found to especially impact negatively on nutrient adequacy in rural households in Nigeria.

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