A SYSTEM ANALYSIS OF THE DEMAND FOR ANIMAL PROTEIN IN RURAL AND URBAN NIGERIA: A CASE STUDY OF IBADAN METROPOLIS

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Abstract
The study was designed to quantitatively analyze the demand for animal proteins in Ibadan, Oyo State, Nigeria. The study examined the effects of household’s socio-demographic characteristics as well as price and expenditure elasticities of the share of meat and fish demand in the households’ food basket. The study employed primary data from 360 households sampled with the aid of a well structured questionnaire using multistage random sampling technique. The analytical technique used in the study was the linear Approximately Almost Ideal Demand System (LA/AIDS) model. The Marshallian own and cross price elasticities of demand on the share of meat and fish in the households’ food basket and also computing the expenditure elasticity. However, the results revealed that the demand for beef and fish in the study area is elastic while that of chicken is inelastic. The cross price elasticity showed substitutive relationship between fish and chicken while there is complementary relationship between beef and fish, then beef and chicken. The cross price elasticity also showed that beef and chicken are luxury goods in the study area and fish is a necessity good.

Keywords: Demand, Protein consumption, rural and urban households, Oyo State, Nigeria.

Introduction
Food is a basic necessity of life (Adegbola, 1997). It is however a combination of macro and micro nutrients (Kushwaha et al; 2007). A balanced diet can be defined as one that contains all the six classes of food components viz carbohydrate, protein, vitamins, mineral salts, fat and oil and water. Deficiency in both diet quality and diet quantity is today a global problem (Abdullahi and Aubert, 2004).

Nutrition is the study of how the body uses the nutritive substances or nutrients contained in foodstuff. Nutrients can be defined as the substances contained in the food, which the body needs to function properly (Nestle, Module 1). The three functions of nutrients are to

(i) provide energy (ii) ensure growth and (iii) protect the body. The lack of adequate nutrients in the right proportion in a diet results in malnutrition.

Carbohydrates and Fats are macronutrients that provide energy. Energy is needed mostly for the functioning of essential organs such as the brain, lung and heart and for walking and running. Fats insulate the body. Also, fat-adipose tissues help to hold the body organs in position and to protect them against damage through physical shock.

The main function of protein is to immune the body system against the environment. It also provides energy but this is not considered to be its major function (Nestle, Module 1). Vitamins and minerals are nutrients that enhance the essential chemical reactions necessary to build up and maintain body defence mechanism against diseases and infection.

Diet quality refers to the ability of foods to supply protein of high biological value and adequate supplies of other micro nutrients (Abdullahi and Aubert, 2004).

It is well-known that Nigeria’s per capita intake of high quality animal protein is too low (Edusogie 1971; Olayide et al, 1972; Oyenuga, 1974; FAO, 1990). The health hazards of protein malnutrition have been well documented (FAO, 1965). According to Awosanmi, (1999); there is an increasing evidence of high infant mortality, low resistance to diseases, poor growth and development, mental retardation which comes as a result of inadequate protein in the diets of most Nigerian. According to FAO (1990), the diets of the people of the tropical zone and Nigeria (Tewe, 1993) are usually protein poor.
The problem statement

The greatest challenge facing policy makers in Nigeria is how to improve household food intake. This is in terms of the quality and quantity of diet as well as to address the problem of nutritional imbalance of the teeming population of the country (Abubakar, 1998). Evidence abound in the literature indicating that Nigerians are inadequately fed. This, it is believed to be due mainly to the high cost of animal protein needed for growth and development. (Kushwaha et al; 2007). The starting point towards raising the level of nutrition must be the knowledge of what people eat and the factors affecting their demand for specific food items. Nutrition refers to both the outcome and the process of providing the nutrients needed for health, growth, development and survival. The need for the supply of the right quantity and mix of essential nutrients to the body arises because nutrients have been found to have a strong empirical linkage with both human health and productivity (Aromolaran, 2004).

Malnutrition problems in the developing countries can be examined in terms of the macronutrients (calorie and protein intake) as well as the inadequate consumption of micronutrients (Abdulai and Aubert, 2004). The inadequate intake of these nutrients hinders healthy growths, affects the individual’s ability to undertake productive activities, and lowers the utilization of other nutrients (Aromolaran, 2004).

Malnutrition and under nutrition are still problems of unacceptable proportions in many developing countries (Abdulai and Aubert, 2004). Global surveys revealed that nearly one billion people mostly in developing countries (including Nigeria) are chronically undernourished, lacking sufficient food to live healthy and active lives (Addo, 2001). A healthy and nutritionally well-fed population is indispensable for attaining economic growth and development objectives of a nation yet there have been persistent reports of widespread malnutrition among Nigerians. Malnutrition in Nigeria has been linked to food shortages, both in terms of the quantity available and access to the right type (quality) of food to provide balanced diets (Durojaiye, 2001). A nation that is burdened with under-nutrition will have to make do with a labour force that is lacking in strength and capacity to be fully productive (Belli, 1971).

Objectives of the study

The broad objective of the study is to estimate a demand system of equations for animal protein among rural and urban households in Ibadan, Oyo state, Nigeria. The specific objective includes to:

- determine the budget share of the respective protein sources for the households
- examine the effects of household’s socio-demographic characteristics on the share of the beef, fish and chicken in the households’ food basket.
- quantify the own, cross price and expenditure elasticity of demand for beef, fish and chicken by the households.

Methodology

Area of study

The area of study is the Ibadan zone of Oyo state. Ibadan is the largest city in West Africa. It has a population of over 2 million inhabitants (Census, 2006). It is a densely populated area. The large population provides a ready market for most commodities. Public offices and private businesses offer job opportunities for the population both in the formal and informal sectors. The Ibadan zone is characterized by a clear cut urban-rural nexus and rural-urban linkages. The five Local Government Areas (LGAs) making up the former Ibadan Municipal Government (IMG) are classified strictly as urban LGAs. These LGAs are thus conceptualized within the context of an urban economy.

According to Ricardo (1817) an urban economy is that which is industrialized, commercialized and provides adequate infrastructural facilities (physical, social and institutional). Such an area must have at least 10 out of the 15 other listed characteristics. The characteristics are (1) electricity, (2) pipe-borne water, (3) tarred roads, (4) industries, (5) federal / state government offices, (6) telephone network, (7) banking services, (8) commercial centres, (9) post offices, (10) private / public hospitals, (11) post-primary institutions, (12) public or private intra-town transport services, (13) courts of magisterial status and above, (14) recreation clubs / facilities (hotels,
cinema houses, amusement parks, zoos) and (15) police stations (Falusi, 1995).

The remaining 6 LGAs are classified strictly as rural LGAS. They are thus situated within the rural economy. This is because most farm households and agricultural activities (livestock, fisheries and crop production) are carried out within the peri-urban rural setting of Ibadan due to land scarcity in Ibadan.

**Method of data collection**

Data for the study came from a sample survey of the area of study. The first stage of sampling, in the multistage procedure used, is the selection of the 5 urban and 6 rural LGAs as the sampling frames for this study. In the second stage, the list of all villages/towns within each LGA was obtained from the State’s Ministry of Local Government. From this list, 6 villages/towns were randomly selected for a total of 30 towns and 36 villages. The third stage involved randomly selecting 5 farm households in each village and 6 households in each town for a total of 180 households in the rural LGAs and 180 households in the towns for a total of 360 households. The data were collected through the use of a structured questionnaire.

Information was collected on the household’s socio-economic characteristics - age, sex, education, occupation, average monthly income and expenditure, marital status, etc. of each member, and the household size at the first visit. In every visit, data on households’ expenditure on (or worth of) various food commodities consumed jointly as well as individually by members of the household were obtained. In addition, the unit cost (price) per kilogram of the various foods items was obtained.

**Methods of data analysis**

**Analytical technique**

The demand system was estimated by using the Linear Approximate Almost Ideal system (L\AIDS) model using Seemingly Unrelated (SUR) estimator (Buse, 1994) as against the AIDS model (See Stone, 1954; Theil, 1965)

The L\AIDS model as a system of equation is specified as:

\[ W_{ij} = \alpha_i + \sum_{j} \beta_{ij} \log P_{ij} + \theta (\log (X_i / P^*) + \sum_{i} \delta_i Z_i + \epsilon_i \]  \( i \) \( j \) \( (1) \)

The price deflator \( P^* \) equals: 

\[ \log P^* = \sum W_{j} \log P_{j} \]  \( (2) \)

In order to overcome the problem of non-linearity, Deaton and Muellbauer (1980), Deaton (1988) suggested the use of the linear price index above which is the one used in this study.

**Restrictions**

To ensure theoretical consistency of the L\AIDS model, certain restrictions such as adding-up, symmetric and homogeneity must be imposed on the model.

The adding up restriction is: 

\[ \sum W_j = 1, \quad \sum \alpha_j = 1 \]  \( (3) \)

The implication of the adding-up restriction is that one equation will drop in the estimation because the system becomes singular when the adding-up restriction is imposed. All the parameters of the drop equation will be fully recovered by using the set of the restrictions.

Symmetry restriction is 

\[ \beta_{ij} = \beta_{ji} \]  \( (4) \)

Homogeneity restriction is 

\[ \sum \beta_{j} = 0, \quad \sum \delta_{i} = 0 \]  where 

\[ W_{ij} = \text{the budget share of } j\text{th animal protein (beef, fish, chicken) of the } i\text{th household, } X_{i} = \text{the total expenditure of the } i\text{th household, } Z_{i} = \text{the household’s socio-demographic characteristics, } P_{j} = \text{is the price of the } j\text{th animal protein items in the households food basket i.e. (beef, fish and chicken), } \epsilon = \text{is the error terms assume to normally distributed with mean zero and constant variance.} \]

**Results and discussions**

The results of the study are presented in this section

<table>
<thead>
<tr>
<th>Items</th>
<th>Beef</th>
<th>Fish</th>
<th>Chicken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share in %</td>
<td>45.3</td>
<td>36.5</td>
<td>18.2</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Table 1 shows the percentage share of the total expenditure devoted to the beef, fish and chicken by the households in the study area. The budget share indicated that the sampled households spent about 45.3% of their budget on beef. This is followed by about 36.5% on fish and about 18.2% is spent on chicken. On a sectoral basis, households in the rural area spent a larger part of their budget
share on beef compared to urban households. However, this quite surprising, but from discussion during the field survey it was discovered that the respondents in the urban centers reduce their meat intake due to awareness on some side effects of red meat (beef) on health.

Table 2: Results of the estimated LA/AIDS Model for Rural and Urban Ibadan

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beef</th>
<th>Fish</th>
<th>Chicken</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBeef (P1)</td>
<td>-0.2721</td>
<td>0.3811*</td>
<td>-0.1090</td>
</tr>
<tr>
<td>PFish (P2)</td>
<td>-0.1864***</td>
<td>0.3693***</td>
<td>-0.1829***</td>
</tr>
<tr>
<td>PChicken (P3)</td>
<td>-0.4982***</td>
<td>0.2314***</td>
<td>0.2668***</td>
</tr>
<tr>
<td>Expenditure</td>
<td>0.1531**</td>
<td>-0.1964***</td>
<td>0.0415</td>
</tr>
<tr>
<td>Educ Head</td>
<td>0.0068*</td>
<td>0.0053</td>
<td>-0.0121*</td>
</tr>
<tr>
<td>H/Hold Size</td>
<td>-0.1204**</td>
<td>-0.0921**</td>
<td>0.2125***</td>
</tr>
<tr>
<td>Depend Ratio</td>
<td>-0.1361**</td>
<td>0.2784*</td>
<td>-0.1419</td>
</tr>
<tr>
<td>Occup Head</td>
<td>0.2431*</td>
<td>0.1165</td>
<td>-0.3596**</td>
</tr>
<tr>
<td>Location</td>
<td>0.2273***</td>
<td>-0.1948**</td>
<td>-0.0325**</td>
</tr>
<tr>
<td>Constant</td>
<td>0.6142</td>
<td>0.2348</td>
<td>0.1510</td>
</tr>
</tbody>
</table>

Source : Field Survey, 2011.

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

Table 2 contains the results of the LA/AIDS equations estimated using the iterative seemingly unrelated regression (ISURE). The set of restrictions such as additivity, symmetric, homogenous needed for demand analysis of this nature was imposed. Such imposition leads to singular variance/covariance matrix problem in the ISURE. Therefore, to avoid singularity problem, the chicken share equation was dropped from the system of demand equations. Hence, only two of the three equations were estimated. The parameters for the chicken equation were later re-called using the set of restrictions mentioned above as often done in most demand analysis. The parameters of the chicken equation c are recovered using the adding up restriction earlier discussed, because share equation for chicken was dropped to avoid singular variance covariance matrix problem. The standard errors of the dropped equation were obtained by using Delta method.

The estimated equations contain some statistically significant coefficients. The coefficients of determination R² are 0.6532, 0.5481 and 0.5503 for beef, fish and chicken respectively. The implication of this is that for the beef equation, the 65% variation in the dependent variable is explained by the independent variables. Also, 55% deviation in the dependent variable is explained by independent variables in the fish equation while 55% variation in the dependent variable is explained by the independent variables in the chicken equation. The coefficients of the prices and expenditure in the share equations have no economic significance or interpretation. The estimated parameters from these variables form the basis for the calculation of the Marshallian and expenditure elasticities.

With regard to the variable Location, for the share of beef equation, the result shows that there is a significant difference from the share of households’ budget devoted to beef, fish and chicken by the households in the rural and urban areas in the study area. The results show the significant variables and the level of significance indicated by the number of asterisks they carry.

Table 3: Own and Cross Elasticities for Animal Protein Demand

<table>
<thead>
<tr>
<th></th>
<th>Beef</th>
<th>Fish</th>
<th>Chicken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>-1.2465</td>
<td>1.0822</td>
<td>-0.8467</td>
</tr>
<tr>
<td>Fish</td>
<td>-0.6381</td>
<td>-1.4796</td>
<td>-1.2439</td>
</tr>
<tr>
<td>Chicken</td>
<td>-1.3757</td>
<td>0.7845</td>
<td>-0.6284</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011. own prices are in bold, the others are cross price elasticities.

Table 3 presents the estimates of Marshallian own-price elasticities and expenditure elasticities. The own price elasticities are all found to be negative as expected which is in conformity with theoretical a priori expectations. The cross price elasticity shows that there is substitutability between beef and fish on one hand and fish and chicken on the other hand. It also shows that fish and beef are complementary sources of protein to the households. This is in conformity with the work of Alboghady and Alashry (2010).
Table 4: Expenditure Elasticities from the estimated model

<table>
<thead>
<tr>
<th>Items</th>
<th>Beef</th>
<th>Fish</th>
<th>Chicken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure Elasticities</td>
<td>1.0026</td>
<td>0.7532</td>
<td>1.0243</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Table 4 contains the expenditure elasticities and they are as expected. The positive coefficient according to a priori expectation implies that beef, fish and chicken are normal goods. Beef and chicken have expenditure elasticity greater than fish implying they are luxury goods and that increase in expenditure will increase their consumption in the study area. This result of beef expenditure elasticity conforms with its elasticity in the estimate of meat demand in Jordan by Jabarin (2005), and meat demand in Egypt by Alboghady and Alashry (2010). Fish has expenditure elasticity less than one implying it is a necessity good in the study area.

Summary of the study.
This study was designed to carry out a research on demand for animal protein among rural and urban households in Ibadan, Oyo state of Nigeria with a view to examining the effects of some socio-demographic characteristics and prices and expenditure on the demand for beef, fish and chicken protein in the study area. The study involved collection and analysis of data from 360 respondents from the 11 Local Government Areas of Ibadan Metropolis. Linear Approximate/Almost Ideal demand systems Model was used to estimate uncompensated and expenditure elasticities. The Marshallian own price elasticity show the expected negative sign with fish having the highest value, followed by beef and then chicken. The cross price elasticities show substitutive relationship between fish and chicken and complementary relationship between fish and beef and also chicken and beef. The expenditure elasticity of beef and chicken are greater than one which implies they are luxury goods in the study area and fish has elasticity less than one which implies they are necessity goods in the study area.

Conclusion
The households’ consumption of animal protein has been discussed based on the results obtained. The empirical results suggest several points of interest for researchers, policy makers, planners and traders with involvement in Nigerian food production and marketing. It is evident from the study that the demand for animal protein in the study area is mostly affected by socio-demographic characteristics. The elasticities show that the price of the animal protein affects their consumption. It is believe that this study will serve as a source of information for studies on other areas of Nigeria. It is also believed that the results herein will be useful to policy makers in formulating policies on protein consumption in the area of study in particular and Nigeria in general.

Policy implications
Policy intervention on animal protein production and consumption are needed. These should focus on stimulating the demand and consumption of animal protein. The policies should also focus on the reduction of expenditure on food and the prices of the relevant protein sources. For the institution of designs aimed at improving protein consumption in the study area, it is however, important that such policies address price related issue. In view of this, efforts should be made at increasing capital investment in the livestock sector of the economy, grants, loans and subsidies should be provided to livestock farmers and marketers to enable them purchase modern equipment in order to increase supply. For any food policy to be effective in alleviating the problems of food insecurity and malnutrition, attention must be paid to the significant factors identified in this study.

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