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# Food Security Implications of Protein Demand of Underutilised Indigenous Vegetables Farming Households in Southwestern Nigeria

**Adeolu B. Ayanwale[1,*], Adesiyan O. Funmilola[1], Adelekun. C. Abiodun[1], Ojo. P. Mathew[1], Ajekigbe N Alaba[1], Durodoluwa J. Oyedele[2]**

[1]Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Soil and Land Resources Management, Obafemi Awolowo University, Ile-Ife, Nigeria
*Corresponding author: aayanwa@yahoo.co.uk

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**Abstract** **Background**: In spite of Nigeria's huge agricultural and human resources potential, recent reports state that most farming households are on the verge of acute food insecurity. Commonly adduced reasons for the food insecurity status do not accord adequate attention the critical role the demand for nutritious protein by these resource-poor farming households especially those cultivating Underutilised Indigenous Vegetables (UIV) plays. This study therefore examines the nature of demand for protein among the UIV farming households and its implication for food security. **Methodology/Principal Findings**: The study area was all the six states in the Southwestern part of Nigeria and Kwara state. Primary data was collected in 144 communities among 1089 households. Findings indicate that the majority of the household experience food shortages on a weekly basis. They cope by borrowing money as well as reducing the quality and quantity of food eaten. A Quadratic Almost Ideal Demand System (QUAIDS) model considered proteinous food items which include egg, chicken, pork, fish, milk, beef and bushmeat. Price elasticity of egg is unitary; chicken, pork and bushmeat are elastic; and fish and milk are inelastic. Pork is the most price elastic. Beef exhibits a Veblen effect and its only substitute is the bushmeat. Chicken, milk and fish are inferior goods while egg is a necessity. Sex, age, household size and educational level significantly affect the budget share to protein among the producers. **Conclusion/Significance**: The study established that poor UIV farming households consider consumption of proteinous food items as a privilege in display of better social status because they (proteinous food items) command higher prices. Others not so privileged farming households seek cheaper alternatives by consuming bush meats and UIVs which thus becomes important in the food security equation.

***Keywords:*** *QUAIDS, underutilized indigenous vegetables, Price elasticity, food security, inferior goods*

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## 1. Introduction

Food security refers to the ability of a household to secure at all times, either from its own production or through purchases, sufficient, safe and nutritious food for meeting the dietary needs and preferences of all its members [1] for an active and healthy lifestyle [2]. This implies physical access to food relating to issues of food supply or food availability; economic access to food as is concerned with capacity to purchase or acquire food; while sustainability of access to food deals with food supply and demand issues that determine the ability of a nation or household to enjoy stable sustained physical and economic access to food over time [3]. In most African countries, rural households produce between 60 and 80% of the food depending on the region [4]. Despite their effort and active participation in food production, 30% of people in Africa are malnourished as at 2010 and over 40% of Nigerians are food insecure [5]. Indeed, report has it that nationally, most households operate seasonally typical access to food and income and remain in minimal acute food insecurity [6].

Though, the proportion of undernourished in total population decreased from 20.8 million in 1992 to 8.9 million in 2008, it increased again to 11.9 million in 2015. Dietary Energy Supply (DES) derived from cereals, roots and tubers decreased from 68% in 1990 to 66% in 2014, while, the minimum dietary energy requirement increased from 1710Kcal in 1992 to 2639 kcal/pc/day in 2014 [7]. However, this is far less than the 3400Kcal average minimum daily energy requirement per person as recommended by FAO. Other food values such as proteins

fall far below the component directory requirements. According to [7], the daily recommended safe level of protein for adults across genders and ages in Nigeria is between 65 and 85g per person. The current supply of protein per capita/day protein intake in Nigeria is 51gm while that from animal sources is 15gm. The recommended protein from animal source is 35gm/capita/day. The quality of the diet of the nation shows an imbalance as a result of heavy dependence on root crops, tubers and cereals as evidence indicates that calories value could be attributed mainly to carbohydrate consumption.

Majority of the peasant farming households resides mainly in the rural areas, and are poorer and less food secure than the rest of the population [8]. Most indigenous vegetable producers are rural peasant farmers constituting the poorest of the poor in their communities. They are part of the rural farming households, which according to [9] constitute about 71 % that are food insecure. Such households have limited economic and physical capacity to sustain their present level of wellbeing or cope with economic shocks [10]. They also experience food shortages during a significant number of months in a year. Reasons adduced to this are the rain-fed nature of cultivation and vulnerability to drought; small scale production with extensive use of primitive farm implements; lack of bulk storage and inefficient food processing facilities also constitute major bottlenecks [11]. They rely on the vegetables grown for essential macro and micronutrients. Vegetables, without the addition of important food elements, cannot meet the basic energy requirement needed for daily activities. Rural farmers may also trade off household consumption of high value vegetables for sale in the market in order to earn more income; the income which may not be used for the purchase of nutritious food items further deepening their deprivation. In addition, rich sources of protein are becoming increasingly expensive beyond the reach of these poor farmers. Moreover, vegetables being produce by the farmers are price inelastic [12] implying that the income from the enterprise do not keep up with the rising prices of protein food sources.

[13] established that when food price increases farming households devise coping strategies such as reducing their number of meals, the quality and variety of their diet, sell some animals and in some cases, withdrawing their children from school [14]. Food price increase the prices of imported commodities like fish, beef and milk and limits the households' ability to purchase such food items. These food items are very essential in boosting the nutritional status of farming households. Animal protein is an essential part of human nutrition because of its biological significance. [15] reported that proteins are required for the growth of young ones, formation of gametes in reproduction, formation of digestive juices, repair of worn-out tissues or cells, production of anti-bodies as well as enzymes and hormones in the body. They provide important sources of iron, vitamins, and phosphorous. [16] reaffirmed that animal proteins are more "biologically complete" than vegetable proteins in terms of their amino-acids composition. These food sources are thus easily neglected when their prices go up despite their huge importance.

Indigenous vegetable farmers are important in the food equation of the country. If the current supply of protein from animal source per capital/per person/day in Nigeria is 15g, then, it is plausible to say that the rest of the protein requirement is obtained from other food crops such as vegetables. Indigenous vegetables farmers offer a cheap source of protein and other macronutrients and micronutrients for millions of poor families who may not afford the relatively expensive conventional and exotic vegetables. A nutritionally adequate diet is seen as a precondition for a higher level of economic productivity in own-farm production [17] in the activities of the indigenous vegetable farmers. The aftermath effect of inadequacy in the availability of minimum food requirement lead to increasing cases of nutritional deficiency symptoms and relatively reduced resistance to disease in the body which proteinous food could check [18]. This could impair the role these farmers play in the sustainability of food security of their region. Advancing the understanding of the types of coping strategies adopted during lean periods, the consumption pattern and the demand for protein and its determinants could shed light on the implications of proteinous food insecurity on households' welfare and other ways of promoting household food security among the indigenous vegetable farmers. Existing literature focused on the food demand of farming households in Nigeria [19,20]. A number of studies also investigated demand for proteins among rural households [21,22]. However, studies investigating the demand for protein food sources among indigenous vegetable farmers are rather scarce.

This study, therefore, seeks to evaluate protein demand among indigenous vegetable producers. It specifically aimed to;

i. investigate food shortages and the coping strategies of the indigenous vegetable farmers in the study area
ii. identify the consumption pattern of the farmers
iii. estimate own price, cross price and expenditure elasticity of demand for protein in the study area
iv. examine the effects of household's socio-demographic characteristics on the share of the protein food sources in the households' food basket.

## 2. Empirical Model

To apply demand theory in the real world, empirical model of demand system is needed. Application of demand systems enables the modeling of allocation of total expenditures among commodities given a certain budget set. Estimating responsiveness of prices, income and demographic factors to demand requires the application of utility-based demand models. The [23] Linear Expenditure System (LES) and [24] Rotterdam model are among the first attempts to derive utility-based demand models. They, however, imposed theoretical restrictions that are not flexible. Based on features of each model, LES has a problem in describing demand behavior based on Engel's law. As income increase, a good might change from normal to inferior good which is implausible to examine in LES. The Rotterdam system is consistent with demand theory and has ability to examine relation across commodities. However, since it is not derived from specific utility or cost function, the model is inconsistent with utility maximizing behavior [25].

In the 1970's researchers thoroughly focused on developing a flexible functional form. The transcendental logarithmic (translog) system of [26]; its modified version of [27] and the Almost Ideal Demand System (AIDS) of [28] are among the two models developed for estimating flexible demand systems. The models necessitate approximating direct and indirect utility functions or the cost function with some specific functional form that has enough parameters to be regarded as a reasonable approximation to whatever the true unknown function might be [29]. They are members of the Price Independent Generalized Logarithmic (PIGLOG) class of demand models [30], which have budget shares that are linear functions of log total expenditure. The translog model is favorable in terms of its flexibility of functional form but has a major problem in the estimation due to relatively large number of independent parameters.

AIDS demand function satisfies a number of desirable demand properties and its estimation is less complicated than other models [25]. AIDS model satisfies axioms of choice exactly and allows exact aggregation over consumer. It can be used to test the restriction of homogeneity and symmetry through linear restriction on fixed parameters (see [31]). Moreover, it allows a linear approximation at estimation stage and has budget shares as dependent variables and logarithm of prices and real expenditure/income as regressors. [32], however, observed the existence of nonlinearity in the budget shares for some, if not all, commodities and subsequently introduced an extension to permit non-linear Engle Curves. They proposed a generalized Quadratic Almost Ideal Demand System (QUAIDS) model which has budget shares that are quadratic in log total expenditure. Moreover, the QUAIDS retains the desirable properties of the popular AIDS model nested within it and allows for flexibility of a rank three specification in the Engel curves. The intuitive explanation of the quadratic term is that, goods can be luxurious at low levels of total expenditure and necessities at higher levels [33]. QUAIDS combines the empirical flexibility of quadratic logarithmic Engel curves with integrability.

## 3. Methodology

This study investigated UIV household demand for protein food sources in the Southwestern part of Nigeria and Kwara state. Primary data was collected with the use of a well pre-tested questionnaire. 144 communities were covered for the study. Data was collected on input and output quantities and prices, food and nonfood purchases quantities per week and prices. About 1089 households were interviewed for the study. Focused Group Discussion was also conducted in each of the communities visited.

### 3.1. Model Specification

Food consumption is assumed to be weakly separable from the non-food consumption and the vegetable consumption is assumed to be weakly separable from other food consumption. Following [34] and [35], we assumed that the consumer's utility maximization decision can be decomposed into three separate stages. In the first stage, the total expenditures are allocated over the food and non-food items. In the second stage, food expenditures are then allocated over the protein food sources and other food items. In the third stage, the protein food sources expenditures are allocated over the following protein food sources commodities: Beef, Chicken, Fish, Pork, Bushmeat, Milk and Egg.

Given a situation of the multi-stage budgeting, let $q$ denote the vector of goods demanded by the consumer and $p$ be the corresponding vector of all prices. Further, let $y$ be the total expenditure and V($p$) represent the indirect utility function, which is continuous, non-decreasing and quasi-convex in $p$, homogenous of degree zero in $(p, y)$. In general, a household solves the following indirect utility function;

$$MaxV\{V_1(p_1), V_2[V_{21}(p_{211}, p_{212}, \ldots, p_{21n}), V_{22}(p_{22})]\} \quad (1)$$

where $V_1$, $V_2$, $V_{21}$, $V_{22}$ each represents the indirect utility from consuming the non-food, food, protein food sources, and non- protein food sources, respectively. Thus, the indirect utility from consuming protein food sources ($V_{21}$) is a function of the vector of prices for all protein food items [$p_{211}, p_{212}, \ldots, p_{21n}$], where $i = 1, \ldots, n$.

Generally, household preferences follow the indirect utility function:

$$lnV = \left\{ \left[ \frac{lnm - lna(p)^{-1}}{b(p)} + \lambda(p) \right] \right\}^{-1} \quad (2)$$

where the term [ln$m$ - ln$a$(p)]/$b$(p) is the indirect utility function of the Price-Independent Generalised Logarithmic (PIGLOG) demand system, $m$ is household income, and a(p), $b$(p) and $\lambda$(p) are functions of the vector of prices p.

To ensure the homogeneity property of the indirect utility function, it is required that $a$(p) is homogenous of degree one in $p$, and $b$(p) and $\lambda$(p) are homogenous of degree zero in p. The price index ln$a$(p) has the usual translog form;

$$lna(p) = \alpha_0 + \sum_j \alpha_j \ln p_j + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j,$$

$b$(p) is the simple Cobb-Douglas price aggregator defined as

$$b(p) = \prod_i p_i^{\beta_i}$$

and $\lambda(p)$ is defined as

$$\lambda(p) = \sum_i \lambda_i \ln p_i$$

where $\sum_i \lambda_i = 0$.

Application of Roy's identity to (1) gives the QUAIDS budget share equations. To control for varying preference structures and heterogeneity across households, we incorporate demographic variables (**z**) into the QUAIDS model through the linear demographic translating method [36]. This leads to the following empirical specification of the QUAIDS budget share equations;

$$w_i = \alpha_i \sum_j \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 + \sum \delta_{is} z_s \quad (3)$$

where $z_s = (z_{1,\ldots,} z_L)$ is a set of demographic variables.

For theoretical consistency and to reduce the number of parameters to be estimated adding-up, homogeneity and symmetry restrictions are commonly imposed. The fact that $\sum_i w_i = 1$ called the adding-up condition, requires that $\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_i \lambda_i = 0$ and $\sum_i \gamma_{ij} = 0 \; \forall j$.

Moreover, since demand functions are homogeneous of degree zero in (p,m) $\sum_i \gamma_{ij} = 0 \; \forall j$. And Slutsky symmetry implies that $0 \; \forall j \; \gamma_{ij} = \gamma_{ji} = \forall i \neq j$.

These conditions are trivially satisfied for a model with *n* goods when the estimation is carried out on a subset of *n* - 1 independent equations. The parameters of the dropped equation are then computed from the restrictions and the estimated parameters of the *n* - 1 expenditure shares.

Then the expenditure and the uncompensated price elasticities are computed as; $e_i = \mu_i/\omega_i + 1$ and, $e_{ij}^{\mu} = \mu_{ij}/\omega_i - \delta_{ij}$ respectively; $\delta_{ij}$ represents Kronecker delta taking value 1 if *i*=*j* and 0 otherwise. Using the Slutsky equation, we can finally compute compensated price elasticities: $e_{ij}^{c} = e_{ij}^{\mu} + e_i \omega_j$

## 3.2. Empirical Specification of the Demand System

$$w_i = \alpha_i \sum_j \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 + \sum \delta_{is} z_s$$

i,j = Beef, Chicken, Fish, Pork, Bushmeat, Milk and egg

*i, j* = protein food products;

$w_i$ is the expenditure share associated with the i*th* protein food product;

$\alpha_i$ is the constant coefficient in the i*th* share equation;

$\gamma_{ij}$ is the slope coefficient associated with the *jth* protein food product in the *ith* 'share equation;

$p_j$ is the price index of the *jth* food product;

$m$ is the total expenditure on the protein food; and

$z_s = (z_{1,\ldots,} z_L)$ is a set of demographic variables.

As in the theoretical model, $\ln a(p)$ and $\ln b(p)$ are specified as the translog and Cobb-Douglas equations.

# 4. Results and Discussions

## 4.1. Food Shortages and Coping Strategies of the Farmers

### 4.1.1. Food Shortages Experienced by the Respondents

The results in Table 1 shows that majority (74%) of the UIV producers experienced food shortage on weekly basis in the last cropping season 2014/2015 cropping season. This implies that the food shortfall is persistent rather than seasonal and the welfare of most of the UIV producers is under threat in that cropping season. This could result in reduced asset holding, increase indebtedness, and reduced uptake of micro and macro nutrient [37]. Food shortages occur either due to the scarcity or non-existence of actual food supplies; inaccessibility of food to people for economic reasons even when it might be available for purchase; or when the shortage is as a result of famine, usually precipitated by a natural disaster [38]. Since there is neither the record of an act of God in the area nor of the inexistence of food items in the market, food shortages amongst the farmers could be attributed to lack of income to purchase required food items for consumption. According to [39], households that do not produce staples such as rice, maize, yam, cassava that could be sold for income and also stored for longer period but rely entirely on food bought from markets, suffer most when food price increases.

**Table 1. Do you experience food shortages in a week**

| Do you experience food shortages | |
|---|---|
| Yes | 74% |
| No | 20% |
| No Response | 6% |
| Total | 100% |

Source: Data analysis 2016.

### 4.1.2. Coping Strategies of Vegetable Farmers

Table 2 presents the practices that farmers take as a decision to mitigate and escape during shortfall of food availability and access. As a result of food insufficiency on a weekly basis, 63% of the UIV producers had to borrow money and at the same time reduce the quantity of meal per person. In addition, 10% of the children from UIV producing families ate less meals, 5% of mothers and 5% of fathers also ate less food. The use of coping strategies in the study area is a reflection of poor access to food by farmers

**Table 2. Distribution of the coping strategies of the vegetable farmers**

| Strategy | Percentage |
|---|---|
| Borrowed money and reduced meals | 63 |
| Children ate less | 10 |
| Mother ate less | 5 |
| Father ate less | 5 |
| Substituted meals with cheaper food | 3 |
| Used modified cooking methods | 4 |
| Sold assets to feed the family | 4 |
| Others | 6 |
| Total | 100% |

Source: Data analysis 2016.

### 4.1.3. Consumption Pattern of UIV Producers

The results as presented in Table 3 reveal that per capita expenditure on weekly basis among UIV growers is highest on Yam (₦135) and least on sweet potato in the food group of roots and tuber. Concerning legumes, cowpea expenditure ranks highest (₦ 99) and lowest with groundnut (₦ 19) among the producers. The table also

shows that UIV farmers spend ₦ 187 per week per person on rice and about ₦ 16 on wheat. In addition, the UIV producers also spend most on banana (₦ 43) in the group of fruits and on tomatoes (₦ 101) in the food group of vegetables. In the world of animal protein, the producers spend more on fish (₦ 187), followed by meat (₦ 159) and bush meat (₦ 132). The least they expend on in this group is egg (₦ 33). These suggest that UIV producers in the Southern part of Nigeria spend more on yam, cowpea, rice, banana and fish.

**Table 3. Per capita expenditure of vegetable farmers per week**

| Food items | Mean and SD |
|---|---|
| Cassava flour | 36.67(57.93) |
| Gaari | 64.43(62.30) |
| Yam | 135(116) |
| Yam flour | 98(126) |
| Sweet Potato | 27(58) |
| Cocoyam | 50(76) |
| *Roots and Tuber* | *412(34)* |
| | |
| Cowpea | 99(122) |
| Groundnut | 19(67) |
| Soybean | 23(508) |
| Melon | 77(90) |
| Locust bean | 37(45) |
| *Legume* | *257(566)* |
| | |
| Maize | 40(57) |
| Guinea Corn | 12(54) |
| Millet | 6(20) |
| Rice | 187(163) |
| Wheat | 16(38) |
| Bread | 75(96) |
| *Cereals* | *336(279)* |
| | |
| Pawpaw | 31(47) |
| Orange | 34(44) |
| Banana | 43(76) |
| *Fruits* | *191(192)* |
| | |
| Onions | 25(30) |
| Okro | 14(20) |
| Tomatoes | 101(46) |
| Pepper | 34(46) |
| | |
| Beef | 159(273) |
| Chicken | 78(162) |
| Bush meat | 132(330) |
| Fish | 187(210) |
| Milk | 62(77) |
| Egg | 33(36) |
| *Animal Protein* | *665(715)* |
| | |
| Vegetable oil | 43(36) |
| Palm oil | 31(33) |
| *Fats and Oil* | *74(62)* |
| | |
| Tea and Coffee | 64(91) |
| Non-alcoholic drinks | 35(56) |
| Maggi | 74(62) |

Source: Data analysis 2016.

## 4.2. Results of Demand for Animal Protein among UIV Farmers

### 4.2.1. Own Price Elasticity of Demand

In Table 4, both uncompensated and compensated own price elasticity of all the protein food sources were of the appropriate negative sign except beef indicating that increase in price leads to reduction in quantity demanded. The absolute value of the elasticity revealed that the demand for pork, bushmeat and chicken were price elastic while fish, milk and egg were inelastic. This implies that fish, milk and egg were necessities. Of all, pork was the most responsive and egg was the least elastic. The positive elasticity for beef is positive indicating that at higher prices, more would be demanded. This is a Veblen effect such that the farming household regards the consumption of beef, whose price may be relatively higher and hence more scarce, as showing a better social status or success than their neighbours.

The uncompensated elasticity of demand refers to changes in the quantity demanded as a result of changes in the prices in the absence of any compensation in terms of either price change or income change. It represents the general price elasticity of demand. On the other hand, compensated elasticity of demand refers to that portion of total change in the quantity demanded which is compensated by price changes representing the substitution effect. Once the allowance for price compensation in the uncompensated elasticity is made, the remaining is the income effect.

The estimated uncompensated own price elasticity indicated that if price increases by 10%, the demand for pork, bushmeat chicken, fish, milk and egg would reduce by 193.4%, 20.2%, 20.0%, 9.3%%, 3.4% and 0.7% respectively. Of this total increase in demand, 193.3%, 18.6%, 19.0%, 6.1%, 2.4% and 10.1% were purely due to substitution effect as the compensation elasticity suggests. The remaining 0.1%, 1.6%, 1.0%, 3.2%, 1.0% and 9.4% is accounted for by the income effect of the fall in price. The income effect shows that all the protein food sources, except egg, are normal goods in which a rise in price results in reduction in purchasing power and hence less consumption. There is further reduction in the quantity demanded through the substitution for other protein source. This accounts for the negative signs. Table 4 showed that substitution effect is high for bushmeat, chicken and pork while the income effect is comparatively low. Bushmeat and chicken serve as substitutes for other relatively scarce and more expensive protein source which may not be readily found on the farm. Pork is not a generally acceptable protein source in most part of the Southwest [40], this suggest that it can readily be substituted for with other protein sources.

Egg is an inferior good with the positive income effect almost as large as the negative substitution effect. This implies that though egg is a necessity, it may also be a normal good at higher level of income. The estimated Hicksian elasticity for beef showed a rare phenomenon of a positive substitution effect. This may be explained by a replacement theory, expounded by [41] and further explained by [42]. In this case, the producers sees beef as a luxury which no close substitute could provide the same

level of utility, hence as price increases, they substitute the relatively expensive meaty beef with cheaper and less quality part such as the bony beef or cow skin.

**Table 4. Income and Substitution effect of elasticity of Demand**

| | uncompensated (Marshallian)Total elasticity | compensated (Hicksian) substitution effect | Income effect |
|---|---|---|---|
| Beef | 0.0792 | 0.3233* | -0.2441 |
| Chicken | -1.9983 | -1.9023* | -0.096 |
| Fish | -0.9286 | -0.6054 | -0.3232* |
| Pork | -19.338 | -19.325* | -0.0129 |
| bushmeat | -2.0237 | -1.8616* | -0.1621 |
| Milk | -0.3398 | -0.2375* | -0.1023 |
| Egg | -0.0653 | -1.006 | 0.9407* |

Source: Data analysis 2016, * significant at 5% level.

### 4.2.2. Cross-price Elasticity of Demand

In Table 5, uncompensated elasticity suggests both substitution and complementary relationship while compensated elasticities are dominated primarily by substitution relationship among the protein food sources. All the cross-price elasticities are significant at 5% except the complementary relationship between chicken vs bushmeat, chicken vs milk and the substitution relationship between pork vs bushmeat. The uncompensated elasticities revealed that bushmeat serves as a significant substitute for other protein source such as beef, fish, milk and egg. This might be attributed to the fact that it could readily be obtained in the rural areas either by purchase or by the hunting and trapping activities of the rural households. Consequently, rural farming households could fall back on bushmeat as a source of protein during lean seasons since access to it has complementarity with farming activities.

The relationship between chicken and egg is complementary in both uncompensated and compensated elasticities. This is because in many farming households, rearing of chicken connote the availability of eggs that are being produced from them. Both uncompensated and compensated cross-price elasticities is negative for beef and other protein sources except bushmeat. This implies that despite the removal of income effect, beef serves as a complement to other protein sources rather than a substitute indicating that the farmers viewed beef as a distinct protein source of which other type may not yield the same utility. Pork has a substitution relationship with all the other protein sources. This may be as a result of the existence of cultural and religious bias against its consumption among many consumers in Southwest Nigeria.

Bushmeat, egg and milk are being substituted for the relatively more expensive fish. In addition, Hicksian elasticity presented a substituted relationship between fish and milk. However, with the inclusion of the income effect in the Marshallian elasticity, the relationship becomes complementary; implying "*a priori*" that increase in real power affords the farmers the opportunity to purchase fish along with milk. This contrasting result is cleared in Table 7. Table 7 revealed that the pattern of demand for fish and egg did not follow the Marshallian view since a unit increase in real income leads to about 0.03% reduction in the budget share of fish. This implies that the present compensation in income is not sufficient to encourage the purchase of fish. Egg serves as a substitute to all the relatively more expensive beef, bushmeat and fish and the less desirable pork but has a complementary relationship with the relatively less expensive milk and chicken.

**Table 5. Cross-price elasticity of demand**

| | | Uncompensated | compensated |
|---|---|---|---|
| 1 | Beef vs chicken* | -0.6397 | -0.3956 |
| 2 | Beef vc fish* | -0.5404 | -0.3919 |
| 3 | Beef vs pork** | -0.5510 | -0.3070 |
| 4 | Beef vs bushmeat* | 0.2280 | 0.4723 |
| 5 | Beef vs milk* | -0.4358 | -0.1915 |
| 6 | Beef vs egg* | -0.2145 | 0.0297 |
| 7 | Chicken vs fish | 0.2297 | 0.5527 |
| 8 | Chicken vs pork* | 13.8992 | 13.9952 |
| 9 | Chicken vs bushmeat | -0.0025 | 0.1580 |
| 10 | Chicken vs milk | -0.0610 | 0.0351 |
| 11 | Chicken vs egg* | -0.6231 | -0.5271 |
| 12 | fish vs pork* | 2.0075 | 2.3304 |
| 13 | fish vs bushmeat* | 0.6572 | 0.9805 |
| 14 | fish vs milk* | -0.2453 | 0.0780 |
| 15 | fish vs egg* | 0.3757 | 0.6988 |
| 16 | pork vs bushmeat | 0.0094 | 0.0222 |
| 17 | pork vs milk* | 0.0767 | 0.0896 |
| 18 | pork vs egg* | 0.4893 | 0.5021 |
| 19 | bushmeat vs milk* | 0.0955 | 0.2575 |
| 20 | bushmeat vs egg* | 0.1939 | 0.3560 |
| 21 | Milk vs egg* | -0.1559 | -0.0536 |

Source: Data analysis 2016, * significant at 5% level.

**Table 6. Expenditure elasticity of Demand**

| | Expenditure (income) elasticity |
|---|---|
| Beef | 0.0071322 |
| Chicken | 0.00534 |
| Fish | 0.2507466* |
| Pork | 0.1173616* |
| bushmeat | 0.4267817* |
| Milk | 0.1659398* |
| Egg | 0.0320383 |

Source: Data analysis 2016.

**Table 7. Effect of the budget share of the protein sources on real income (proxied by expenditure)**

| Dependent variable (real income) | Coefficient | Standard error | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| Beef | 0.0001104 | 0.0000737 | 0.134 | -0.0000342 | 0.0002549 |
| Chicken | -0.0000534 | 0.000067 | 0.426 | -0.0001847 | 0.000078 |
| Fish | -0.000255*** | 0.0000963 | 0.008 | -0.0004437 | -0.0000663 |
| Pork | .0000252 | 0.0000196 | 0.198 | -0.0000132 | 0.0000635 |
| bush meat | 0.0001494 | 0.0001026 | 0.145 | -0.0000516 | 0.0003505 |
| Milk | -0.000033 | 0.0000443 | 0.457 | -0.0001198 | .0000539 |
| Egg | 0.0000563*** | 0.0000253 | 0.026 | 6.78e-06 | 0.0001059 |

Source: Data analysis 2016, *** significant at 1% level.

#### 4.2.3. Expenditure Elasticity of Demand

Expenditure (income) elasticity measures the responsiveness of demand to a change in consumer income. All the expenditure elasticity was significant except beef and egg. The estimates were positive and less than unity which implies that they were not only normal goods but also necessity good in which an increase in real income will lead to a less than proportionate increase in quantity demanded. This follows '*a priori*' expectation that food items are generally a necessity good.

In the Table 7 present the result of the relationship between the shares of the household income allocated for each protein sources and the total expenditure. The analysis revealed that only the budget share of fish and egg significantly affected the total expenditure, while the other did not. A unit increase in real income decreases the budget allocated to fish by 0.025% but increases the budget allocated to egg by 0.006%. This is instructive because expenditure on fish is the highest while egg is the lowest (Table 3). Hence, the farmers will readjust their expenses as income increases by purchasing more of the relatively cheap egg and less of the more expensive fish.

**The effects of household's socio-demographic characteristics on the share of the protein food sources.**

The results obtained from analysis of effects of households socio-demographic characteristics on the share of protein food sources is presented in Table 8. From the table, sex of the household had positive and significant effect on the budget share of beef and fish while a negative and significant relationship exist between sex of the producer and budget share of bush meat. This implies that being a female will increase the budget allocated to beef and fish and reduces the expenditure on bushmeat. Since, per capital expenditure per week on fish and beef is the highest (Table 3), we may infer that females tend to spend more of their income on the nutrition of the household. In addition, culturally, bushmeat trapping and hunting is an exclusive preserve of the male gender. Indeed, given the fact that imputed cost was used for the kilogram of bushmeat consumed in some cases in the analysis, the expenditure on bushmeat will reduce as for the females who may not be able to trap or hunt for it hence they have access to less of it and make do with other sources of protein.

Age of the producer affected the budget share to beef and egg negatively and significantly. However, it has a positive and significant effect on household budget share to fish. The negative significance of age on the expenditure on beef and egg may be as a result of the consciousness of the implication of the consumption of red meat and the cholesterol in egg on health. In addition, the relative dearness of beef might make it beyond the reach of the older producers who may be growing beyond the economic active age. Though significant at 10%, budget share to chicken increases as age increases.

Similarly, a positive and significant relationship was observed between household size and budget share to bush meat while it affected the budget of pork significantly and negatively. A household with a larger number of members may have to augment protein requirement with meat obtained from the bush. In addition, years of education of UIV producers have a significant and positive relationship with the budget share to chicken and a negative and significant relationship to bush meat. Younger farmers may not have the desire for game hunting activities which is usually passed down generations and uses primitive tools. The fact that younger farmers are more literate may also help them in understanding the intricacies of successful poultry husbandry. On the other hand, years in school may provide opportunity for an additional income from off farm jobs that will help them afford the purchase of chicken and reduce the need to augment with hunting for bushmeat.

**Table 8. Determinants of protein demand**

| | Sex | Age | Household size | Education |
|---|---|---|---|---|
| Beef | .0000429* | -2.79e-06* | | |
| Chicken | | 9.98e-07** | | 5.27e-06* |
| Fish | .0000502* | 2.94e-06 * | | |
| Pork | | | -1.25e-06* | |
| Bush meat | -.0000902* | | 5.10e-06** | -4.75e-06* |
| Milk | | | | |
| Egg | | -7.85e-07* | | |

Source: Data analysis 2016, *5% and ** 10%.

## 5. Summary and Conclusion

This study examined demand for protein among UIV producers in the six Southwestern states and Kwara state, Nigeria. Primary data was collected in 144 communities among 1089 UIV farming households. Data analysis revealed that that the food shortfall is persistent and not seasonal and the households cope with food shortages by borrowing money as well as reducing the quality and quantity of food eaten. Consumption pattern favours yam, cowpea, rice, banana and fish. QUAIDS model considered proteinous food items which include egg, chicken, pork, fish, milk, beef and bushmeat. The results showed that while other protein food sources are normal goods, egg is an inferior good. Of all, pork was the most responsive and egg was the least elastic. The demand for pork, bushmeat and chicken were price elastic while fish, milk and egg were inelastic. Beef showed a positive elasticity indicating increased demand at higher prices, implying a Veblen effect such that the farming households regard the consumption of beef, whose price may be relatively higher and hence scarcer, as a showing a better social status or success than their neighbours. Bushmeat, egg and milk are being substituted for other proteins except beef. Beef served as a complement. Sex of the household had positive and significant effect on the budget share of beef and fish while a negative and significant relationship exist between sex of the producer and budget share of bush meat. Age of the producer affected the budget share to beef and egg negatively and significantly. However, it has a positive and significant effect on household budget share to fish. Similarly, a positive and significant relationship was observed between household size and budget share to bush meat while it affected the budget of pork significantly and negatively. The results showed beef and fish seems to be the least affordable and farmers augment households' protein need by hunting for bush meat, rearing of chicken for its meat and egg. Hence, promotion of complementary activities such as livestock rearing, and preserves the forest to sustain the availability of game will

increase the consumption of protein and enhance the wellbeing of the farming households.

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