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Rural household expenditures for roots and tubers in South Western Nigeria: An almost ideal demand system analysis

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Abstract. This paper analyzes rural household expenditure patterns on root and tuber-based products in the forest and savanna zones of southwestern Nigeria. A multistage sampling technique was used to select 252 respondents in two communities during the 2001-2002 period. Daily data on household expenditure were collected over two weeks in each quarter of the year. In addition, demographic characteristics of households were collected. Data were analyzed using descriptive statistics and the Almost Ideal Demand System (AIDS) model. Respondents' mean age was 42 years in the forest and 54 years in the savanna. Education level was low: only 8.3 years (forest) and 4.52 years (savanna). Mean household size was 7 in the two ecologies. Household expenditure was 83% of mean income in the forest and 100% in the savanna. Contrary to expectations, food accounted for 21.5% of household expenditure for the forest and 15.5% for the savanna despite a major share of harvest being used for home consumption. Major root and tuber-based products identified were: *gari/eba*, cassava flour, *fufu*, *amala*, boiled yam, pounded yam, and cocoyam. There was no major difference in household budget expenditure patterns on these commodities in the two ecologies, though the total budget allocation to roots and tubers was higher in the forest zone. Own price elasticity estimates show that some products are price elastic, many are income elastic, while others have positive cross price effects (substitutes) or negative effects (complements). Demographic factors significantly influenced decisions on household budget allocation, particularly in the forest zone.Budget shares and elasticity estimates of commodities may assist in the construction of cost of living indices. Linking farmers to growth markets will ensure sustainable root and tuber production to meet the country's food sufficiency objective.

Introduction

Improving rural food security, income, and nutritional status requires an understanding of the food demand structure of the households. The increase in global population from 5.7 to 7.5 billion people and the growing urbanization particularly in developing countries have placed tremendous pressure on the global food system (Pinstrup-Andersen *et al*., 1999). This suggests the need to produce more food and to provide increasing percentages of that output to urban areas while still attending to the needs of rural dwellers. Food crop production remains the main source of income for a large majority of households in Nigeria. However the rural households with their limited income and unlimited expenditure profile have to make choices from among alternatives in a manner that is consistent with the evaluation of their self-interest. This choice is guided by the utility derived from the consumption of goods and services, and households allocate income among the various goods and services to be consumed in such a manner that the marginal utility per price of all goods and services consumed is equal (Nweke *et al.* ,1994). Thus, food crops are constantly evolving, not only in terms of genetic makeup but also with respect to the changing pattern of expenditure on the food items and the social, economic, and environmental relationships with the people who grow, sell, and consume them. This fact applies more emphatically to roots and tubers such as cassava (*Manihot esculenta*), potatoes (*Solanum tuberosum*), sweetpotato (*Ipomoea batatas*), and yams (*Dioscorea* spp.). According to Scott *et al*. (2000), over two billion people in the tropics and subtropics depend on roots and tubers for their sustenance and livelihood. In 1995-1997, farmers in developing countries harvested 439 million tonnes of the major roots and tubers cassava, potato, sweetpotato and yam with an estimated annual value of more than US$41 billion, nearly one-quareter of the value of the major cereals.

These crops deserve particular attention because many of the poorest and most food insecure households in the developing world look to these crops as the principal source of food, nutrition, and cash income. They provide diversity in diet: as a vegetable for some, a basic calorie source for those less affluent, and an additional source of essential micronutrients for many. Producers are increasingly inclined to exploit their potential as animal feed, as sources of starch and speciality foods, and as competitors to grains (Alexandratos, 1995; Best 1996). The adaptation of roots and tubers to marginal environments and their great flexibility in mixed farming systems make them an important component of a targeted strategy that seeks to improve the welfare of the rural poor and to link smallholder farmers with the emerging growth markets. This could be achieved through the efficient and environmentally sound production of different high quality, and competitive products for food, feed, income, and industry. In addition, farm households see the value of roots and tubers in their ability to produce more edible energy/ha/day than other commodities and in their capacity to generate yields under conditions where other crops may fail. Therefore, the importance of roots and tubers on consumption behavior in any rural household budget cannot be overemphasized.

This paper analyzes the expenditure pattern of rural households on root and tuber-based products in two agro-ecological zones of southwestern Nigeria with the aim of improving the food security and nutritional status of households as well as alleviating rural poverty.

Research Methodology

The study was conducted in two communities in two ecological zones of southwestern Nigeria. Akinlalu (rain forest) is in Ife North Local Government Area (LGA) of Osun State, with a population of 20388 by 1991 provisional census figures (NPC, 1991). Ilero (derived savanna) is in Kajola LGA, Oyo State, with a population of 36283 by 1991 provisional census figures (NPC, 1991).

A multistage sampling technique was used to select 252 respondents in the two communities, 2001-2002, the primary sampling unit was the household (the number of persons living under the same roof and eating from the same pot). A list of household heads was generated; and 123 were selected in Akinlalu and 129 in Ilero, based on age, gender, and wealth categorization.

Primary data were collected over two weeks in each quarter for one year with the aid of a structured questionnaire. This frequency of data collection was meant to take into consideration the seasonality in crop production which is the basis for food supply. During the course of the survey, daily data were collected on items of income and expenditure, types of food consumed, and their quantity/value in the household. Demographic and socioeconomic data on households were collected once a year and checked for any change during the quarter sessions. Secondary data on household statistics were obtained from the LGA secretariats, State Ministries of Agriculture and Agricultural Development Projects (ADPs).

Data were edited and analyzed using descriptive statistics to describe the socioeconomic characteristics of the respondents and household resource structure, and the Almost Ideal Demand System (AIDS) model was employed to analyze the expenditure pattern of the households. The AIDS model specified makes possible the empirical measurement of the standard relationship between food consumption, commodity prices, income, and household characteristics by a system of budget shares (Deaton and Muellbauer 1980). It is expressed as follows:

$$W_i = \alpha_o + \sum_{c}^{C} \alpha_{ic} H_c + \sum_{j} \lambda_{ij} \ln(P_j) + \beta_i \ln(\frac{X}{P*})$$

Where:

W_i = Budget share of the ith commodity;
X = Total expenditure on roots and tubers;
P_j = Price of root and tubers;
H_c = Household characteristics (e.g. age, gender, education);
P^* = (Stone price index) defined as $\sum w_j \ln P_j$;
α, β, and λ = Coefficients to be estimated (with α_o being the intercept; α_{ic} the coefficient of household characteristics, β is the income elasticity of demand which determines whether root and tuber-based products are luxuries or necessities).
Note that with

$$(\frac{X}{P*}) = \frac{X}{\sum wj \ln Pj}$$

the effect of P_j is reduced when logged such that w_j becomes paramount.

In effect, $X / \sum wj$ relates quantity demanded to income; λ measures the change in the i^{th} budget share following one proportional change in P_j with $(\frac{X}{P*})$ held constant. Thus, relative price changes work through this term. Thus, a commodity for which λ is negative (positive) has an own price elasticity greater (less) than 1 in absolute value. When λ is positive (negative), the commodities are considered substitutes (complements).

There are however, restrictions on the parameters of the AIDS equation that are required to make the model consistent with demand theory (Deaton and Muellbauer 1980). That is,

(i) $\sum i \alpha i = 1$; (ii) $\sum i \lambda i = 0$; (iii) $\sum i \beta i$; (iv) $\sum j \lambda ij$; and (v) $\lambda ij = \lambda ji$

Restrictions (i to iii) imply the adding up condition of the model. Homogeneity and symmetry of the model are satisfied if equations (iv) and (v) apply respectively. From the micro-model in equation (1), the following are obtained: the expenditure elasticity (Ei), uncompensated own (Eii) and cross-price (Eij) elasticity (Teklu and Johnson, 1988; Ahmed and Shams, 1994):

$Ei = 1 + (\beta i/wi)$; $Eii = (\lambda ii - \lambda ij)/wi - 1$; $Eij = (\lambda ij - \beta iwj)/wi$; and $E^H ij = Eij + wjEi$.

The AIDS model is being used for modelling household behavior because of its theoretical consistency with the postulate that households maximize utility (minimize cost) in their decision process and its flexibility to encompass broad ranges of behavior. The AIDS methodology is widely used in empirical demand research because it satisfies the requirements of demand theory and allows a complete matrix to be obtained of own-price, cross-price, and expenditure elasticities (Soe *et al.*, 1994; Zeller and Minten, 2000). As the relative change in a variable associated with a relative change in another variable, elasticities, are dimensionless measures of household behavior and are therefore better employed for general interpretation than the basic parameters. According to Timmer *et al.* (1983) and Pindyke and Rubinfeld (1998), elasticities computed from cross-section data are generally interpreted as long-run parameters that reflect the adjustment of all variables causing households to be different.

In the AIDS system, the explanatory variables are in log form (except for demographic characteristics). Thus, each coefficient represents the effects on the dependent variable of a one percent change in the explanatory variable. Since the dependent variable is budget shares, the estimated parameters are occasionally very small (Savadogo and Brandt, 1995). Additionally, the sign of the coefficients does not have the same meaning as in demand systems where the dependent variables are in expenditure or quantity form. For instance, a negative income coefficient implies that the corresponding income elasticity is less than unity and not necessarily that the corresponding good is inferior. The constant term or intercept represents the average value of the budget share in the absence of price and income effects, while the F and R^2 values respectively measure the degree of significance and goodness of fit of the models.

Results and Discussion

Socioeconomic characteristics of respondents. The socioeconomic characteristics of respondents are shown in Table 1. The age of the household head varied between the mean of 54 years (forest) and 42 years (savanna). For the two agroecologies the male-headed households are in the majority (98.4% in the forest and 86.8% in savanna) as a consequence of the local culture. The economic implication is that men have ownership and command over farm resources while women have only user rights as a result of marriage.

The average level of education of respondents is very low: 8.3 years (forest) and 4.52 years (savanna). The difference between the mean years of education was statistically significant at the 5% level of probability. Household size varied between 1 and 33 (forest) and 1 and 24 (savanna) with a mean of about 8 in the two agroecologies. Household size determines the labor supply within the farming systems in the study area and it also influences household consumption expenditures. A mean farm size of 5.9 ha was recorded for the forest zone while 4.7 ha was obtained in the savanna. Respondents ascribed the seemingly large size of cultivated

Table 1: Selected socioeconomic characteristics of sampled households.

Characteristics	Forest	Savanna	t-value
Age (years)	53.60	41.75	6.31[a]
Sex male (%)	98.4	86.8	0.348
Years of education of household head	8.30	4.52	5.12[a]
Household size (No.)	8.32	7.85	0.70
Farm size (ha)	5.9	4.7	1.10
N	123	129	

N = sample size
Source: Data analysis 2003
Note: [a] = significant at $p < 0.01$.

farmland to extension into marginal lands, arising from increased farm population, while some of the farmers have ventured into commercial production.

Cash expenditure patterns of households. The total income used in household consumption expenditure was N244577 (forest) and N193478 (savanna). This amount corresponds to only Naira84/day/person (US$0.7) for the forest and Naira66/day/person (US$0.55). Therefore, households in these ecological zones are generally poor according to the World Bank indicators (World Bank, 2003).

Total household cash expenditure consists of expenditure on food and nonfood items such as housing, clothing, health, education, and infrastructure services, among others. In the forest zone, food is the largest item in household budgets accounting for 21.5% of all expenditure while savings followed closely with a budget share of 21.4%, festivities and ceremonies (9.8%), clothing (8.8%), and education (8.6%) in descending order of importance Respondents claimed that the high percentage recorded for food is to complement the food supply from their own production. Savings are needed to reserve some of their farm harvests for the next seasons' production, since their previous savings were used in the current year's production operations. This implies that about 79% of the budget is really used on household consumption expenditure when the savings are made.

The high level of household cash expenditure on education suggests that respondents in the forest community recognize the need to educate their wards, even though the level of education was higher than that recorded in the savanna. The low figure recorded for housing (0.23%) may be explained by the fact that most of the respondents either owned their houses or resided in their family compound. Respondents in the forest zone do not depend on pipe-borne water for their water needs as nearby streams and wells provide the main sources of water used by the people. Hence, the low percentage (0.04%) recorded for this item of expenditure too.

The patterns for cash expenditure in the savanna deviate from those observed in the forest. Education, accounting for 18.8%, had the largest share of cash expenditure. This may suggest that respondents are becoming more aware of the need to send their wards to school, having realized the importance of education since their own years of education were the primary school. As a result, respondents complain about the lack of family labor for their farm operations as children who would usually assist on the farms are being sent to school. Savings were lower in the savanna than in the forest, probably because of the large share of cash disbursed as remittances to the extended family.

Household expenditure estimates follow the quarterly trends for the different items of expenditure. In the forest community, food, savings and clothing were prominent in the first, second and fourth quarters while the percentage of budget share to savings was highest in the third quarter. This could be ascribed to the period of harvest, which falls within the third quarter and is capable of increasing farmers' reserves for the subsequent year's production and use. In the savanna, food, education, and ceremonies were dominant in the first quarter; education, food, and ceremonies in the second and fourth quarters; and education, food and clothing in the third quarter. Households in the forest zone recorded a higher spending profile (double that found in the savanna), probably because the large share of income is from cash crops (tree crops and vegetables against food crops only in savannas) and they consume less of their own food production (35% against 88% in the savanna).

Budget shares of commodities and commodity groups. The budget share value allocated to each food category is used to show the importance of the food item in household budgets. There is no major difference in the patterns of the budget for food expenditure between the two research sites (Table 2). The energy-based food commodities (cereals, roots and tubers, and plantain/banana) occupy the larger share of cash expenditure. Imported rice was the major food among cereals in these rural areas. Protein-based food items (meat and fish, legumes, dairy products) occupy up to 45% of the budget. A high share of the energy-based food commodities in the total budget is another indication that their own production is not sufficient to meet the family's needs.

The budget spent on root and tuber-based products was small because a large part of harvest for cassava and yam (the major root and tuber crops) is used for home consumption. These crops are processed into rich and diversified food products (Table 3). As expected, cassava-based products (*gari/*

Table 2: Average budget shares of the household (%) on food commodities in the forest and savanna zones.

Food category	Budget share	
	Forest	Savanna
Cereals	28.55	20.43
Roots and tubers	8.78	14.18
Vegetables	3.71	4.62
Meat and fish	28.75	29.57
Fruits	0.66	0.64
Legumes	11.80	12.44
Plantain/banana	0.74	0.69
Dairy Products	4.30	5.06
Fats and oils	5.03	5.66
Bakery	7.68	6.71
Total percentage	100.00	100.00

Source: Data analysis, 2003.

Table 3: Average budget shares of household (%) on root and tuber products in the forest and savanna zones.

Root and tuber product	Budget share	
	Forest (n = 8.78%)	Savanna (n = 14.18%)
Fufu	2.16	0.49
Gari and *Eba*	41.12	13.54
Boiled yam	20.39	11.28
Amala	14.01	59.59
Pounded yam	5.01	4.87
Cassava flour	8.88	3.53
Cocoyam	8.43	6.70
Total	100.00	100.00

n = total percentage

eba and cassava flour) are important in the forest zone, while yam-based products (boiled yam, *amala*, and pounded yam) are important in the savanna zone. In this zone, yam was ranked as the most nutritious, the most important, and the tastiest crop by more than 90% of respondents in the 1970s (Zuckerman 1979). The current budget for yam-based foods (about 75.7% of the budget for roots and tubers) is an indication of the relative decline of this commodity in the food basket.

Determinants of household demand for root and tuber products in the forest and savanna zones. This section discusses results from the statistical analysis using the AIDS model. For almost all equations, the F values are large and significant at the 1% level or below. Therefore, the models are robust enough to be used in estimating the coefficients of the explanatory variables included in the analysis. The low R^2 values were observed for some of the AIDS equations. However, the recorded figures appear good for cross-section data as revealed by previous studies (Deaton and Muellbauer, 1980; Savadogo and Brandt, 1995), particularly since the dependent variables represent budget shares. The Durbin-Watson statistic for each equation and each food commodity was computed to test the presence of serial correlation. These results led to the rejection of the hypothesis of serial correlation in most cases. Thus, the data were considered free of autocorrelation. According to Pindyke and Rubinfeld (1998), elasticities computed from cross-section data are generally interpreted as long-run parameters that reflect the adjustment of all variables causing households to be different (Timmer *et al.*, 1983).

Each coefficient in the results from AIDS models represents the effect on the dependent variable of a 1% change in the explanatory variable. However, since the dependent variables are budget shares (i.e., total expenditure on the commodities), the estimated parameters are occasionally very small. Therefore, multiplying the original coefficients by 100 will allow for easy interpretation (Deaton and Muellbauer, 1980). The coefficients can therefore be read to represent 100 times the effects on budget shares of a 1% change in the independent variables.

Factors determining the demand for root and tuber products. The results of the AIDS model on roots and tubers show that among the demographic characteristics in the forest zone (Table 4), household size recorded a positive and significant relationship on the budget share for *fufu* and pounded yam. This implies that one more household member in the family will increase the budget share of *fufu* by 0.18% and that of pounded yam by 0.21%. A negative and significant effect was obtained for boiled yam, which implies that as the household size increases by 100%, the budget share of boiled yam reduces by 0.57%. This suggests that households in the forest zone prefer pounded yam to boiled yam. The response to education is significant and positive in the *amala* equation while age recorded a negative significant coefficient in the cassava flour equation. Raising the educational level by 100% in the forest will increase the percentage budget share of *amala* by 0.68%, while age tends to reduce the budget share allocated to cassava flour. Thus, demographic variables such as household size, age, and education are very important in determining the household budget allocation to roots and tubers in the forest ecology. Surprisingly, none of the demographic variables was statistically significant in determining the budget share of roots and tuber products in the savanna zone (Table 5). No clear explanation could be found for these results.

In the forest ecology, the coefficients for root and tuber products show that *gari/eba* has an own-uncompensated price of –0.3050, meaning that an increase of *gari/eba* price by 100% would result in the decrease of its budget share by 30.5% (Table 4). To compensate for such a price increase and smaller budget (thus lowered consumption), households would increase the consumption

Table 4: Coefficients of estimates for root and tuber products in the forest zone: results from the AIDS model.

Explanatory variable	Dependent Variable*						
	Gari/ Eba	Cassava flour	Boiled yam	*Fufu*	Cocoyam	Pounded yam	*Amala*
Uncompensated price							
Gari/Eba	-0.3050	0.0222	-0.196[b]	0.0259	0.3060[a]	0.0575[c]	0.0890
Cassava Flour	0.0147	0.1140	0.163[c]	0.0463	-0.0721	0.0110	-0.2770[a]
Boiled yam	-0.0750	0.0190	0.0542[b]	-0.0047	0.0105	0.0009	-0.0049
Fufu	-0.0202	0.0078	-0.0869	0.0473[c]	-0.0014	0.0243	0.0290
Cocoyam	-0.0059	0.0326	0.0888	-0.0027	-0.0238	-0.0103	-0.0788
Pounded yam	0.174	-0.0358	-0.243	-0.0720	0.1470	0.1750[b]	0.1490
Amala	0.0071	0.0360	-0.0509	-0.0001	0.0359	0.0229	-0.0508
Income							
Expenditure	-0.2320	-0.0414	0.140[a]	-0.0071	0.0589[a]	0.0272[a]	0.0547[b]
Demographic Characteristics							
Household size	0.0024	-0.0015	-0.0057[c]	0.0018[c]	-0.0003	0.0021[c]	0.0010
Age	-0.0012	-0.00001[b]	0.0004	-0.0005	-0.0009	0.0008	0.0013
Education	-0.0011	-0.0005	-0.0056	-0.0017	0.0009	0.0012	0.0068[c]
Intercept	2.418	-0.4060	0.358	-0.141	-0.8130	-0.8620[a]	0.4470
F	18.505	3.025	7.964	1.176	4.5820[a]	3.190[a]	1.870[b]
R^2	64.7	23.1	44.1	10.4	31.2	24.0	15.6

*Dependent variables are represented as budget shares
[a], [b], [c] indicates significance at p <0.01, p <0.05, and p <0.10 respectively.
Source: Data analysis, 2003.

of cocoyam by 30.6% and pounded yam by 5.8% as shown by the magnitude of their respective cross-price coefficients. The positive significant cross-price coefficients of cassava flour and boiled yam, *gari/eba* and pounded yam, as well as *gari/eba* and cocoyam suggest that they are likely to be substitute goods. Complementarity exists between products with a negative significant coefficient such as *gari/eba* and boiled yam and cassava flour and *amala*. The negative income coefficients of *gari/eba*, cassava flour, and "fufu" indicate that the commodities have less than one income elasticity, while the significantly positive income coefficients of boiled yam, cocoyam, pounded yam, and *amala* show that the commodities are highly responsive to household income, with an income elasticity greater than one.

In the savanna ecology, statistically significant, own-uncompensated price coefficients were recorded for *gari/eba*, boiled yam, and *amala* (Table 5). The positive and significant cross-uncompensated price effects between cocoyam and cassava flour, *fufu* and pounded yam, and *amala* and pounded yam suggest that these commodities are likely substitutes, while complementarity exists between *fufu* and boiled yam, *gari/eba* and *fufu*, as well as between boiled yam and *amala*. Except for the budget share of *amala* in the roots and tuber food category, all the statistically significant income coefficients recorded a negative sign and suggest less than one income elasticity.

Estimates of own and cross-price elasticities for root and tuber products. The own price for each commodity of root and tuber products can be read diagonally from the

Table 5: Coefficient of estimates for roots and tuber products in the savanna zone: results from the AIDS model.

Explanatory variable	Dependent variable*						
	Gari/ Eba	Cassava flour	Boiled yam	*Fufu*	Cocoyam	Pounded yam	*Amala*
Uncompensated price							
Gari/Eba	-0.034[c]	-0.0011	0.0307	-0.0072[c]	0.0538[a]	-0.0168	-0.0251
Cassava flour	-0.159	0.047	0.118	-0.0075	-0.0830	0.0368	0.0454
Boiled yam	0.0082	-0.0031	0.067[a]	-0.0015	-0.0038	0.00138	-0.0677[a]
Fufu	-0.317	0.168	-1.139[b]	0.00932	0.218	0.640[c]	0.426
Cocoyam	-0.024	0.019[b]	0.000097	-0.00112	0.0112	0.0094	-0.0147
Pounded yam	0.029	-0.014	0.0217	0.00139	-0.0196	0.0103	-0.0288
Amala	0.043	0.0137	0.178[a]	0.00799	-0.0146	0.102[a]	-0.315[a]
Income							
Expenditure	-0.055[b]	-0.0122	-0.221[a]	0.0043	-0.0787[a]	-0.155[a]	0.517[a]
Demographic characteristics							
Household size	0.00025	-0.00095	0.00034	-0.000129	-0.00197	0.00119	0.00127
Age	-0.00074	0.00009	-0.000024	0.000145	0.00074	-0.00042	0.000216
Education	-0.00056	-0.00011	0.000867	0.000265	-0.00031	-0.00060	0.000431
Intercept	1.705	-0.595	2.499	0.0496	-0.0635	-1.594	-0.960
F	1.604***	1.109	8.054[a]	0.955	3.525[a]	10.218	75.378[a]
R^2	13.1	9.4	43.1	8.2	24.9	49.0[a]	87.6

*Dependent variables are represented as budget shares

[a], [b], [c] indicates significance at p <0.01, p <0.05, and p <0.10 respectively.

elasticities matrix in Tables 6 and 7 for the forest and for the savanna zones, respectively.

In the forest zone, the own (direct) price elasticity for *gari/eba*, *amala*, pounded yam, cocoyam, and *fufu* are large in absolute value (i.e., >1). This shows that the demand for these commodities is price elastic, while the demand for boiled yam (-0.874) and cassava flour (-0.913) are price inelastic. In the savanna ecology, only the demand for *gari / eba* (-1.1962) and *amala* (-2.0455) were price elastic while the demand for other commodities was inelastic.

Except for *fufu*, all other food commodities had the expected negative own price signs in the two zones. For example in the forest zone, a 1% price decrease will induce households to increase their consumption of *gari/eba* (+1.5%), *amala* (+1.4%), pounded yam (+1.9%) and cocoyam (+1.3%). The positive coefficients of *fufu* may be due to the insignificant level of its consumption in the two ecologies. A similar positive coefficient (0.3465) was obtained for cassava flour in the savanna zone. This could be due to the small proportion of income spent on this product since most cassava flour is obtained from own farm production.

The cross-price elasticities for some of the commodities in the zones are positive while others are negative (reading down in Tables 6 and 7). The positive cross-price elasticities of demand between *gari/eba* and *amala* (0.5434) in the forest and between *gari/eba* and boiled yam (0.8822) in the savanna, for example, suggest that these commodities are substitutes. This implies that an increase in the price of *amala* will lead to an increase in the demand for *gari/eba*. Similar relationships were recorded for *gari/eba* and *fufu*, *gari/eba*

Table 6: Own-price, cross-price and expenditure elasticity estimates for root and tuber products in the forest zone: results from the AIDS model.

Commodity	Price elasticity						
	Gari/ Eba	Boiled yam	*Amala* yam	Pounded flour	Cassava	Cocoyam	*Fufu*
Gari/Eba	-1.509	0.3156	0.5153	0.9211	0.5337	0.4840	0.4489
Boiled yam	-1.1225	-0.874	-0.4098	-1.353	0.6408	0.2763	-0.0174
Amala	0.5434	-0.126	-1.4167	-.9710	-2.065	-0.653	0.1157
Pounded yam	-0.2350	-0.1074	0.3283	-1.870	0.0926	-0.3290	0.3559
Cassava flour	0.142	0.105	0.2969	-0.510	-0.913	0.2587	-0.0202
Cocoyam	3.4674	-0.0378	-0.0378	1.5814	-1.017	-1.3421	1.6986
Fufu	1.144	-0.299	-0.083	-3.47	2.106	-0.205	1.2382
Expenditure elasticity	0.4489	1.68	1.8676	-2.196	1.9149	0.6534	-0.1781

Table 7: Own-price, cross-price and expenditure elasticity estimates for root and tuber products per household in the savanna zone: results from the AIDS model.

Commodity	Price elasticity						
	Gari/ Eba	Boiled yam	*Amala*	Pounded yam	Cassava flour	Cocoyam	*Fufu*
Gari/Eba	-1.1962	-0.4261	0.1794	1.4102	0.2354	0.0830	-0.022
Boiled yam	0.8822	-0.6289	2.1834	0.8027	1.6534	0.6118	-7.797
Amala	-0.3121	-0.3836	-2.0455	-0.3183	-0.1938	0.2947	0.1428
Pounded yam	0.6536	-0.3958	3.1031	-0.3134	1.7588	1.1938	14.1959
Cassava flour	0.0768	0.0199	0.4972	-0.2897	0.3465	0.6478	4.8807
Cocoyam	0.4364	-0.4259	-0.5875	-0.6624	-1.6115	-0.9013	2.8945
Fufu	-1.8219	-0.6091	1.4100	0.0057	-1.8857	-0.5283	0.9787
Expenditure elasticity	0.5944	-0.9523	1.8676	-2.196	1.9149	1.6534	-0.1781

and cassava flour, and *gari/eba* and cocoyam. The degree of substitutability between most of the commodities was not strong (i.e., with coefficients < 1). Negative cross-price elasticities were obtained for products that are complements such as *gari/eba* and pounded yam (-0.2350) in the forest or *gari/eba* and *amala* (-0.3121) in the savanna. Thus, an increase in the price of pounded yam, for example, will lead to a decrease in the demand for *gari/eba* in the forest zone. The degree of complementarity was found strong between pounded yam and *fufu* (-3.47) in the forest and between *fufu* and boiled yam (-7.797) in the savanna.

Expenditure elasticity estimates for roots and tuber products. In the forest zone, the expenditure elasticities for root and tuber products (Table 6) show that when income increases, households will consume relatively more cassava flour (1.9149), *amala* (1.8676) and boiled yam (1.68). On the other hand, households will consume relatively less *gari/eba* (0.4489) and cocoyam (0.6534). This implies that when income increases by 10%, expenditure on *gari/eba* increases by 4.49%. So, *gari/eba* is an income-inelastic food item and a necessity for the households. The negative expenditure elasticity estimate for pounded yam (-2.196) and *fufu* (-0.1781) imply that increases in household income will lead to decreases in the consumption of these commodities.

In the savanna zone, cassava flour, *amala* and cocoyam recorded positive estimates (Table 7). Thus, households in the savanna will consume relatively more of these commodities as income increases. All the other products recorded negative expenditure elasticities.

Conclusion and Policy implications

This paper examined the expenditure patterns of households in two rural communities of the forest and savanna zones in southwestern Nigeria. Despite the fact that farmers dispose a high proportion of harvest for home consumption, expenditures on food items were found to be relatively high. This is another indication of poverty with food shortages in the study area. The above facts on poverty re-emphasize the needs for the development of strategies, programs, and projects targeted to poverty alleviation and wealth creation in sub-Saharan Africa. It was found that farmers spend their financial capital in order to attend to many household needs, including social obligations. Successful development programs must embrace the entire rural space rather than limiting their intervention to agricultural production only.

Roots and tubers represent an important component of a food security strategy. In the study area, they are processed into many products and consumed in different forms: *gari/eba*, cassava flour, *fufu*, boiled yam, *amala*, pounded yam, and raw cocoyam. These products were already identified 30 years ago in the 1970s (Zuckerman, 1979). Therefore, no progress seems to have been made on linking farmers to markets despite increases observed for the study villages in community assets such the building of new roads, banks, daily market places, churches, light street, etc. The availability of market infrastructure alone is not a sufficient condition of igniting a commercial farming. Infrastructure needs to be complemented with clear market development oriented strategies for subsistence farmers to fully enter into commercial farming.

There is a contrast in the sources and level of income between the study villages. A difference was also observed in the food basket between the two communities: cassava-based products are important in the forest zone, while yam-based products are important in the savanna zone. Therefore, ecological (regional) differences must be taken into consideration in the design of interventions to promote the utilization and consumption of root and tubers in Nigeria. The concept of development domains could be used in developing and targeting research-for-development strategies for these commodities.

Demographic factors, such as household size and age, were found to be significant factors for consideration in household budget allocation decisions on root and tuber products in the forest zone. None of the demographic factors was found significant for the savanna zone.

The analysis of own-price and cross-price elasticities in the two agroecologies revealed that, except for *fufu*, roots and tubers products conform to a priori expectations. The expenditure (as a proxy of income) elasticity indicated responsiveness to income for boiled yam, *amala*, pounded yam, cassava flour in the forest zone and *amala*, pounded yam, cassava flour, and cocoyam in the savanna zone. Therefore, prices and income appear to have a major effect on households' budget allocation to roots and tubers in southwestern Nigeria. Thus, exploiting market opportunities for root and tuber products through new product development and formulating conducive policies that will enhance stakeholders' (farmers, processors, and traders) production, processing, and utilization of these crops will immensely assist in improving food security within the country. However, root and tuber-based products respond differently to market forces as shown in the differences for own, cross, and income elasticity of various products, including in remote rural areas. Therefore, exploiting market opportunities must be product specific and not commodity specific, even for roots and tubers. Extension education to farmers on the use of appropriate land management practices is still required to overcome constraints to low productivity of roots and tuber crops in farmers' fields.

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