Resource and Crop Management Research Monograph No. 11

Elasticities of Demand for Major Food Items in a Root and Tuber-Based Food System

Emphasis on Yam and Cassava in Southeastern Nigeria

Felix I. Nweke, E. C. Okorji,
J. E. Njoku and D. J. King

Resource and Crop Management Division
International Institute of Tropical Agriculture

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Preface

The Resource and Crop Management Research Monograph series is designed for the wide dissemination of results of research about the resource and crop management problems of smallholder farmers in sub-Saharan Africa, including socioeconomic and policy-related issues. The range of subject matter is intended to contribute to existing knowledge on improved agricultural principles and policies and the effect they have on the sustainability of small-scale food production systems. These monographs summarize results of studies by IITA researchers and their collaborators; they are generally more substantial in content than journal articles.

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I. Introduction and Data Collection Method

Importance of yam and cassava

Yam and cassava are the two most important root and tuber crops grown for food in West and Central Africa. The yam zone in West Africa stretches from Côte d'Ivoire to Cameroon. Yam is especially important throughout coastal West Africa, where some 60 million people obtain more than 200 dietary calories per day from it. Yam is a preferred staple food, appreciated for its taste and cultural role. This notwithstanding, cassava is the chief source of dietary food energy for the majority of the people living in the lowland tropics, and much of the subhumid tropics of West and Central Africa. One reason for this is the high cost of production of yam when compared with that of cassava and maize. Yam costs per calorie are four times the cost of maize. Yam is, therefore, not a major food source for the urban poor.

Objectives

The First Triennial Root Crops Symposium of the International Society of Tropical Root Crops—Africa Branch was concerned with the 'proposition that yams are threatened with extinction . . .'. It recognized 'some serious production constraints with regard to cost . . .' among others, but concluded that 'as long as yam eaters exist, the crop will continue to be in demand' (Terry et al. 1981, 264). The objective here is to ascertain the future of yam in Southeastern Nigeria by estimating and comparing the expenditure elasticities of demand for yam with those of other staples.

The study area

The analyses were based on primary information collected cross-sectionally in two states in Southeastern Nigeria (namely, Benue and Imo), between October 1984 and September 1985. Southeastern Nigeria lies south of the River Benue and east of the River Niger. Most of the areas of Southeastern Nigeria fall within the yam zone of Nigeria (Bachmann and Winch 1979). West and Central Africa produce 93% of the world's yams; Nigeria 75% and Southeastern Nigeria, 42% of total world yam production (FOS 1983, IITA 1988). Although cassava is produced throughout Southeastern Nigeria, the major yam growing areas within this region are found in the deep, fertile and well-drained soils of the upper part of the alluvium, in all of the metamorphic and most of the shale geological zones (fig. 1). Hence, the region can be divided into major and minor food-producing areas.

Sampling procedure

Yandev in Gboko local government area of Benue State was identified as a major food-producing area; Mbaise in Mbaise local government area of Imo State was used to represent the minor food-producing area. Yandev and Mbaise were also selected to represent different rural ethnic groups—Yandev is mainly populated by the Tiv, and Mbaise by the Igbo. In addition, Owerri, an Igbo urban center, was selected for urban-rural comparisons.

Tax lists in the various local government offices were used as sample frames for household selection. They were cross-checked with village heads in Yandev and Mbaise. As

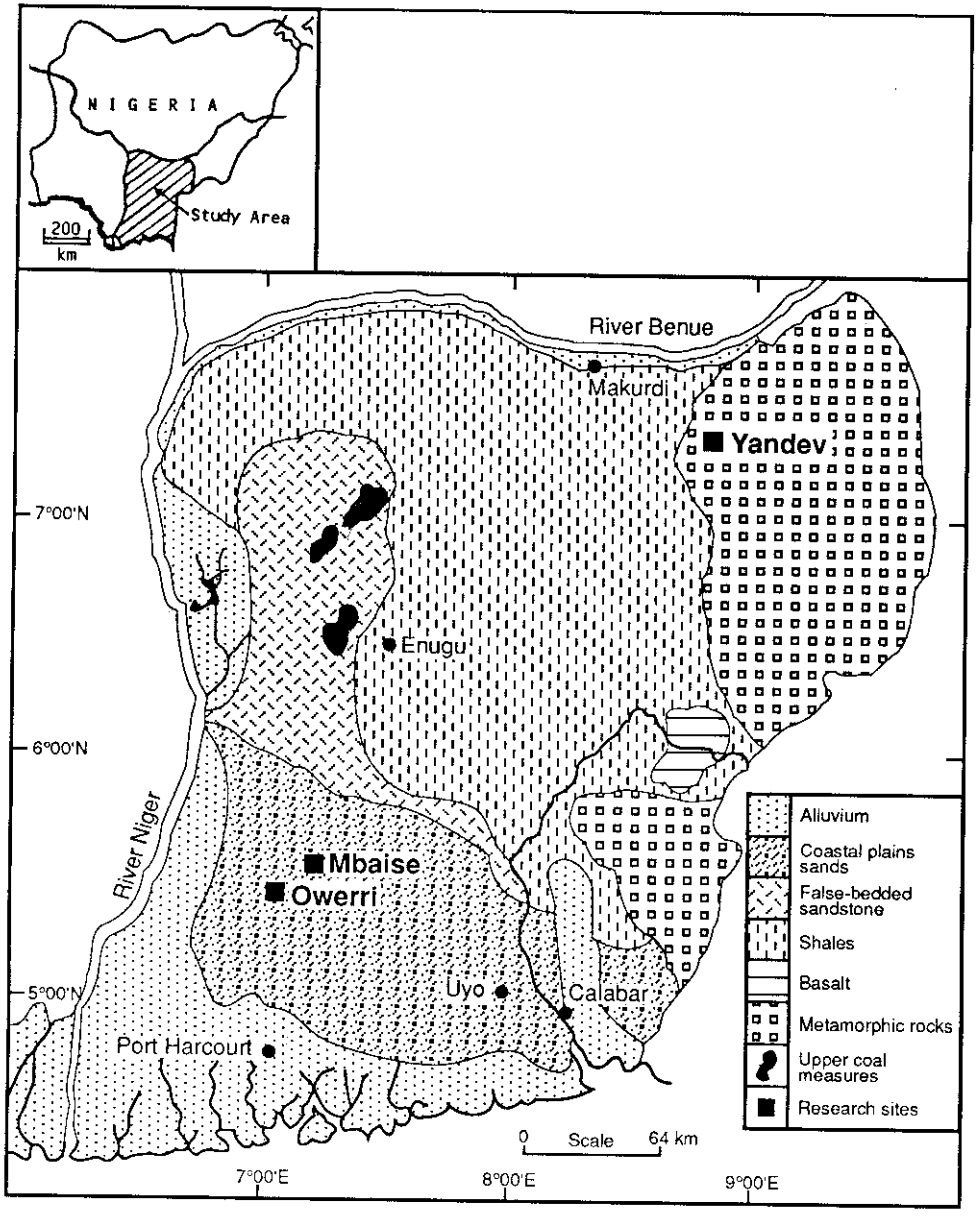

Figure 1. Geological map of Southeastern Nigeria.

taxation was uniform in the rural sites, 30 households were selected randomly in Yandev and Mbaise. In the Owerri urban site, the frame was stratified into three income groups and ten households were selected randomly in each stratum.

Data collection method

Household variables for which data were collected included total household consumer expenditure, household consumption of various food items, and household composition and characteristics. Non-household variables for which data were also collected consisted of the retail market prices for the various major food items.

Household consumer expenditure items included clothing, appliances, utilities and power, education, medical care, social/religious obligations, transportation and communication, housing and other household durables, food and entertainment. Expenditure on household durables was represented by rental values, if any, or by resale values for the relevant period. Interview visits were fortnightly over a 15 calendar month period. Recall periods varied so that the most frequently occurring events were ascertained over the shortest recall period. The recall periods were 24 hours for food, fortnightly for utilities, education, medicare, social obligations and transportation, and quarterly for durables.

Quantities of each staple food item consumed over the recall period, whether purchased or home-produced, were determined. For commodities with no standard measures, the enumerator used scales and volume measures to convert local to standard measures. Since enumeration was after the fact, the respondent provided an equivalent quantity of each item for measurement. A household was defined as people who ate from the same pot. Household population was determined at every interview visit.

Spencer (1989) has observed that repeated interview visits per se were likely to aid memory recall, because the fact that the investigator was coming back for specific information became fixed in the mind of the respondent. Thus, although information from the first few interviews could be inadequate, the quality improved with subsequent interviews. Information was, therefore, collected for 15 calendar months, but data from the first three months were discarded.

Price data were collected only for major food items. For each item the price of the leading form of consumption was obtained and prices of other less popular forms estimated from it, based on certain factors such as processing costs and conversion factors. The price data were collected only when the markets were full. In some markets, where prices were negotiated by haggling, the enumerator negotiated hard enough and purchased at least one consignment to give the impression of being a buyer. For each commodity, prices were collected on each occasion for a number of consignments and the mean taken. The enumerators carried scales and volume measures to convert local units to standard units.

II. Summary of Data Collected

Consumption levels of food items

The mean daily per capita consumption of staple food items is presented in Table 1. Wheat was third in magnitude after yam and cassava. If yam and cassava were reduced to dry matter basis, wheat would come second after yam. The large-scale importation of wheat at subsidized prices in Nigeria during the study period (Nweke et al. 1989) accounts for this situation. Maize is not a staple, but consumed mainly fresh as a vegetable. The dietary calorie equivalent of the daily per capita consumption of the staple foods were: 1743 in the major food-producing rural area, 1233 in the minor food-producing rural area, and 1564 in the urban sites. The estimate for Nigeria as a whole was 1920 calories per capita per day from all cereals, grains, grain legumes and all root and tuber crops (FAO 1979).

Yam consumption was seasonal, being highest in November to January and lowest in May to July following the production calendar. Gari, a cassava product, and grain legumes substituted for yam on a seasonal basis.

Expenditure

Total annual expenditure per capita was ₦649.00 in the urban area, ₦480.00 in the major food-producing area, and only ₦345.00 in the minor food-producing rural sites (Table 2). National level gross domestic product (GDP) per capita at current factor cost was ₦589.00 in 1984 (FOS 1985).

Following Engel's law, the percentage of total expenditure spent on food was inversely related to total expenditure (Reardon and Delgado 1987). It was 48% for the highest, 50% for the medium, and 56% for the lowest of the three expenditure groups. The percentage of expenditure on food was lower in the urban than in the rural sites; between the rural sites, it was lower in the major than in the minor food-producing areas.

Table 1. Consumption of food groups (gms/cap/day) by location, southeastern Nigeria, 1984/1985

Item		Major food-producing rural		Minor food-producing rural		Urban	
	cal/ 100gm*	gms/cap/ day	calorie equiv.	gms/cap/ day	calorie equiv.	gms/cap/ day	calorie equiv.
Yams	104	728	757	72	74	256	266
Cassava	153	231	354	533	816	258	396
Rice	354	84	298	34	121	76	268
Wheat	350	53	185	48	167	155	545
Grain legumes	340	44	149	16	55	26	89
Total	—	—	1743	—	1233	—	1564

*Platt, 1965.

Table 2. Percentage distribution of total annual expenditure per capita by location, southeastern Nigeria, 1984/1985

Expenditure Item	Major food-producing rural	Minor food-producing rural	Urban
Total (₦/cap/year)*	480	345	649
	%	%	%
Food	50	56	48
Clothing	18	5	13
Transportation	10	9	15
Education	8	12	10
Health	6	7	5
Others	8	11	9
—	100	100	100

*₦1.0 was approximately US$1.2 in 1984

The percentage of total expenditure spent on clothing was lowest in the minor food-producing site. It was higher in the major food-producing rural site than in the urban site In both relative and absolute terms, expenditure on the education of children was significantly higher in the minor food-producing rural site than in the major food-producing area. The percentage spent on education was lower in the urban site than in the minor food-producing area, because absolute total expenditure in the urban center was higher. In both relative and absolute terms, expenditure on transportation was much higher in the urban than in either rural site, and higher in the major food-producing rural site than the minor. This reflects differences in economic activities. The proportion of total expenditure on health was lower in the urban than in the rural sites; urban salaried workers often had access to subsidized modern health facilities.

Household size, composition and characteristics

Household size was relatively higher in the major food-producing site than in other sites, because of the large number of wives among the farmers, as reflected in the large numbers of adults and teenage females and children (Table 3). Household size was low in the minor food-producing rural site, where there was probably a high rate of out-migration because of limited economic opportunities.

Household size was highest among the highest-expenditure group, because high income households absorbed most of the rural to urban migrants. The number of teenagers per household was highest among the highest-expenditure households and lowest among the lowest-expenditure households. Most of the rural to urban migrants were teenagers and they were recruited from the low-expenditure rural households. A few of the lowest- and medium-expenditure households were headed by women.

Table 3. Mean household size and composition by location, southeastern Nigeria, 1984/1985

Composition	Major food-producing rural	Minor food-producing rural	Urban
Male—20 yrs and above	1.22	0.81	1.42
Female—20 yrs and above	1.48	1.32	1.15
Male—13-19 yrs	0.67	0.32	0.43
Female—13-19 yrs	0.71	0.32	0.63
Children—12 yrs and below	3.63	3.02	2.70

The age of household head was highest in the minor food-producing rural households because of out-migration; it was lowest in the major food-producing rural households because of the high economic opportunities in food production activities (Table 4). For the same reasons, the proportion of households headed by women was also highest in the minor food-producing site and lowest in the urban site. However, years in formal education both for male and female heads of households were highest in the urban site and lowest in the major food-producing rural site.

Table 4. Household characteristics by location, southeastern Nigeria, 1984/1985

Composition	Major food-producing rural	Minor food-producing rural	Urban
Age Household head, years	38.00	47.00	42.00
Education Household head, years	3.47	7.03	13.09
Education first wife, years	2.57	5.62	9.71
Household head percentage male	83.00	75.00	89.00

Prices of food items and sizes of staple crops harvested

Yam and rice prices were significantly lower in the major food-producing rural area than in the urban sites (Table 5). In addition to yam, guinea corn was produced in the major food-producing rural site (Table 6) Rice was produced only in limited amounts in the major food-producing rural site. It was imported into Nigeria in large amounts at subsidized prices and distributed by government agencies which absorbed transportation costs throughout Nigeria (Nweke et al. 1989). Gari and cowpea prices were higher in the major food-producing rural sites than in either the minor food-producing rural area or urban site. Cassava was produced in relatively small amounts in the major food-producing rural site. Subsidized wheat was

Table 5. Mean monthly prices (₦/kg) of staple food items by location, southeastern Nigeria, 1984/1985

Item	Major food-producing rural	Minor food-producing rural	Urban
Yam (dry matter)	1.14	2.14	2.09
Gari	0.98	0.55	0.54
Rice	2.60	2.69	2.66
Semovita	1.21	1.21	1.21
Cowpea	2.60	2.41	2.40

Table 6. Size of staple crops harvested (ha/household) in 1984 by location, southeastern Nigeria

Item	Major food-producing rural	Minor food-producing rural	Urban
Yam	2.40	0.21	0.12
Cassava	0.46	0.65	0.18
Maize	0.10	0.21	0.12
Guinea corn	0.52	0.00	0.00
Rice	0.13	0.00	0.00

imported from outside Nigeria, and milled at major flour mills sited near the sea ports. Cowpea was imported into the southeast from northern Nigeria.

The prices of almost all food items were slightly higher in the minor food-producing than in the urban site. The minor food-producing area imported virtually all food items; cassava was produced only in small amounts. The difference in price reflected the cost of transportation of the imported items from the urban to the rural area.

The prices of major food items, besides rice and gari, were highest between May and August and lowest between September and January. September to January was the harvest season for most crops, including yam and cowpea. Those crops, but especially yam, were scarce from May to July. The seasonal trend was not definite for prices of rice and semovita. In fact, the price of rice was lower than average during the hungry season of May to July. These conditions reflected the import distribution situation.

III. The Demand Model

The demand function

The Working-Lesser (Deaton and Case 1987) demand function was adopted.

$$W_{it} = A_{it} + B_{it} \log M_T$$

where:

i	=	commodity
t	=	month
T	=	year

$W_{it} = \frac{P_{it} Q_{it}}{M_T}$ is budget share of the commodity i at time t.

where:

P_{it}	=	price of commodity i at time t
Q_{it}	=	quantity of commodity i consumed at time t
M_T	=	total expenditure for period T if the assumption is that permanent not temporary income determines consumption of commodity i (t if otherwise).

This function which is a variant of the ordinary least squares (OLS) regression model, relates the value of budget shares to the logarithm of total expenditure (Deaton and Muellbauer 1980). Budget shares are the most convenient variables for demand analysis because they are dimensionless, so that although they can vary with prices, incomes, and living conditions, they can be compared across households, time and countries without the need for price and exchange rate conversions. Moreover, the shares also add up to unity by construction so that it is possible to analyze the allocation of the total budget which they represent (Deaton and Case 1987).

Further, the model in its quadratic form overcomes some of the major limitations of linear expenditure models which assume linearity of the Engel curves by allowing for quadratic Engel curves and permitting more implicit incorporation of demographic variables, thereby allowing richer specification than can be obtained by using per capita variables.

Hence, a quadratic form of M was added to allow for non-linearity as follows:

$$W_{1t} = X_{1t} + B_{1it} \log M_T + B_{2it} (\log M_T)^2$$

Household composition consisting of the number of adult males, adult females, teenage males, teenage females and children, and household characteristics consisting of age, in number of years, of household head, sex (dummy) of household head, number of years of formal education of household head and of first wife were used to avoid arbitrary assignment of consumer equivalent scales (Strauss 1986). Seasons were in the form of dummies for months; rural/urban and major/minor food-producing site dummies were also used. Prices were in logarithmic form.

Expenditure elasticity was calculated as follows when the assumption was that permanent income determined consumption of commodity *i*:

$$(LNW_{it})^{-1} * (B_{1it} + 2B_{2it} * LNM_T) + 1$$

where:

LNW_{it} = mean of log of budget share of commodity *i* at time *t*
LNM_T = mean of log of total expenditure at period *T*

When the assumption was that temporary income determined consumption of commodity *i* expenditure elasticity was calculated as follows:

$$B_{1iT1} + 2B_{2iT1} * LNM_T \, [(LNW_{it})^{-1} * (B_{1it2} + 2B_{2it2} * LNM_t) + 1]$$

where:

B_{1iT1} = coefficient of log of total yearly expenditure in the first stage of commodity *i* equation
B_{2iT1} = coefficient of log of total yearly expenditure quadratic in the first stage of commodity *i* equation
LNM_T = mean of log of total yearly expenditure
LNW_{it} = mean of log of budget share of commodity *i* at time *t*
B_{1it2} = coefficient of log of total monthly expenditure in the second stage of commodity *i* equation
B_{2it2} = coefficient of log of total monthly expenditure quadratic in the second stage of commodity i equation
LNM_t = mean of log of total monthly expenditure

Price elasticity was calculated as follows:

$$(LNW_{it})^{-1} * B_j - d_{ij}$$

where:

LNW_{it} = mean of log of budget share of commodity *i* at time *t*
B_j = coefficient of log of price of commodity *j* in demand equation
d_{ij} = 1 if $i = j$
0 if $i = j$

Food commodities were aggregated into major items where numerous zero entries in the data would not allow unbiased estimates for individual items as follows:

Yam	-	white, water, yellow, and any other cultivar, tuber and flour (reconverted to fresh weight)
Cassava	-	roots, gari, akpu, tapioca, and flour
Rice	-	all qualities
Wheat	-	bread, wheat flour not suitable for bread (semovita) and biscuits
Grain legumes	-	soybean, cowpea, bambara, groundnut and any other pea
Meat	-	beef, mutton, goat meat, pork, chicken and game
Fish	-	smoked, frozen and crayfish

Fruits	-	banana, orange, pineapple, papaya, decroydes (African purple pear), avocado, sour-sop, mango, guava, and cashew
Vegetables	-	leafy, fruity, tuberous, bulby and green maize
Oils	-	all edible oils

Bi-weekly data were aggregated into monthly observations. According to Strauss (1986), the assumption of linearity of Engel's curve may be reasonable when a high level of commodity aggregation is used.

Model specification

The demand model was specified for each commodity in ten iterations based on annual and monthly total expenditure, seasonality, prices, household characteristics and location by rural-urban, and food-producing status. Predicted values of the dependent variables and total monthly expenditures were used in four of the ten specifications. They were predicted on the bases of annual total expenditure and the other variables using the two stage least squares method.

IV. Elasticity Estimates

Expenditure elasticity estimates for all groups

An estimate for the best specification, in terms of F-value and an adjusted coefficient of determination, was adopted for each commodity (Table 7).

Yam. Based on the 10 model specifications, 0.91% to 1.52% was the range of expenditure elasticity of demand for yam. Two of the estimates were less than unity and eight were above. The best estimate was 1.29% which was based on the model specification in which total annual expenditure, household composition, and prices were specified. Total annual expenditure (F-value = 17.2524) and prices (F-value = 51.9533) were significant determinants of yam consumption, but household composition was not. The influence of seasonality and location were adequately reflected in price movements. Total annual expenditure was a more important determinant of yam consumption than household composition or characteristics.

Table 7. Expenditure elasticities of demand for major food items, all households and by expenditure groups, southeastern Nigeria, 1984/1985

Item	All households*	Low-expenditure households**	Medium-expenditure households**	High-expenditure households**
Yam	1.29	1.69	0.98	0.39
Cassava	0.78	1.42	0.54	0.20
Gari	0.83	0.87	0.82	0.78
Rice	1.13	1.47	1.00	0.62
Wheat	1.15	0.91	1.24	1.52
Grain legumes	1.15	0.89	1.24	1.54
Fish	0.80	0.65	0.86	1.03
Meat	1.31	1.62	1.20	0.84
Edible oils	0.65	0.67	0.65	0.62
Vegetables	0.56	0.37	0.63	0.84
Fruits	1.04	0.47	1.24	1.85

* estimate from the best model specifications in terms of F=value and adjusted coefficient of determination.

** estimates based on group means of total expenditures from the same equation specified for all households.

Yam is a preferred staple, highly appreciated for its taste and role in the culture of many of the people of the yam zone (IITA 1988). Although the calories from cassava are substantially less expensive (₦0.07/1000 calories) than from yam (₦0.26/1000 calories) at 1984/85 prices, protein from cassava is more expensive (₦13.87/1000 gm) than from yam (₦12.67/1000 gm) (Nweke et al. 1991). The reason for this is that while cassava has a higher calorie content, yam has asubstantially higher protein content per unit weight (Platt 1965).

Cassava. Expenditure elasticity of demand was estimated both for all forms of cassava combined (including gari) and separately for gari. The range of expenditure elasticity of demand estimates for all forms of cassava combined was 0.14% to 0.91%. The best estimate was 0.78%, which was based on the model specification in which annual total expenditure, household composition and price were specified. Total annual expenditure (F-value = 20.6817) and price (F-value = 3.8960) were significant determinants of cassava consumption.

The range of expenditure elasticity of demand estimates for cassava in the form of gari was 0.49% to 0.85%. The best estimate was 0.83%, which was based on the model specification in which total monthly expenditure, household composition and price were specified. Total monthly expenditure (F-value = 3.2410) and household composition (F-value = 5.3623) were barely significant determinants of gari consumption.

The postharvest management of cassava presents more problems than that of yam. Yam is generally consumed fresh, but it can be stored up to six months (Ugwu 1990). A certain period of storage even improves its taste and economic value. Cassava, however, begins to deteriorate within a few days after harvest, and many varieties require three to five processing days to reduce hydrocyanide levels before consumption (Ngoddy 1977). Processing also extends the shelf-life of cassava and reduces transportation costs. Although some varieties of cassava can also be consumed fresh, cassava does not share the important socio-cultural role which yam enjoys because of its specific function in birth, marriage, and funeral ceremonies (Coursey 1984, Arua 1981, Okorji 1983).

The influence of seasonality and location on the consumption of all forms of cassava and gari (measured separately) was adequately reflected in price effect. Total annual expenditure for all forms of cassava (including gari) and gari alone were more important determinants of consumption than household characteristics or composition.

Rice and Wheat. The range of expenditure elasticity of demand estimates for rice was 1.01% to 1.26%. The best estimate was 1.13%, which was based on the model specification in which total expenditure, household composition, price and household characteristics were specified. Household composition was not a significant determinant of rice consumption and total monthly expenditure (F-value = 2.5785) only a marginally significant determinant.

The range of expenditure elasticity of demand estimates for wheat was 0.94% to 1.19%. The best estimate was 1.15%, which was based on the model specification in which annual total expenditure, household composition and price were specified. Total annual expenditure was barely significant (F-value = 2.8270), but household composition (F-value = 5.1291), and price (F-value = 8.5529) were marginally significant determinants of wheat consumption. It does appear that determinants of consumption of cereals were not fully identified.

Grain legumes. The range of expenditure elasticity of demand estimates for grain legumes was 0.98% to 1.15%. The best estimate was 1.15%, which was based on the model specification in which total annual expenditure, household composition and prices were specified. Amongst the determinants of grain legume consumption, total annual expenditure (F-value = 2.0144) and household composition (F-value = 2.6403) were barely significant, while price (F-value = 8.7604) was highly significant.

Meat. The range of expenditure elasticity of demand estimates for meat was 1.17% to 1.34%. The best estimate was 1.31%, which was based on the model specification in which annual total expenditure, household composition and seasonality were specified. Total annual expenditure (F-value = 13.0568) and seasonality (F-value = 8.9818) were significant determinants of meat consumption, while household composition was not. Seasonality was more important than price or location because of seasonal festivals such as Christmas and New Yam, etc., during which a lot of meat is eaten. Similarly, total annual expenditure was more important as a determinant of meat consumption than household composition or characteristics.

Fish. The range of expenditure elasticity of demand estimates for fish was 0.06% to 0.84%. The best estimate was 0.80%, which was based on the model specification in which total monthly expenditure, household composition, seasonality and location were specified. Only the location variable (F-value = 27.4145) was a significant determinant of fish consumption.

Edible oils. The range of expenditure elasticity of demand estimates for edible oils was 0.49% to 0.68%. The best estimate, 0.65%, was based on the model specification in which total annual expenditure, household composition, price, household characteristics and location were specified. Household characteristics and location were not significant; total annual expenditure (F-value = 3.8030) and price (f-value = 2.1464) were marginally significant.

Vegetables and fruits. The range of expenditure elasticity of demand estimates for vegetables was 0.23% to 0.56%. The best estimate, 0.56%, was based on the model specification in which total monthly expenditure, household composition, seasonality and location were specified. Total monthly expenditure (F-value = 7.0205) and location (F-value = 14.6264) were significant determinants of vegetable consumption.

The range of expenditure elasticity of demand estimates for fruits was 0.52% to 1.09%. The best estimate, 1.04%, was based on the same specifications as for vegetables. Also, as in the case of vegetables, total monthly expenditure (F-value = 3.9661) and location (F-value = 6.6315) were significant determinants.

Seasonality was not a significant determinant of consumption because, although supplies of individual vegetables or fruits were seasonal, the total supply of the vegetables or the fruits was non-seasonal.

Permanent vs temporary income as a determinant of consumption expenditure

The best estimates of expenditure elasticities of demand for yam and cassava (all forms of cassava taken together), grain legumes, wheat ,and meat were from the model in which total annual expenditure was specified on the assumption that consumption expenditure depended on permanent income. On the other hand, the best estimates for expenditure elasticities of demand for gari, rice, fish, vegetables and fruits were from the model in which total monthly expenditure was specified on the assumption that consumption expenditure depended on temporary income.

Both groups included commodities which, on the basis of bulk consumption, could be classified as staples for many households: yam, cassava, grain legumes, and wheat. Here expenditure appeared to depend on permanent income; while expenditure on gari and rice

seemed to depend on temporary income. However, per capita consumption of yam, all forms of cassava, and wheat were higher than of rice (Table 1). The data seem to suggest that consumption expenditure on staples depends on permanent income, while consumption expenditure on non-staples depends on temporary income, although these observations are not conclusive.

Expenditure elasticity estimates by population sub-groups

Expenditure elasticities were estimated for each commodity for nine sub-samples, namely, three expenditure groups and three location groups. The location groups were the major and minor food-producing rural areas, and the urban site. In addition, estimates were made for three expenditure groups within the urban location alone. The elasticities for the sub-groups were estimated, using group means of log of total expenditures, from the same equation specified for the overall sample. This was because of the degree of freedom limitations.

Expenditure groups. Of the sample households, 16% were from the lowest-expenditure group, 63% from the medium and 21% from the highest. Virtually all the major food-producing rural and urban households fell into the medium and highest groups, while the majority of low-expenditure households were found in the minor food-producing rural location.

The highest of the three expenditure household groups had high expenditure elasticities of demand for fruit, grain legumes, wheat (bread) and fish (Table 7). Among the highest-expenditure group, all these foods were considered non-staples. Grain legumes, mainly in the form of *akara* or *moin-moin*, and wheat in the form of bread were consumed mostly at breakfast. Many high-income households preferred to eat more fish than meat. Expenditure elasticity of demand for yam was less than unity, but still positive, indicating that within the high-expenditure group, yam is a normal good. As their disposable income increases, those high-expenditure households would increase their expenditure on yam, although proportionally less than their income increase. Among the high-expenditure households, expenditure elasticity of demand for cassava products combined was less than zero, while expenditure elasticity of demand for gari, though less than unity, was well above zero. These estimates clearly show that, although in certain forms cassava might be an inferior commodity, in other forms, notably in the form of gari, cassava was definitely a normal good among the people of Southeastern Nigeria.

The lowest of the three expenditure household groups had high-expenditure elasticities of demand for most of the major food items, but particularly for yam, meat, rice, and all forms of cassava, which with the exception of meat, were all staples. This suggested that the low-expenditure households did not consume enough of the staples, but would consume significantly more should their disposable income increase. The expenditure elasticity of demand among low-expenditure households was less than unity for gari, but well above unity for other cassava products. This implied that if their disposable income increased, the low-expenditure group would increase their gari expenditure, but by less than the proportionate increase in their disposable income. They would, however, increase their other cassava products expenditure proportionally more than the increase in their disposable income. This might be explained by the high cost of transforming cassava roots into gari. 'The labor required for processing the roots into gari is very high and equals the total labor input for the production of the roots themselves' (IITA 1988, p.28).

Rural and urban groups. Expenditure elasticity estimates among the minor food-producing rural households, were for the same reasons, similar to those of the low-expenditure households, as they were almost the same households (Tables 7 and 8). Expenditure elasticity estimates among the major food-producing rural households and among urban households were in each case similar to those of the medium-expenditure household group. Expenditure elasticities of demand were high for fruits, grain legumes, wheat, and meat.

Urban expenditure groups. Among the urban low-expenditure households, elasticities of demand were high for yam, meat, cassava, and rice (Table 9). Thus, similar to the rural low-expenditure households, urban low-expenditure households did not meet their needs for basic staples. Yam was not considered a major food source for the urban poor because of its high cost (IITA 1988).

Table 8. Expenditure elasticities of demand for major food items by rural-urban location, southeastern Nigeria, 1984/1985

Item	Minor food-producing rural	Major food-producing rural	Urban
Yam	2.52	0.97	0.94
Cassava	1.21	0.53	0.49
Rice	1.39	1.00	0.96
Wheat	0.98	1.24	1.26
Grain legumes	0.97	1.25	1.26
Meat	1.52	1.19	1.17
Fish	0.69	0.86	0.88
Vegetables	0.80	0.79	0.79
Fruits	0.62	1.25	1.30
Edible oils	0.67	0.65	0.64

Table 9. Expenditure elasticities of demand for major food items by expenditure groups in the urban location, southeastern Nigeria, 1984/1985

Item	Urban low-expenditure	Urban medium-expenditure	Urban high-expenditure
Yam	1.66	0.88	0.34
Cassava	1.42	0.44	-0.22
Rice	1.40	1.01	0.75
Wheat	0.91	1.28	1.53
Grain legumes	0.94	1.34	1.60
Meat	1.62	1.15	0.83
Fish	0.64	0.90	1.04
Vegetables	0.37	0.67	0.85
Fruits	0.46	1.37	1.89
Edible oils	0.67	0.63	0.61

Price elasticities of demand for yam

Price elasticities were estimated for yam alone. The estimates were 1.58% and 1.42%, which indicated that yam was price elastic. The best estimates of cross-price elasticity of demand for yam were 0.95% for gari, 1.63% for rice, and 1.48% for grain legumes. These show that gari, rice, and grain legumes were substitutes for yam and that the demand for yam was gari, rice, and grain legume price elastic, respectively.

During the period 1976 to 1985, the annual average imports of rice per person in Nigeria increased by more than 1500% of its 1961 to 1965 level (fig. 2). The imported rice was distributed at implicitly subsidized prices. First, the Nigerian currency was overvalued; at the foreign exchange bidding in September 1986, when the naira was first floated, its value dropped from $1.12 to about $0.30. Secondly, the distribution of the rice was through the Nigerian National Supply Company Limited, a government agency, which absorbed transportation costs by selling at a uniform price nation-wide. Consequently, the price of yam relative to rice was high for most of the period, peaking in 1978 and 1983 (fig. 3) as rice was additionally distributed free by politicians during the campaign periods preceding the general elections held in 1979 and 1983.

In 1985/1986 the Federal Government of Nigeria introduced an economic (structural) adjustment program (SAP), which included floating the currency and banning the importation of various foods: notably, wheat, rice, and maize. At the same time, however, the Federal Government also put a ban on the export of certain foods, essentially yam and cassava

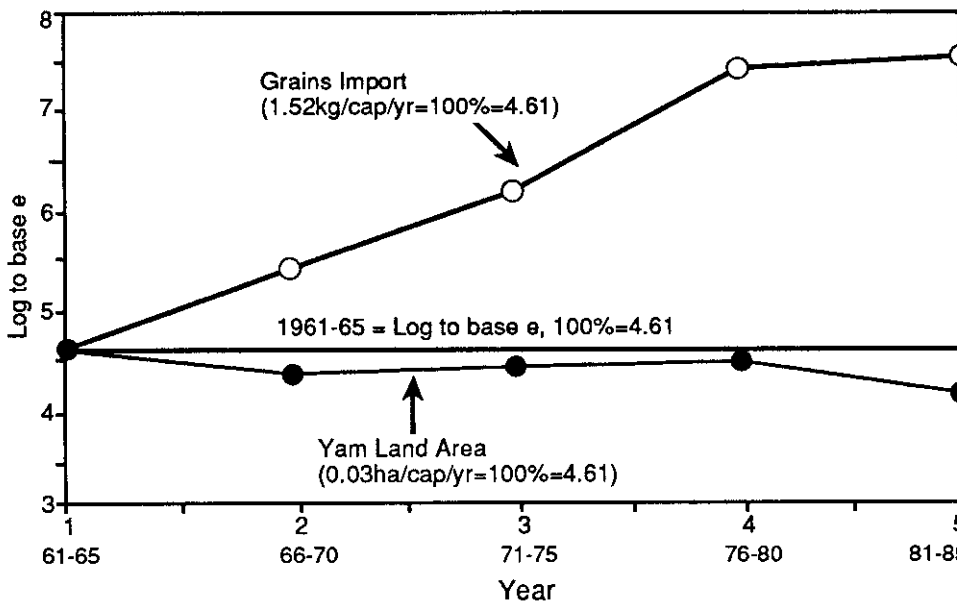

Figure 2. Indices (log to base e; 1961-1965 average = 100%) of per capita grain imports and yam land area in Nigeria, annual averages, 1961-1985.

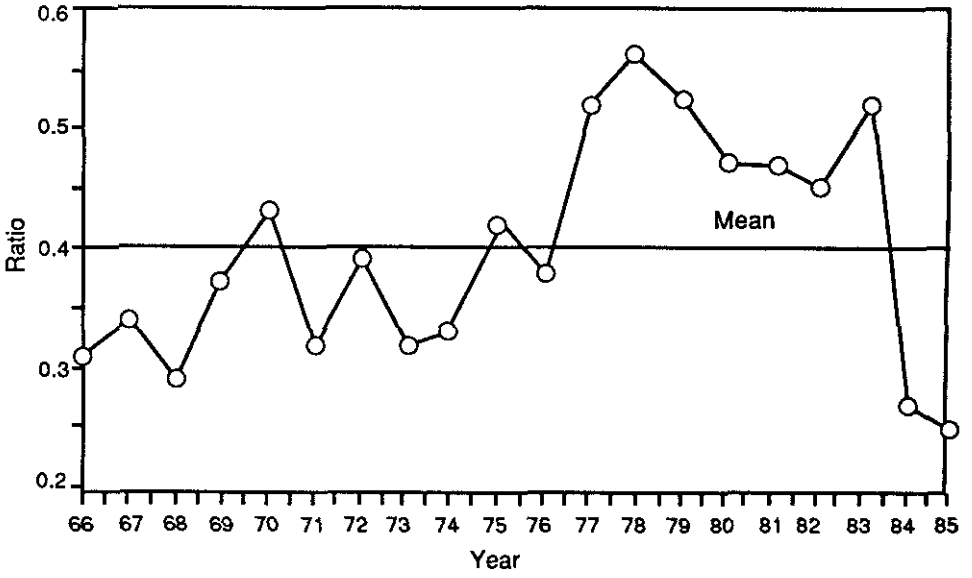

Figure 3. Yam to rice price ratio, Bendel State, Nigeria, 1966-1985.

products which have alternative markets in neighboring West African countries. Yam and cassava are the two largest sources of dietary food energy for the majority of the people in the lowland humid tropics and much of the subhumid tropics of West and Central Africa (IITA 1988).

V. Implications of the Elasticity Estimates

Summary

Overall expenditure elasticity of demand for yam was greater than unity. Though relatively low even among the highest of the three expenditure groups, it was still positive. Overall expenditure elasticities of demand for cassava, in all forms and separately in gari form, though less than unity were relatively high. For all forms of cassava, expenditure elasticity of demand was less than zero at the high-expenditure level; however, for cassava in gari form, it remained relatively high, in fact double that of yam at that expenditure level.

Expenditure elasticities of demand for the cereals appear low in relation to those of the root and tuber crops. Confidence in the cereals estimates may be lacking because of the distortions in the cereals market at the time of the study. Demand for yam will respond to changes in yam prices and in the price of rice and other carbohydrate substitutes; the demand for yam is own price and rice price elastic. Household total food budget and prices were a more important determinant of expenditure on root and tuber crops than rural-urban location.

The probable conclusion is that in Southeastern Nigeria, elasticities of demand for yam and for cassava would likely be lower than those for grain legumes. However, the elasticities of demand for the root and tuber crops are significantly greater than zero, even above unity in some cases and except for certain forms of cassava products for high-expenditure household groups.

Implications for policy and research

The expenditure elasticity estimates show clearly that the domestic market potentials for yam and cassava are high in Southeastern Nigeria. Among the low-expenditure households, the estimates are such that should their incomes increase, they will spend proportionately more than their income increase on root and tuber staples. This indicates that at the present level of their expenditure incomes, they are not consuming enough of the root and tuber staples.

The increase in the domestic demand for root and tuber crops, which is an apparent result of the ban on the importation of rice and wheat as from 1985, should have led to an increase in the incomes of the large numbers of root crop farmers in the low-expenditure household group. However, the devaluation of the naira has resulted in higher production costs in domestic currency, which has had a counter effect on these gains in income. Removal of the ban on the export of yams and cassava to neighboring West and Central African countries may offset the effect of the devaluation on the real income of the low-expenditure households. A large number of neighboring, countries, including Cameroon, Benin, Togo, Central African Republic, Chad, Niger and Mali, would readily import the relatively cheap Nigerian food crops if offered to them.

Among the high-expenditure households the expenditure elasticity estimates are such that, should their disposable incomes increase, they would decrease their expenditure on various cassava products except gari. They would increase their expenditure on yam and gari (cassava), although their expenditure increase would be proportionately less than their

income increase. The proportionate increase in their gari (cassava) expenditure would be substantially higher than their increase in their yam expenditure. Thus, among the people of Southeastern Nigeria, although cassava may be considered an inferior commodity in certain forms, in other forms it is far from being inferior, and could even be superior to yam.

Yam would continue to have a high market potential since the expenditure elasticity of demand is positive at all expenditure levels. However, a cheap rice supply and distribution policy would restrict the potential market for yam. As rice and yam are substitutes for each other, policies which affect the price of rice will affect the quantity of yam consumed. The Nigerian government's liberal import policy and implicit price subsidy on cereals in the mid 1970s to mid 1980s resulted in a shift in the yam demand curve downward to the left, creating a disincentive for private investment in yam production. The 1985 ban on imported rice which reversed this policy may have shifted the demand curve upward to the right, creating incentives for private investment in yam production. On the other hand, since yam is own price elastic, production research aimed at yam improvement and cost reduction which will shift the supply curve to the right, is likely to increase quantities consumed at low-expenditure levels.

In the case of cassava, however, the market potential depends on transformation. The market for certain processed cassava products is largely limited to low-income groups. Other forms of cassava, especially gari, have a significant market among the high-income population groups. The extent to which the potential market for cassava may be expanded, would, therefore, depend largely on the degree to which the quality of the various processed products can be improved to make them attractive to the high-income consumers, without significant increases in the processing costs, which are already relatively high. The observation implies that the development of appropriate and cost effective farm-level processing technologies is critical for expanding the market for cassava in the future.

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