

# Feed the Future Nigeria Agriculture Policy Activity

Policy Research Brief # 2

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## Nigeria Agricultural Policy Activity

### Heterogeneous consumption patterns of fruits and vegetables in Nigeria: A panel data analysis

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#### Introduction

The consumption of vitamin-rich fruits and vegetables (FV) is a major issue in the food security debates of developing countries, including in Sub-Saharan Africa in general and Nigeria in particular. Supply-side issues such as low availability and high production costs are often asserted as reasons for observed FV consumption below optimal levels. Demand-side issues such as lack of consumer preference for FV in general is also asserted. Indeed, some demand elasticity studies that aggregate fruits and vegetables have found a low income elasticity for overall FV. A priori, however, it can be problematic to lump fruits and vegetables. Studies across various countries and regions have found fruit to be a luxury (high income elasticity) and vegetables necessities (low income elasticity).

In testing the above “conventional wisdom” we find it necessary to conduct a disaggregated analysis of FV consumption (including trends and elasticities) to identify consumer preferences and demand for different types of FV, both between fruit and vegetables, and within vegetables such as between non-traditional (for Nigeria) but now important items such as tomatoes and onions, versus traditional vegetables such as green leafy vegetables. Such information may provide insights for creating sustainable and demand-driven supply chains and in turn increase FV consumption by strengthening supply chains and reducing wastage.

In this study, we rely on a detailed panel dataset to analyze consumption trends for different types of FV in Nigeria across regions and income groups. We also examine how their demand changes with income and prices using an Exact Affine Stone Index demand system. Our findings uncover interesting behavioral patterns and demonstrate how efforts could be made to support FV producers and consumers.

#### Key Findings

- Fruit consumption has expanded rapidly across all regions and income groups in Nigeria, and fruit demand will continue to rise with income.
- Vegetable consumption has declined across regions and income groups and is much below the recommended levels. Yet, there is low preference and hence lower demand for vegetables as compared to other “tastier” foods.
- Diets have westernized with predominance of onions, tomatoes, and peppers possibly due to their versatility.
- There is reliance on convenient-to-use products in the South (such as tomato paste).
- Except onions, all FV items are a luxury in the rural North, the poorest area of the poorest region having lowest consumption levels

#### Data

We use detailed LSMS (Living Standards Measurement Study) survey data from the World Bank) with four yearly observations over the period 2010-2019, covering households in North and South Nigeria, in urban and rural areas. We use four waves of these data collected in 2010/11, 2011/12, 2015/16, 2018/19.

Each wave includes about 5000 unique households surveyed twice a year during post-planting and post-harvest seasons. This helps capture seasonal heterogeneity in consumption. The first three waves generate a panel as the same households were interviewed in each round of data collection.

The household food consumption module collects quantities of various food items consumed in the 7 days



preceding the interview.<sup>1</sup> We aggregate the food items into 17 food-at-home groups including different vegetables and fruits (as a group) and other food groups. The 17 categories include 10 FV items (okra, onions, peppers, fresh tomatoes, tomato paste, potatoes, African eggplant, green leafy vegetables, other vegetables, fruits), and 7 other food groups (cereals, tubers, pulses, edible oils, animal proteins other than dairy, dairy, and other foods).

## Data Descriptive statistics

We explore consumption patterns for FV items over time across urban vs rural areas (as seen in Table 1) and by income groups (as seen in Table 2) in both regions – the poorer North and the more affluent South of Nigeria. Several points stand out.

**Table 1: Consumption of fruit and vegetable (FV) as a food group by region over time across urban/rural areas**

	2010-2011			2012-13			2015-16			2018-19		
	<b>North</b>											
	All	Urban	Rural	All	Urban	Rural	All	Urban	Rural	All	Urban	Rural
	<b>Share of households (%)</b>											
<b>FV combined</b>	99	99	98	99	100	98	100	100	99	100	100	100
Fruit	32	50	27	34	48	30	50	59	48	63	78	59
Vegetable	98	98	98	99	99	98	99	99	99	100	100	100
	<b>Share of food budget* (%)</b>											
<b>FV combined</b>	12	13	12	9	9	8	10	11	9	13	14	13
Fruit	1	2	1	1	1	1	2	2	1	2	3	2
Vegetable	11	11	11	8	8	7	8	9	8	11	11	11
	<b>Daily per capita consumption (grams)</b>											
<b>FV combined</b>	160	200	147	149	197	136	104	151	90	149	203	135
Fruit	19	32	15	14	23	12	38	63	31	71	105	62
Vegetable	141	168	132	135	174	124	66	88	59	78	98	73
Observations	2494	528	1966	2400	486	1914	2312	486	1826	2510	532	1978
	<b>South</b>											
	All	Urban	Rural	All	Urban	Rural	All	Urban	Rural	All	Urban	Rural
	<b>Share of households (%)</b>											
<b>FV combined</b>	99	99	99	100	99	100	100	100	100	100	100	100
Fruit	58	61	55	77	74	80	89	88	91	83	86	80
Vegetable	99	98	99	99	99	100	100	99	100	99	98	99
	<b>Share of food budget* (%)</b>											
<b>FV combined</b>	13	12	14	11	11	12	14	14	15	16	15	16
Fruit	2	2	2	3	3	4	5	5	6	4	4	4
Vegetable	11	10	12	8	8	8	9	9	9	12	11	12
	<b>Daily per capita consumption (grams)</b>											
<b>FV combined</b>	179	178	180	174	165	185	164	169	158	243	250	238
Fruit	38	40	36	46	46	45	85	88	82	110	117	106
Vegetable	141	138	144	128	119	140	79	81	76	133	133	132
Observations	2493	1085	1408	2310	984	1326	2268	980	1288	2465	1056	1409

<sup>1</sup> Does not include food-away-from-home and hence quantities could be lower than the actual total consumption.

Source: Authors' calculations from LSMS data; \* "Food budget" is total consumption of a product, and equals the value of consumption from all sources (purchases, own production, and gifts received and in-kind payments of food received).

**Table 2: Consumption of fruit and vegetable (FV) as a food group by region over time across income terciles<sup>s</sup>**

	2010-2011			2012-13			2015-16			2018-19		
<b>North</b>												
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
<b>Share of households (%)</b>												
<b>FV combined</b>	97	99	100	98	99	99	99	100	100	100	100	100
Fruit	14	34	52	21	33	57	41	67	80	54	73	85
Vegetable	97	99	98	98	99	99	99	100	98	99	100	98
<b>Share of food budget* (%)</b>												
<b>FV combined</b>	13	12	12	8	9	9	10	10	12	13	14	16
Fruit	0	1	2	1	1	2	1	2	5	2	3	5
Vegetable	13	11	10	7	8	7	9	8	7	11	11	11
<b>Daily per capita consumption (grams)</b>												
<b>FV combined</b>	93	154	250	84	148	256	69	148	310	91	187	361
Fruit	3	16	45	5	10	41	19	60	160	40	89	190
Vegetable	90	138	205	79	138	215	50	88	150	51	98	171
Observations	724	1151	619	725	1189	486	1550	642	120	1425	836	249
Share of observations (%)	29	46	25	30	50	20	67	28	5	57	33	10
<b>South</b>												
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
<b>Share of households (%)</b>												
<b>FV combined</b>	98	99	100	99	100	100	100	100	100	100	100	100
Fruit	33	51	72	65	78	79	83	92	96	72	81	89
Vegetable	98	99	99	99	100	99	100	100	99	100	99	98
<b>Share of food budget* (%)</b>												
<b>FV combined</b>	17	14	13	12	11	11	13	13	15	16	16	16
Fruit	2	2	3	3	3	3	4	5	7	3	4	5
Vegetable	15	12	10	9	8	8	9	8	8	13	12	11
<b>Daily per capita consumption (grams)</b>												
<b>FV combined</b>	89	145	238	84	145	216	91	171	279	111	205	349
Fruit	10	27	57	21	30	63	40	86	164	43	84	175
Vegetable	79	118	181	63	115	153	51	85	115	68	121	174
Observations	484	980	1029	348	911	1051	885	956	427	412	1232	821
Share of observations (%)	19	39	41	15	39	45	39	42	19	17	50	33

Source: Authors' calculations from LSMS data; \$ Terciles are created based on average per capita daily total expenditure of a household in both seasons (pre-harvest and post harvest) : T1: less than or equal to \$1.9, T2: between \$1.9 and \$4, T3: greater than \$4. \* "Food budget" is total consumption of a product, and equals the value of consumption from all sources (purchases, own production, and gifts received and in-kind payments of food received).

Table 1 shows FV consumption in both North and South. We find that almost all households consistently consumed at least some vegetable in a typical week in each year in both regions. The share of fruit-consuming households almost doubled from 32% to 63% in the North over the past decade. In the South, the share of fruit-consuming households increased from 58% to 83% during this time.

In per capita daily quantities, per the 2010/11 data, FV consumption in the North was only marginally lower than the South at 160 grams (per day per capita) vs. 179 grams respectively. However, over the past decade FV consumption in the North declined (from 160 grams to 149 grams.) while that for the South increased from 179 grams to 243 grams over the same period. When disaggregated, we find that while vegetable consumption almost halved in the North (from 141 grams to 78 grams), fruit consumption increased by almost 4 times from 19 grams to 71 grams. In the South, fruit consumption tripled (from 38 grams to 110 grams) while vegetable consumption declined from 141 grams to 133 grams.

Further, Table 1 shows that almost all households in both urban and rural areas of both regions have been consuming at least some form of vegetable in a typical week over the last decade. Also, in the South, the share of fruit-consuming households in rural areas has been similar to that in urban areas over the decade (55% and 61% in rural and urban areas in 2010/11 and 80% and 86% in rural and urban areas in 2018/19). Contrary to this, in the North, as per the 2010/11 data, the share of fruit-consuming households was significantly higher in urban areas (50%) than in rural areas (27%). However, a sharp increase in fruit consumption in the rural North over the last decade has reduced this gap (as seen from 2018/19 data), with the share of fruit consumers at 59% in rural areas and 78% in urban areas.

In per capita quantities, in 2018/19, per capita daily consumption of combined FV in the urban North (203 grams) is 1.5 times higher than that in the rural North (135 grams). This difference is predominantly driven by fruit consumption as per capita daily quantity in the urban areas (105 grams) is much higher than that in the rural areas (62 grams). In contrast, in the South, per capita daily FV consumption is almost similar at 250 grams and 238 grams in urban and rural areas respectively.

Table 2 describes FV consumption over time across income groups in both regions. The striking point here is that as per 2018/19 data 57% of the households in the

North belong to the poorest group having per capita daily expenditure below \$1.9 while only 17% in the South belong to this category. In fact, in the North, share of households belonging to the poorest category increased from 29% to 57% over the last decade. This confirms that poverty is more widespread in the North than in the South. Further, per capita quantities of FV consumed by the majority in the North (who belong to the poorest category) is abysmally low at just 91 grams per day in 2018/19 and has remained stagnant over the last decade (93 grams in 2010/11).

Overall, this suggests that while fruit consumption increased dramatically in both the North and the South over the past decade, vegetable consumption declined in both regions, albeit marginally in the South. Yet, fruit and vegetable combined consumption levels are well below the per capita daily recommended levels (by the World Health Organization) of 400 grams across Nigeria and especially lower in rural areas and among the poorest.

We further conduct a disaggregated analysis by different types of FV over time across urban/rural areas and income groups in both regions.

### **Key consumption trends (2018/19 survey)**

First, onions are the most popular FV item consumed all over Nigeria with almost all households across regions and income groups consuming them in a typical week. Per year an average person in the North and South consumes about 8kg and 10kg of onions respectively. The ubiquity of onion consumption is explained by its versatility, and ability to bolster flavor and combine with traditional recipes.

Second, peppers are another widely consumed FV item in both North and South with the share of consumers being 70% and 92% respectively. While per capita annual consumption of peppers is about 3.6 kg in the North, it is twice of that in the South (7.4 kg). As with onions, peppers are versatile and spice up a wide range of dishes.

Third, fresh tomatoes are another important item with a consumer share of about 80% in both regions. This similarity is surprising as tomato production predominantly takes place in the North; thus reflecting the importance of long supply chains moving perishable commodities all over the country. In fact, average annual per capita consumption of fresh tomatoes is higher at 11kg in the South than that in the North (7.7kg).

Fourth, tomato paste (mostly imported) is also an important product particularly in the South where 58% of

the households consume it in a typical week. Surprisingly, tomato paste consumption has also penetrated Southern rural areas possibly due to occasional constraints in supply of fresh tomatoes from the North, and to longer shelf-life and convenience of use. In fact, per capita annual consumption of tomato paste (in terms of fresh equivalent weight) is 8 kg, at par with fresh tomatoes.

Fifth, okra (a traditional African vegetable) is important but more popular in the poorer North (consumed by 74% households) than the affluent South (66%). Despite widespread adoption of non-traditional dishes as regular food (e.g., tomato and onion-based sauce of the popular jollof rice), traditional sauces using okra are still consumed in both the poorer North and the more prosperous South. The average annual per capita consumption is about 3kg in both the regions.

Sixth, green leafy vegetables (GLV) are more popular in the South with a consumer share of 52% versus 31% in the North. Even per capita annual consumption in the South (6.5kg) is twice that in the North (3.3 kg). GLVs are typically not long-distance traded, so local production counts a lot. The South has much wetter conditions year-round that would favor leafy greens production.

Seventh, African eggplant (a traditional vegetable) and potato (a non-traditional vegetable) account for small shares of FV consumption in terms of both popularity and per capita quantity. Anecdotal evidence suggests that African eggplant is now eaten as just a snack and might be facing stiff competition with non-traditional but convenient-to-cook vegetables. Similarly, potato (in the form of French fries) is likely primarily eaten outside of home and has not been captured in food-at-home consumption data that we use.

Eighth, as expected, annual per capita consumption in rural areas is lower than urban areas for all important vegetables—onions, peppers, fresh tomatoes, and fruits in the North. In the South, rural areas have lower annual per capita consumption of fruit, peppers, fresh tomato than urban areas. However, while onion consumption is similar in both rural and urban South, tomato paste consumption is slightly higher in the rural South (8.7 kg fresh equivalent) than in the urban South (7.5 kg fresh equivalent).

#### **Trends over the past decade (2010/11 to 2018/19)**

In the North, while the share of consumers for onions slightly increased over the decade, that for peppers and fresh tomatoes declined. Fruit, on the other hand, jumped

from 32% to 63% in shares of consumers and GLV doubled from 7% to 14%.

In terms of per capita annual consumption, it is concerning that per capita quantities declined for onions (10.1 kg to 8.5 kg), peppers (declined by almost 50% from 6kg to 3.6kg), and fresh tomatoes (16kg to 8kg). Even okra quantities declined considerably from 8kg to 2.5kg. On the contrary, per capita consumption of fruits increased four-fold from 7kg to 26kg. Similarly, although low, GLV consumption increased three times from 1 kg to 3.3 kg.

In the South, contrary to the North, the share of consumers for most vegetables either increased or remained constant over the decade. Further, per capita quantities consumed increased for most FV and only declined slightly for fresh tomatoes. For example, per capita annual consumption of onions doubled from 5kg to 10kg and that of fruit tripled from 14kg to 40kg. Even traditional okra consumption increased from 2.4 to 3.3 kg. On the contrary, per capita annual consumption of tomato paste declined significantly from 23kg to about 8kg.

### **Key Regression Results**

We estimate expenditure and price elasticities for different food groups and report median uncompensated elasticities.

As expected, all FV are normal goods in Nigeria. In the North, onion and okra are necessities with lowest expenditure elasticities of 0.74 and 0.99 respectively. Further fresh tomatoes and peppers are luxury items with expenditure elasticities greater than 1 for overall North. However, these items have an expenditure elasticity of 0.94 and thus are necessities in the urban North (while being luxuries in rural areas). Further, fruit has the highest expenditure elasticity, at 2.23, indicating that despite the rapid expansion of fruit consumption that has taken place, as incomes increase, a more than proportionate share of that additional income is going to fruit consumption.

In the South, low expenditure elasticities are observed for onions (0.65), pepper (0.83), okra (0.84), and fresh tomato (0.87). Our results indicate that these vegetables are necessities in both urban and rural South. However, tomato paste is still a luxury in both urban and rural South suggesting that the demand will increase with rising incomes. Fruit exhibits the highest expenditure elasticity (1.28) again depicting that the demand for fruit will continue to increase with incomes.

## Policy implications

Our findings have important policy implications for further development of FV production and supply chains given the declining consumption of vegetables and the dramatic increase in fruit consumption.

We note that diets have westernized with onions, fresh tomatoes, and peppers being the most important vegetables across regions and income groups. Yet, per capita consumption, although higher than the poorer North, is low (relative to optimal intake per nutrition norms) even in the richer South. Moreover, low expenditure elasticities suggest that preferences for vegetables are low and their intake is unlikely to increase with incomes.

Further, our findings suggest that there is reliance on convenient-to-use items in the South. Producing and promoting such products may help increase FV consumption in the South. For example, the importance of tomato paste in the South, imported mainly from China, indicates excess demand for tomatoes and constraints to production and/or supply chains of fresh tomatoes. It is an opportunity for Nigerian entrepreneurs to produce

tomato paste, and policies and infrastructure to make that processing foray feasible are called for.

Additionally, the ubiquitous expansion of fruit consumption in Nigeria is worthy of note. This is also an opportunity for the Nigerian government and donors to explore and support the domestic supply chains that produce and distribute fruits in the country.

## Key references

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We choose EASI (Exact Affine Stone Index) functional form over other widely used forms such as Almost Ideal Demand System (AIDS) for several reasons. First, the EASI allows Engel curves to follow a flexible form and is more appropriate in the context of developing countries where income ranges are wide and food expenditure elasticities vary significantly with household income. Second, consistent with utility theory, the two-way EASI model allows Hicksian demand to change with total expenditures by interacting log prices with real expenditures. The AIDS model, however, allows only Marshallian demand to change with total expenditures through the income effect in the Slutsky equation.

For our demand analysis, we consider two rounds per wave separately making our data a panel of 6 rounds (2 for each wave). Given low consumption of African eggplant, potatoes, GLVs, and other vegetables, we combine them as one group for the purposes of elasticity estimations.

The two-way approximate EASI demand system is specified as

$$w_{hit}^* = \sum_{j=1}^J a_{ij} \ln p_{hjt} + \sum_{j=1}^J a_{ijy} y_{ht} \ln p_{hjt} + \sum_{r=1}^L b_{ir} y_{ht}^r + \sum_{k=1}^K v_{ik} z_{hkt} + u_{hit} \text{ --- (1)}$$

$$h = 1, \dots, H; i = 1, \dots, J - 1; t = 1, 2, 3, 4, 5, 6$$

where  $w_{hit}^*$  is the latent budget share on the  $i$  th category for household  $h$  at time  $t$ ;  $p_{hjt}$  is the Fisher price index for household  $h$  and category  $j$ ;  $J$  is the number of demand categories and equals 14 food at home categories (13 distinct categories and other foods as a numeraire),  $h$  denotes the household id and  $H$  is the total number of households;  $y_h$  is the real total household expenditure;  $L$  is the highest degree of total expenditure polynomial to be determined by statistical tests, the  $z_{hkt}$ 's are  $K$  exogenous demand shifters including a constant, the  $a_{ij}$ ,  $a_{ijy}$ ,  $b_{ir}$ ,  $v_{ik}$  terms are parameters;  $u_{hi}$  is the regression residual. The latent budget share  $w_{hit}^*$  is associated with observed budget share  $w_{hit}$  by  $w_{hit} \equiv \max\{0, w_{hit}^*\}$ , where  $w_{hit}$  is calculated as the category expenditure divided by household food expenditure. Following Lewbel and Pendakur (2009), we construct the Stone price-deflated household expenditure  $y_{ht} = \ln x_{ht} - \sum_{j=1}^J w_{hjt} \ln p_{hjt}$  where  $x_{ht}$  is total nominal household expenditures on food. Further, we also include interactions between real total household food expenditure and log prices thus allowing Hicksian demand to vary with income.

Moreover, we include the vector of demand shifters,  $z_{hkt}$ , to control for observed taste heterogeneity among households. This vector, in addition to a constant, includes household head age, household size, and binary variables for education, gender, and areas (urban vs rural). We log and demean continuous variables in our analysis.

Furthermore, we exploit the panel structure of our data to account for time-invariant unobserved heterogeneity among households using correlated random effects specification (see Meyerhoefer et al. (2005)). The correlated random effects are specified by household level means across all survey rounds of (1) log prices for each food group (2) interactions between log prices and real household food expenditure. These effects are included as additional demand shifters in the vector  $z_{hkt}$  in equation (1). Thus, our model with household level correlated random effects specification includes an additional 28 demand shifters due to inclusion of mean log price and mean log price- real expenditure interactions for 13 food categories and the numeraire (other foods).

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