fraym

Fortified Food Access in Nigeria

Large Scale Food Fortification

September 2023

Mapping Humanity

We use advanced machine learning models to produce unprecedented, local information on human and population characteristics in critical geographies around the world—down to 1km^2 even in remote areas.

Solving Global Challenges Requires Local-Level Insights

ENERGY

Helped inform investments that will bring electricity to almost half a million forcibly displaced households in the Lake Chad Basin

US GOVERNMENT

Mapped migration drivers in Guatemala & Honduras for 27 million people

PANDEMIC RESPONSE

Empowered 21 global health partners in 10 countries to address COVID-19 vaccine hesitancy through targeted messaging

CLIMATE

Generated data on **70 million people** who will be most affected by climate stress in the next 20 years

GENDER INEQUALITY

Helped mobilize **$180 million** in new funding to place women at the center of an inclusive economic recovery

HEALTH

Identified **2.5 million people** in need of life saving care who may be better served by private medical services

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Overview of Project

OVERVIEW OF PROJECT

Key Findings

Subnational Variation	**Subnational variation** at the State, LGA, and hyperlocal level for both household access and branded fortifiable food vehicle coverage **is common and substantial**. This highlights the need for more focused targeting to improve the reach and coverage of fortified foods.
Access as Drivers	Although the **Fortified Food Access Index** can be used to identify drivers of fortified and fortifiable food coverage, access components are not the sole drivers. Positive, statistically significant correlations exist but of generally weak magnitude. This analysis is one important component of the fortified food lifecycle that can be combined with other data to guide LSFF programmatic focus.
Coverage Correlations	Positive, statistically significant correlations exist between household coverage of branded fortifiable food vehicles, but the correlation is generally weak. **Household purchasing and consumption decisions for different food vehicles are more nuanced, even when people understand the benefits of fortified foods.**
Data Comparability	There were differences in coverage cascade values between Fraym's novel dataset and the National Food Consumption and Micronutrient Survey (NFCMS) 2021 and GAIN's FACT survey in Ebonyi and Sokoto, 2017[2]. This can partially be explained by differing survey methods and sample frames but requires additional examination.

Note 1: https://cgspace.cgiar.org/handle/10568/125113
Note 2: https://www.gainhealth.org/resources/reports-and-publications/fortification-assessment-coverage-toolkit-fact-survey-two-nigerian-states-ebony-sokoto-2017

Goal: Map fortified food access to explore drivers of coverage, and better understand who *is* and *is not* being reached with critical micronutrients from large scale food fortification.

This analysis applies Fraym's machine learning technology to a novel geospatial data set produced in July 2023.

OVERVIEW OF PROJECT

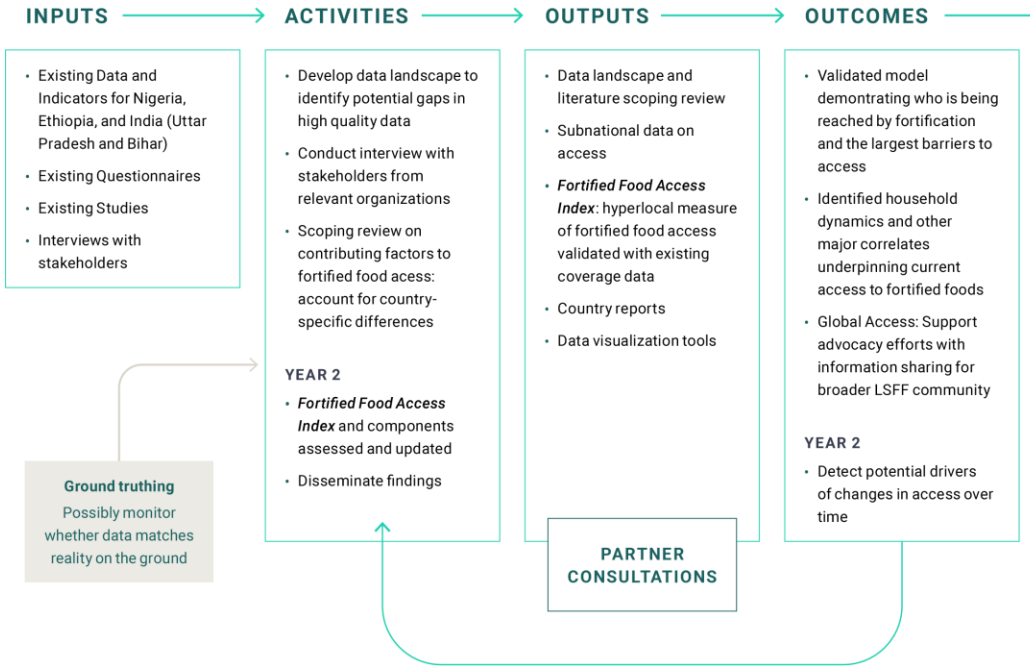
Theory of Change

PROBLEM STATEMENT

Donors, program managers, implementing partners, and policymakers do not have an adequate measure of household level fortified food ***Access – availability, affordability, agency, and awareness***.

THEORY OF CHANGE

By developing a measure of fortified food access to explore drivers of household coverage, we will be able to fill the existing gaps in understanding who is and, importantly, is not being reached by fortification and whether LSFF programming is reaching those who are most vulnerable.



Data Collection & Production

DATA COLLECTION & PRODUCTION

Data Processing Steps

To measure access to fortified foods and compare that to food vehicle coverage, Fraym collects and processes data through the following steps:

1 Survey

Comprehensive yet targeted questionnaires developed for each country cover key analytical concepts and relevant demographic information for interpolation—all while incorporating contextual idiosyncrasies and survey methodological best practices. This novel data fills gaps in existing data.

2 Sample Design

For novel data, samples are designed to be nationally representative from a demographic and socioeconomic perspective. This ensures that Fraym can accurately predict across the target geography for every indicator of interest.

3 Spatial Data Production

Fraym's proprietary machine learning technology takes variables from the novel survey or existing data, combines them with other spatial datasets as inputs and outputs an interpolated raster layer with 1 square kilometer estimations for proportions and populations for all key indicators.

4 Analysis

Using the interpolated rasters, Fraym runs analyses on the indicators of interest, including how they correlate and vary spatially, and builds indices to condense this information.

Data Collection Overview

Fraym developed a **Fortified Food Access Index** using both novel data and existing data from the 2018 Nigeria Demographic and Health Survey (DHS)[1]. To collect novel data, Fraym partnered with the company, GeoPoll, to conduct a georeferenced, **nationally representative** Computer Assisted Telephone Interview (CATI) survey in 2023. The sample frame was based on interlocking demographic quotas that encompass geographic location, age bracket, and sex, from the US Census Bureau International Database of Population Projections[2]. National level socioeconomic quotas based on asset ownership and education were based on the 2018 Nigeria DHS.

YEAR 1 2023

Data Collection: May to July 2023

Languages: English, Hausa, Yoruba, and Igbo

Final Sample: 7,391 respondents (ages 18-69)

Demographic Quotas: State, age, and sex

Socioeconomic Quotas: based on asset ownership and education at the national level

QUOTA EXAMPLE

Women between the ages of 18 and 24 living in the north central region of Nigeria (Kwara, Kogi, Niger, Benue, FCT, Nasarawa, and Plateau) account for roughly 2% of the adult national population. Therefore, as a baseline assumption, our interlocking quota for this population subgroup would represent this proportional share of our total survey sample (2% x 7,000 = 140 respondents).

Note 1: https://dhsprogram.com/methodology/survey/survey-display-528.cfm
Note 2: https://www.census.gov/programs-surveys/international-programs/about/idb.html

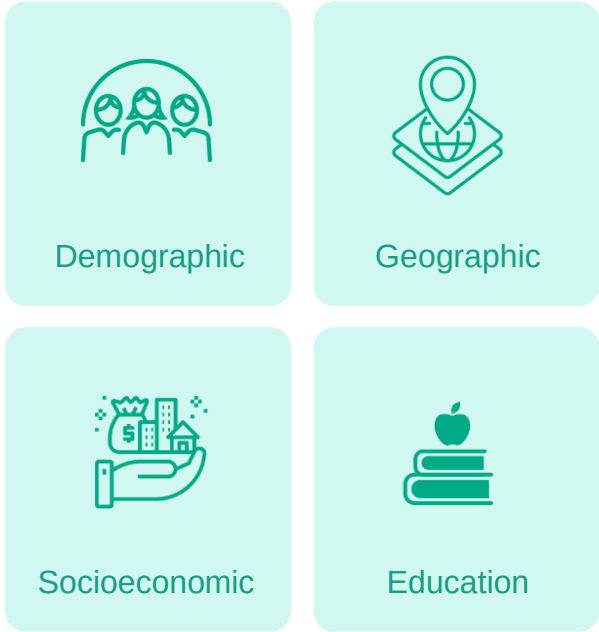
DATA COLLECTION & PRODUCTION

Sample Design

Quality training data is critical to producing a valid and actionable index.

- Fraym's vendor, GeoPoll, conducted Computer Assisted Telephone Surveys (CATI) using random digit dialing (RDD) to ensure all phone subscribers (18-69) in the country have an equal probability of being surveyed[1].
- Through extensive re-sampling and sample trimming exercises, Fraym has identified the minimum sample size to reliably make 1km^2 estimates.
- Fraym sets quotas based on 4 categories to ensure representativeness across the data inputs to our models. The RDD approach is pursued until all the quotas are filled. More information can be found in **Annex I**.

QUOTA CATEGORIES



Note 1: According to the 2018 Nigeria DHS, 90% of the population live in a household that owns a mobile phone.

DATA COLLECTION & PRODUCTION

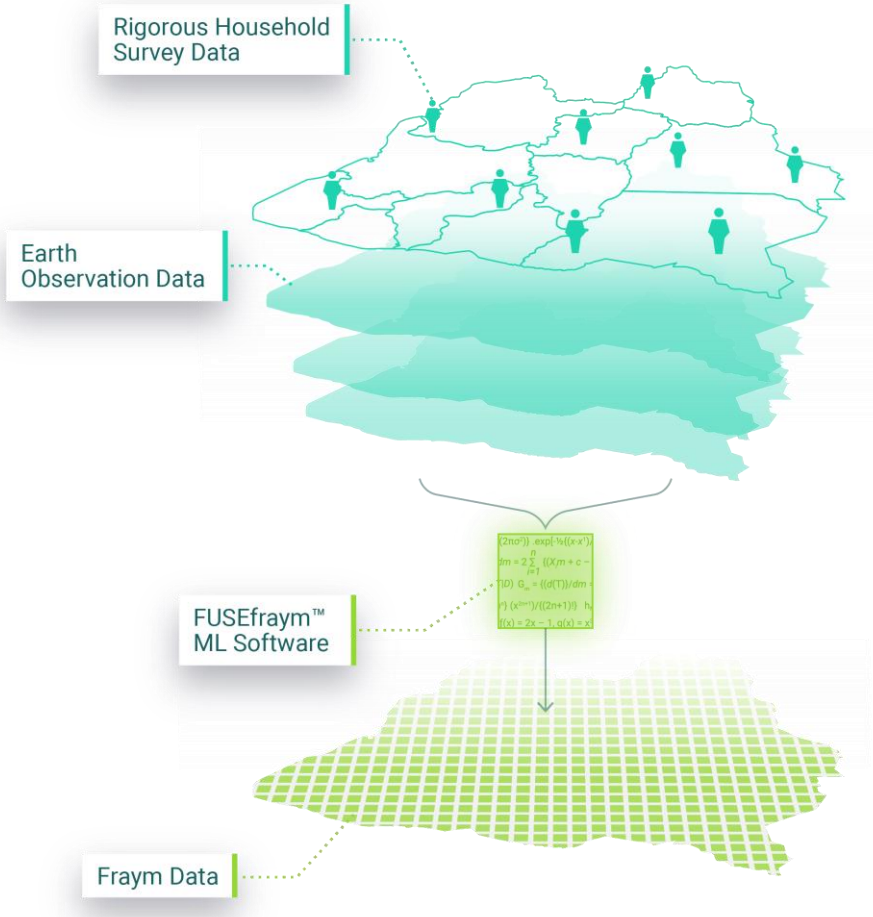
About Fraym

Fraym has built machine learning (ML) software that weaves together geo-tagged household survey data with satellite imagery to create localized population information (1 km^2).

1 The primary ML model input is data from high-quality, geo-tagged household surveys. Key indications of a high-quality household survey include implementing organization(s), sample design, sample size, and response rates. After data collection, *post-hoc* sampling weights are created to account for any oversampling and ensure representativeness.

2 The second major data input is satellite imagery and related derived data products, including earth observation (EO) data, gridded population information (e.g., human settlement mapping, etc.), proximity to physical locations (e.g., health clinics, ports, roads, etc.) and biophysical surfaces like soil characteristics. As with the survey data, Fraym data scientists ensure that the software only uses high-quality imagery and derivative inputs.

3 To create spatial layers from household survey data, Fraym leverages machine learning to predict an indicator of interest at a 1km^2 resolution. This methodology builds upon existing, tested methodologies for interpolation of spatial data. The resulting model is used to predict the survey data for all non-enumerated areas. A similar approach was originally developed by academic researchers focused on health outcomes, which were expanded upon by USAID's Demographic and Health Surveys program since then by Fraym and others.



DATA COLLECTION & PRODUCTION

Unmasking Local Human Trends

National or even regional datasets mask critical local patterns.

Fraym data reveals communities that are 65+ percentage points above the national average on key access indicators.

AGGREGATED SURVEY RESULTS

Proportion of Nigerian adults who have heard of fortified foods:

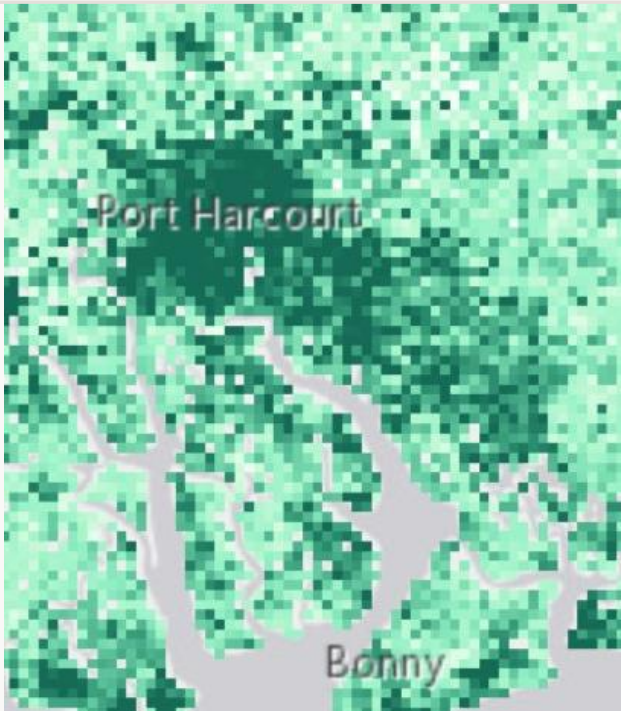
31%

VS.

SUBNATIONAL VARIATION

Proportion of adults who have heard of fortified foods: *Port Harcourt, Nigeria: 1 km resolution*

0% 100%



Fortified Food Access Index

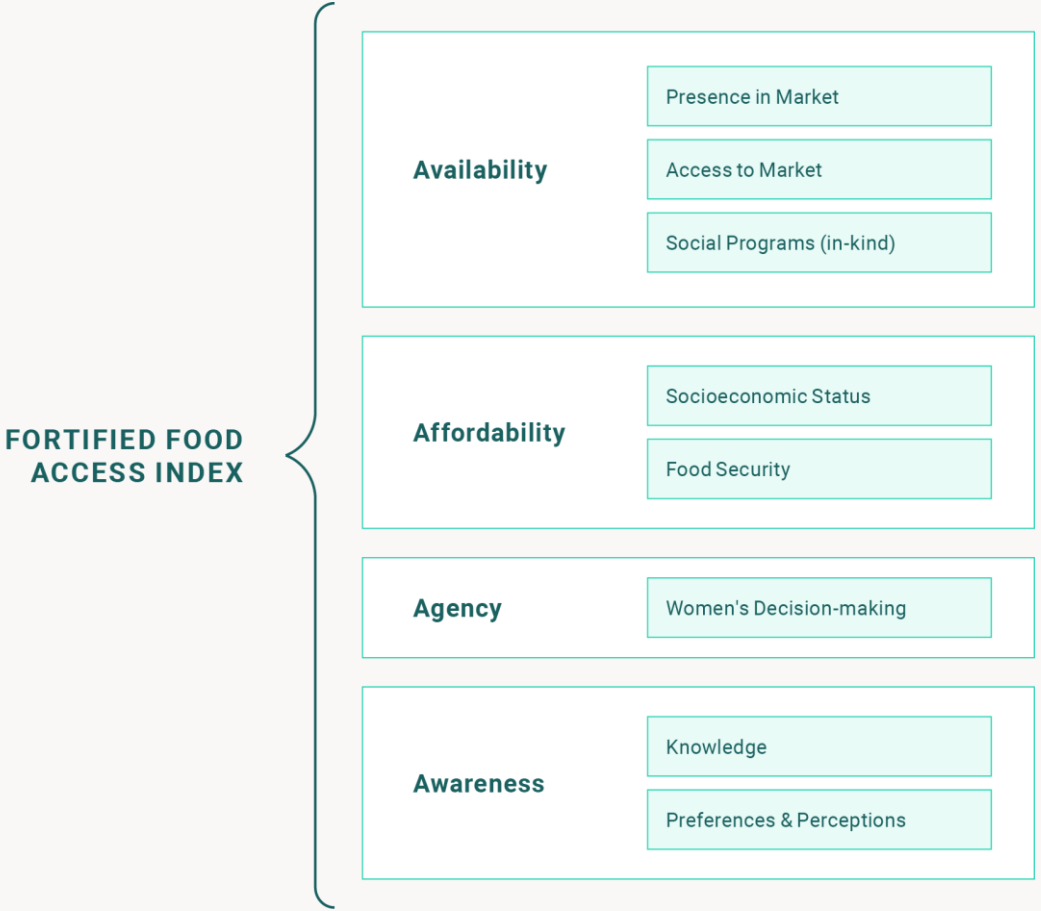
Fraym's Fortified Food Access Index combines indicators related to the current availability, affordability, agency, and awareness around fortified foods at the community level in Nigeria. When combined, this index from 0 (low) to 100 (high) provides insight into the key drivers of access that influence household fortified food coverage.

FORTIFIED FOOD ACCESS INDEX

Index Framework

This 2-year program produces community-level data on fortified food access and household coverage in Nigeria and Ethiopia. The **Fortified Food Access Index** contains the following components:

- **Availability:** Fortified foods offered directly through a social program, combined with a household's capacity to access nearby food markets.
- **Affordability:** Financial ability of a household to purchase the fortified version of a food vehicle.
- **Agency:** Household's capacity to purchase fortified foods in terms of intra-household decision-making dynamics and women's empowerment.
- **Awareness:** Knowledge, preferences, and perceptions around fortified foods.



FORTIFIED FOOD ACCESS INDEX

Geographic Variation

Geographically, the most drastic differences in access uncovered by the **Fortified Food Access Index** exist between the north and south of the country and between urban and rural areas. South South and South West have the highest access scores while North West and North East have the lowest. Yobe and Sokoto are the states with the lowest scores, while Lagos and Federal Capital Territory have the highest overall access scores.

Availability

Availability scores do not vary greatly between zones. At the state-level, availability is lowest in Oyo (42) and Yobe (43) and highest in Federal Capital Territory (55). As expected, availability is generally higher in urban cities than in rural areas.

Affordability

Affordability varies greatly between zones. Northwest has the lowest affordability score (29) compared to the highest in South South (51). The state with the lowest affordability score is Zamfara (21) while Lagos has the highest (65).

Agency

Agency varies slightly between zones with northern zones having overall lower scores than zones in the south. Lagos has the highest agency score (65) while Sokoto has the lowest agency score (42).

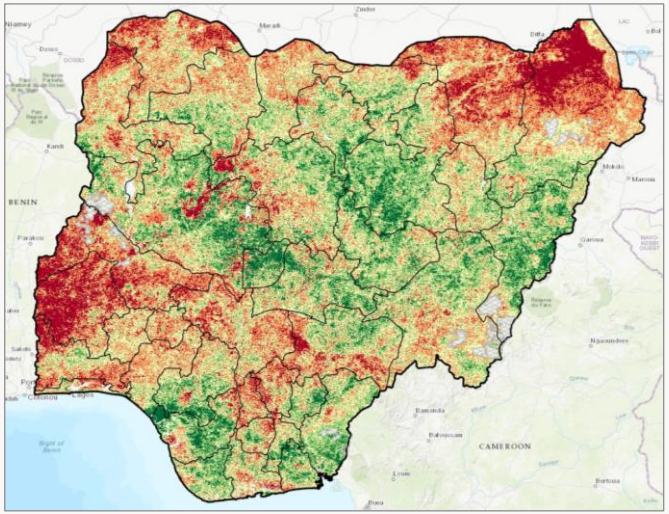
Awareness

Awareness varies slightly between zone with a smaller divide between the north and south of the country. Awareness is lowest in Yobe (40) and Jigawa (41) and highest in Lagos (53) although the variation throughout the country is fairly low.

Indicators for Availability

Availability is defined as the household's capacity to access the markets most likely to have fortified foods. In Nigeria, the relative dearth of in-kind social programs precludes the inclusion of foods offered directly through social protection programs, so this element is excluded.

INDICATOR	DESCRIPTION
Access to Market: *Fewer barriers in buying fortified foods at the market means a household has greater market access.*	
Time to food market (driving)[1]	Driving time to nearest food market using least cost distance equation
Time to food market (asked)	A household takes 15 minutes or less to get to at least one place where they shop for food
Market has convenient hours	At least one place a household shops for food at is open every day
Supermarket shopper	Household shops at a supermarket for at least one food vehicle
Market has good choice of products	Household chooses at least one of the places where they shop because it has a good choice of products



Fortified Food Access Index: **Availability**

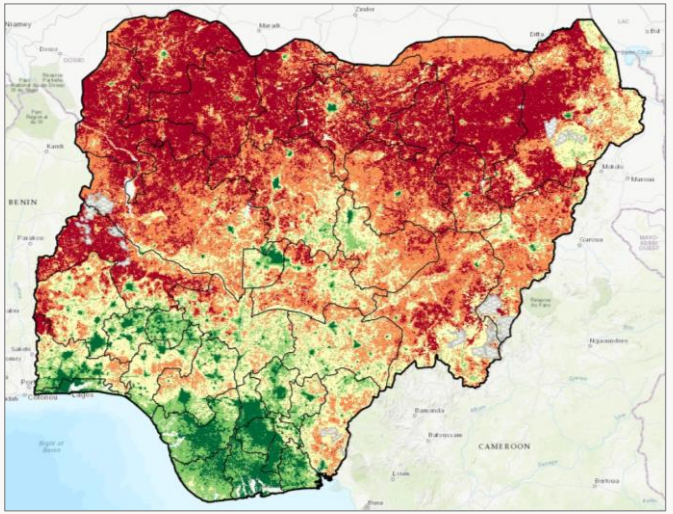
(Low) 0 100 (High)

Note 1: This indicator is produced by Fraym using Malaria Atlas Project friction layers and OpenStreetMap point of interest (POI) data.

Indicators for Affordability

Affordability is defined as the financial ability of a household to purchase the fortified version of a food vehicle. Low affordability indicates that the household is financially constrained on fortified food purchases.

INDICATOR	DESCRIPTION
Socioeconomic Status: *Households with more wealth and higher education levels are more likely to have access to fortified foods.*	
Household wealth index[1]	Household is in the top two wealth quintiles
Education level	Individual in household has completed at least secondary education
Food expenditure	Household spends only a small amount of their income on food purchases
Food Security: *Households have not compromised on the variety or quality of foods that they've eaten due to financial constraints*	
Food security: healthy & nutritious	Household has not been unable to eat healthy and nutritious foods due to lack of money or resources over the past 12 months
Food security: variety	Household has not been unable to eat a variety of foods due to lack of money or resources over the past 12 months



Fortified Food Access Index: **Affordability**

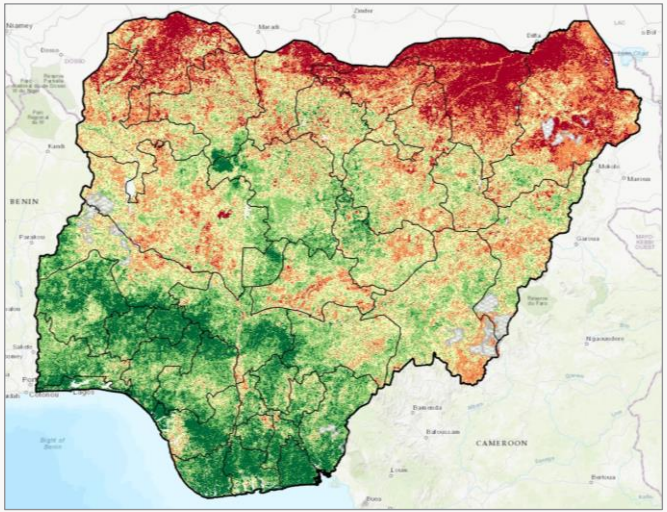
(Low) 0 — 100 (High)

Note 1: This indicator is from the 2018 Demographic and Health Survey.

Indicators for Agency

Agency is defined as a household's capacity to purchase fortified foods in terms of intra-household decision-making dynamics and women's empowerment.

INDICATOR	DESCRIPTION
Women's Decision-making: *If a woman in the household generates her own income and has decision-making power, the household is more likely to purchase fortified foods.*	
Sex of household head	Household head is female
Woman earns income	At least one woman in the household earns income
Woman controls income	Income-generating woman/women in the household have sole control over how that money is spent
Household meal planning and prep	Woman/women in the household is solely responsible for meal planning and preparation
Household shopping	Woman/women in the household solely does the grocery shopping



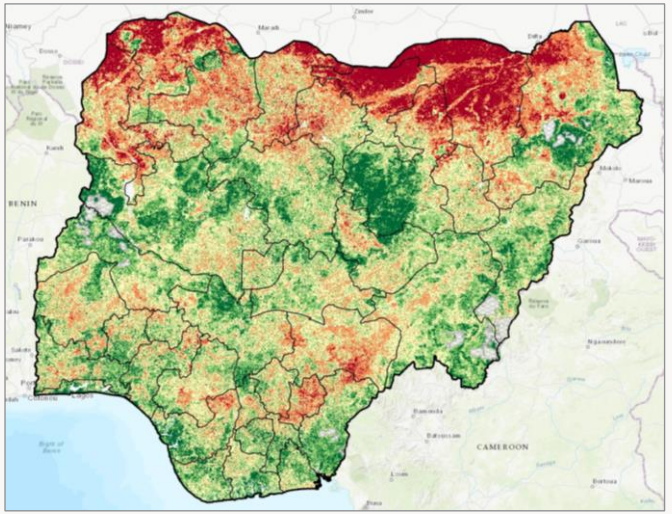
Fortified Food Access Index: **Agency**

(Low) 0 100 (High)

Indicators for Awareness

Awareness is defined as the household's knowledge, preferences, and perceptions around fortified foods.

INDICATOR	DESCRIPTION
Knowledge: *Households with individuals knowledgeable of the benefits of fortified foods are more likely to seek them out.*	
Heard of fortified foods	Individual has heard of fortified foods
Knows benefits of fortified foods	Individual knows that fortified foods have added micronutrients, are good for health, and/or are good for growth and development of children
Heard messaging through the media	Individual reported hearing about fortified foods through media outlet (TV, newspaper, radio, or social media)
Preferences & Perceptions: *Households with individuals that have positive preferences and perceptions around fortified foods are more likely to seek them out.*	
Nutrition-sensitive	Individual says nutrition is a moderately or very important factor in determining what to buy
Willingness to pay for fortified foods	If individual knows food vehicle is fortified, he/she would be willing to pay more
Brand preference	Individual is more likely to purchase name brand(s) of staple foods
Reads labels or nutritional information	Individual reads food packaging materials before making purchasing decisions
Trust in institutions	Individual trusts government institutions and food producers to provide safe and healthy foods



Fortified Food Access Index: **Awareness**

(Low) 0 100 (High)

FORTIFIED FOOD ACCESS INDEX

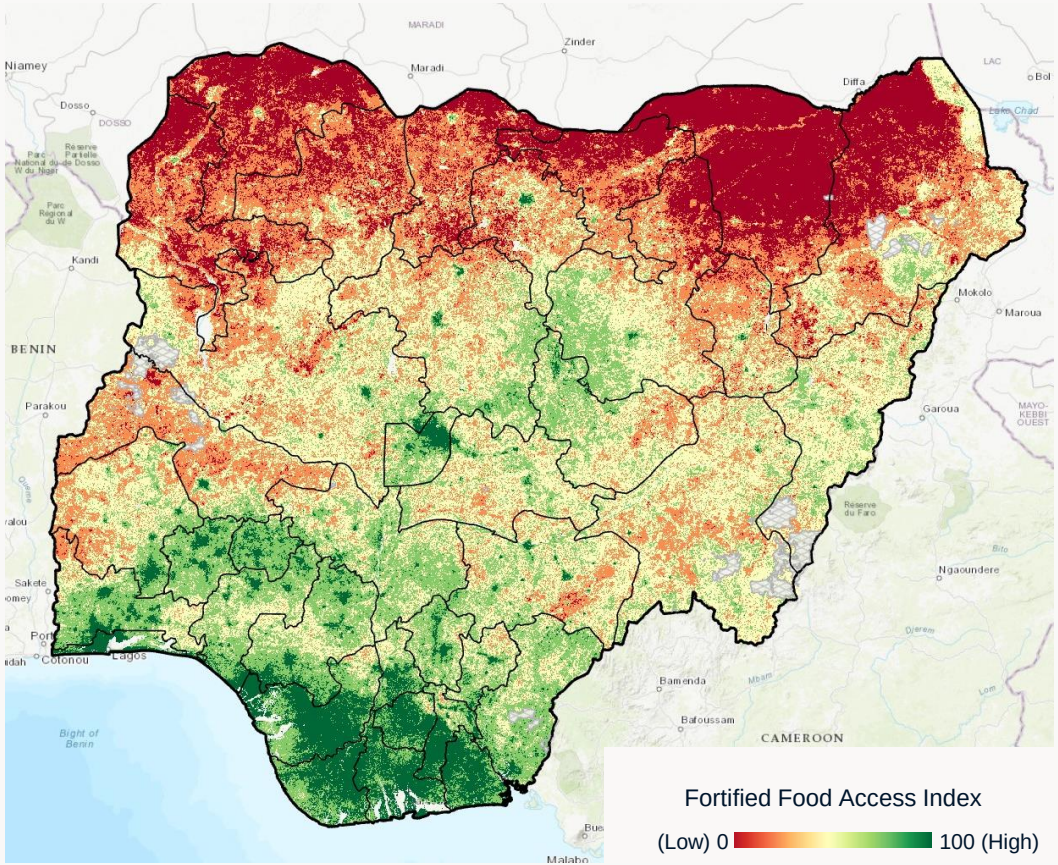
Access Index Methodology

The foundational inputs of the access index are the spatially interpolated rasters of the indicator proportion data from the questionnaire. Using these, index rasters were generated for each of the 4As using spatial principal component analysis (PCA).

Relevant initial checks confirmed that there was sufficient and appropriate correlation between the component indicators to justify this methodological approach for each of these themes, as evidenced primarily by the validity of the eigenvalues.

Results were normalized, and zero-population areas filtered out, to facilitate comprehension and comparability.

Finally, the overall access index was developed with an equally weighted average of all the As and the results were filtered. Although this approach required assigning equal relative importance to each A component, it facilitates interpretability of the overarching access index.



Coverage Cascade

Understanding how Access relates to Coverage is important for determining the utility of the Fortified Food Access Index. Additionally, Fraym's coverage data can be compared and validated with existing datasets. This section covers food vehicle acquisition as well as common food vehicle types and brands used throughout Nigeria.

Coverage Definition

To validate our index and evaluate the interplay between the 4A's, household coverage data was also collected. Additionally, data related to a food vehicle coverage was collected so that it can be directly compared with other survey coverage data available in Nigeria.

INDICATOR	DESCRIPTION
Presence in Household: *If branded "fortifiable" food vehicles are present, the household is more likely to have and consume fortified foods.*	
Branded "fortifiable" food vehicles in household[1]	Individual reports having name-brand food vehicles in the household

Note 1: If the respondent answers that their household last got the food vehicle in its original packaging, they are asked the brand of food vehicle. The brands used to construct this variable for each food vehicle are noted on pages 27, 31, 33, 35, and 37.

Branded Food Vehicle Correlations

Fraym first investigated the correlation between household coverage of each branded food vehicle. One might expect correlations to be high—if a households has a branded fortifiable version of one common staple, they are more likely to have a branded fortifiable version of other common staples. However, although all correlations are positive and statistically significant at the 95% confidence level, there are no strong correlations (above 0.50).

The highest correlation is between branded sugar and branded wheat flour (0.43), while the lowest is between branded bouillon cube and branded maize flour (0.06). This highlights the fact that households in Nigeria do not always have consistent purchasing patterns for staple foods and that different food vehicles require different targeting strategies to improve reach.

Correlation Coefficients of Household Coverage

How correlated is household coverage of branded food vehicles

	Branded Oil	Branded Wheat Flour	Branded Maize Flour	Branded Salt	Branded Sugar	Branded Bouillon Cube
Branded Oil	1.00					
Branded Wheat Flour	0.34*	1.00				
Branded Maize Flour	0.34*	0.25*	1.00			
Branded Salt	0.14*	0.17*	0.13*	1.00		
Branded Sugar	0.42*	0.43*	0.34*	0.20*	1.00	
Branded Bouillon Cube	0.08*	0.21*	0.06*	0.18*	0.16*	1.00

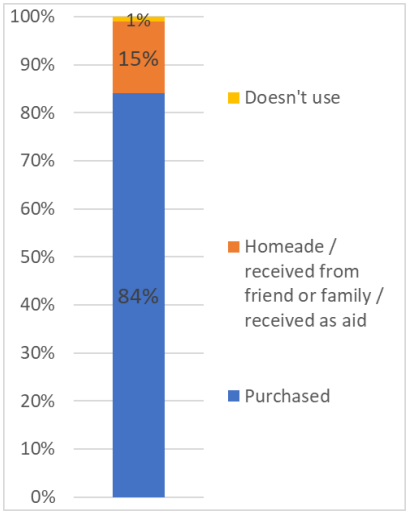
* Pearson's *r* correlation significant at 95% Confidence Level when compared to a null hypothesis of no correlation.

COVERAGE CASCADE

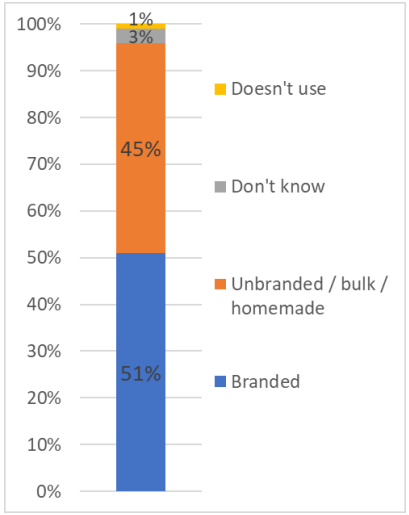
Edible Oil Usage

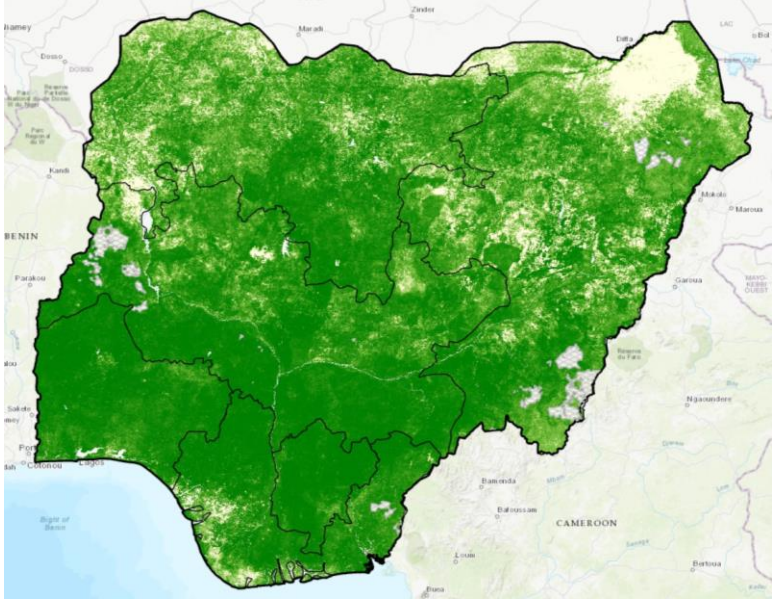
Edible oil is used widely throughout Nigeria – 99% of households report typically using the food vehicle[1]. Additionally, 84% of households purchase oil and 51% of households report having a branded version.

Edible Oil Acquisition



Fortifiable Edible Oil





Household typically uses edible oil

50% 100%

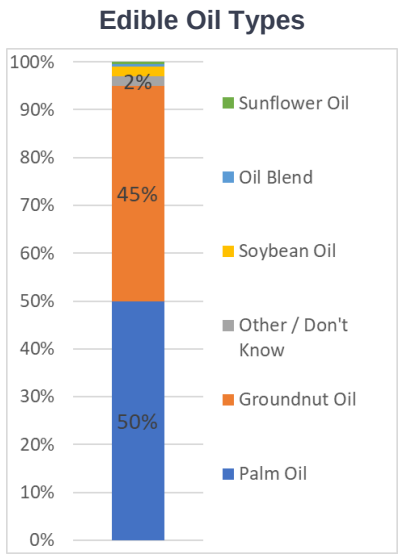
Geopolitical Zone	Proportion of households that use edible oil
North Central	99%
North East	98%
North West	99%
South East	100%
South South	99%
South West	100%

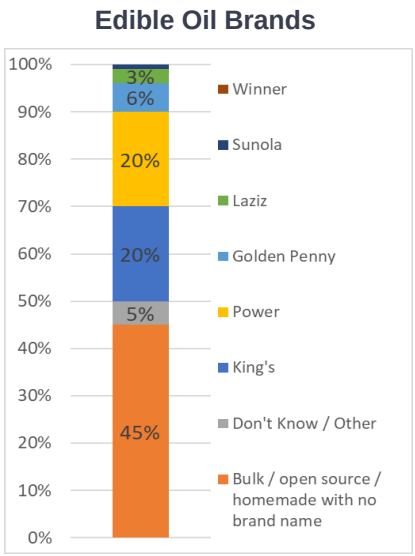
Note 1: Households are asked, “Does your household typically use oil to prepare foods at home?”
This compares to the NFCMS 2021 and GAIN FACT survey question, “Does your household use [FOOD VEHICLE] to prepare foods at home?”

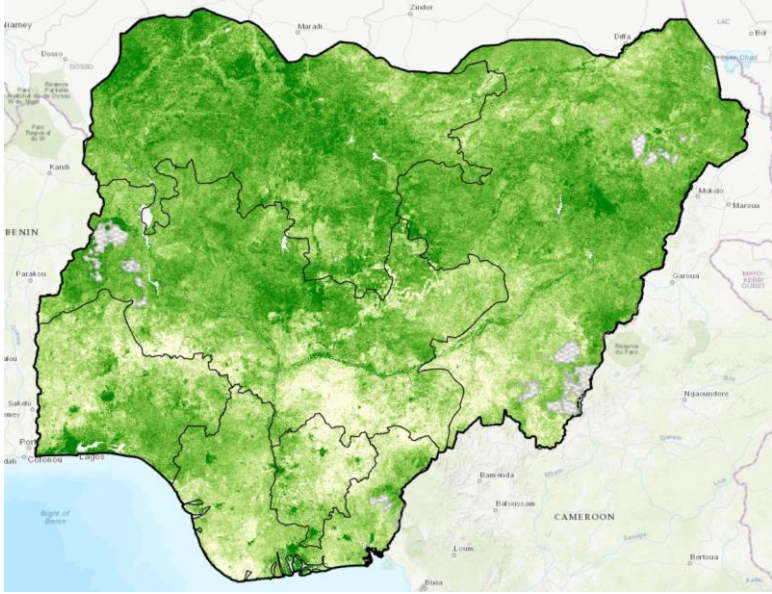
COVERAGE CASCADE

Edible Oil Brands and Types

Branded edible oil usage is relatively similar across geopolitical zone. The most common types of edible oils used are palm oil and groundnut oil and the most common brands are King's and Power.







Household typically uses branded edible oil

0% 100%

Geopolitical Zone	Proportion of households that use branded edible oil
North Central	50%
North East	50%
North West	52%
South East	47%
South South	48%
South West	56%

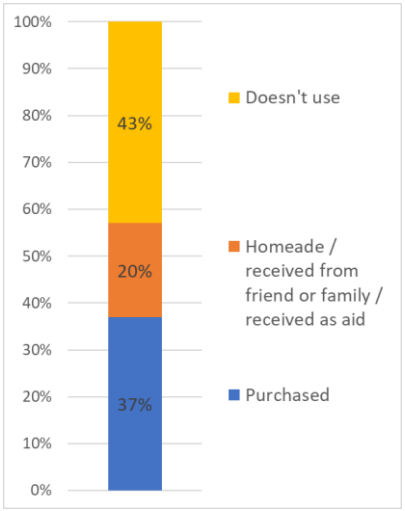
Note 1: Brands included in this variable are King's, Laziz, Power, Sunola, Winner, and Golden Penny.

COVERAGE CASCADE

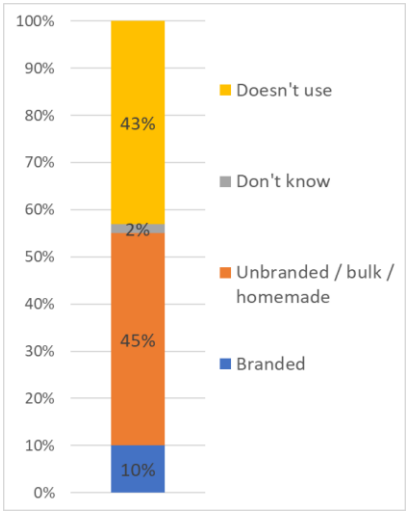
Maize Flour

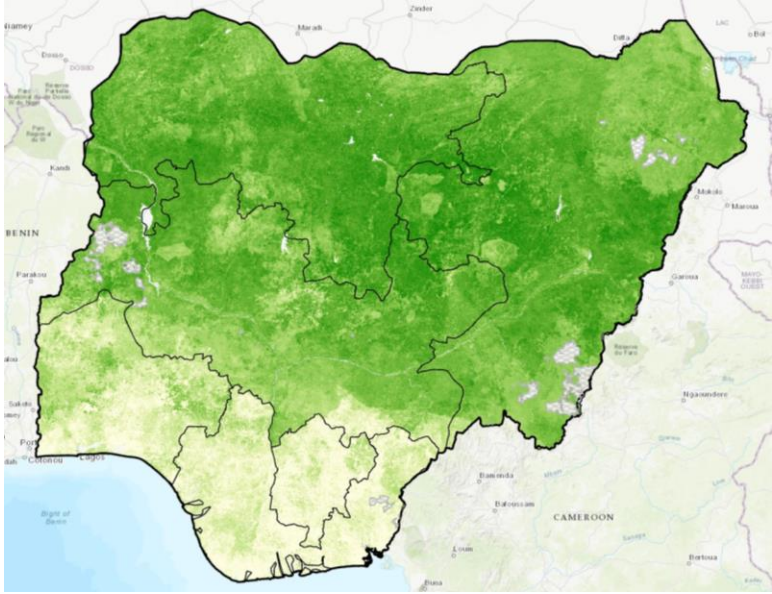
Although only 57% of households typically use maize flour to prepare foods at home, maize flour is more common in the north[1]. Nationally, around 37% of households purchase maize flour, and only 10% of households report having a branded version.

Maize Flour Acquisition



Fortifiable Maize Flour





Household typically uses maize flour

0% 100%

Geopolitical Zone	Proportion of households that typically use maize flour
North Central	67%
North East	78%
North West	79%
South East	36%
South South	38%
South West	43%

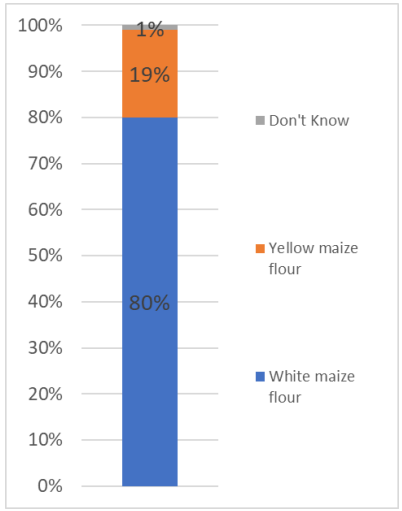
Note 1: Households are asked, "Does your household typically use maize flour to prepare foods at home?"
This compares to the NFCMS 2021 and GAIN FACT survey question, "Does your household use [FOOD VEHICLE] to prepare foods at home?"

COVERAGE CASCADE

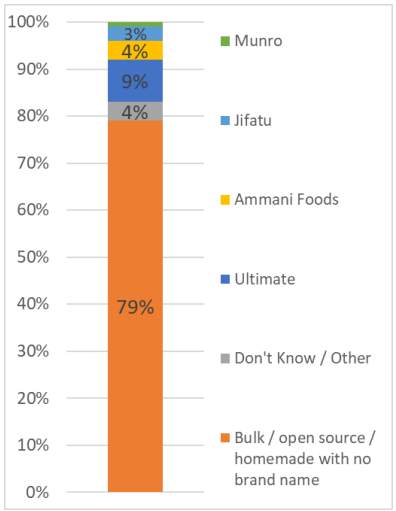
Maize Flour Brands and Types

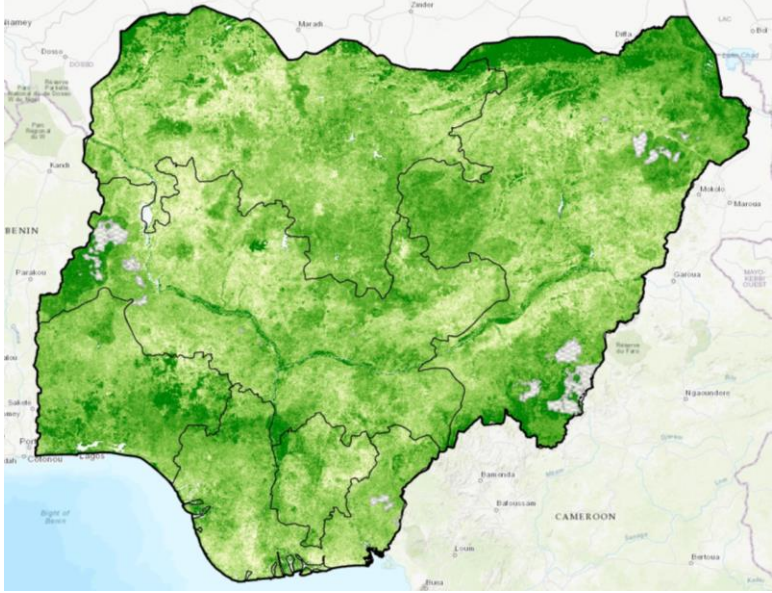
Although maize flour is not very common in South West, it is the zone with the highest proportion of households that use a branded version. The most common type of maize flour used is white, and the most common brands are Ultimate and Ammani.

Maize Flour Types



Maize Flour Brands





Household typically uses branded maize flour

0% 100%

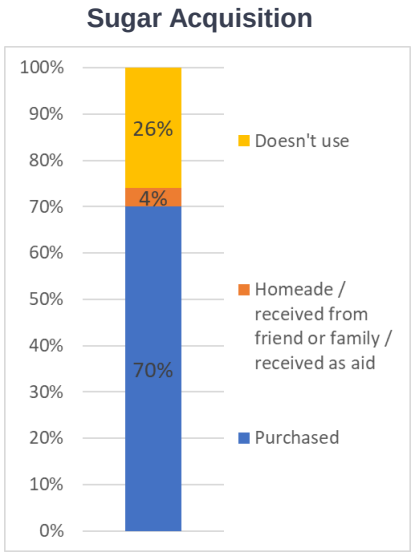
Geopolitical Zone	Proportion of households that use branded maize flour
North Central	17%
North East	19%
North West	17%
South East	19%
South South	18%
South West	23%

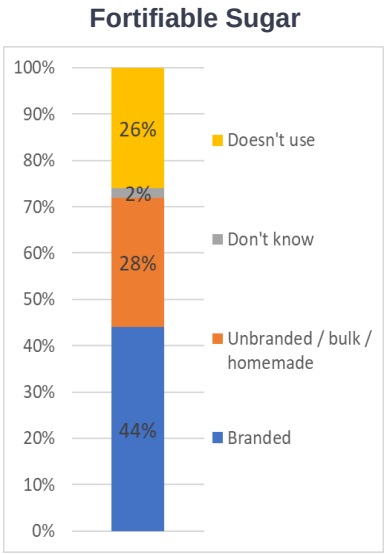
Note 1: Brands included in this variable are Ultimate, Jifatu, Ammani Foods, and Munro.

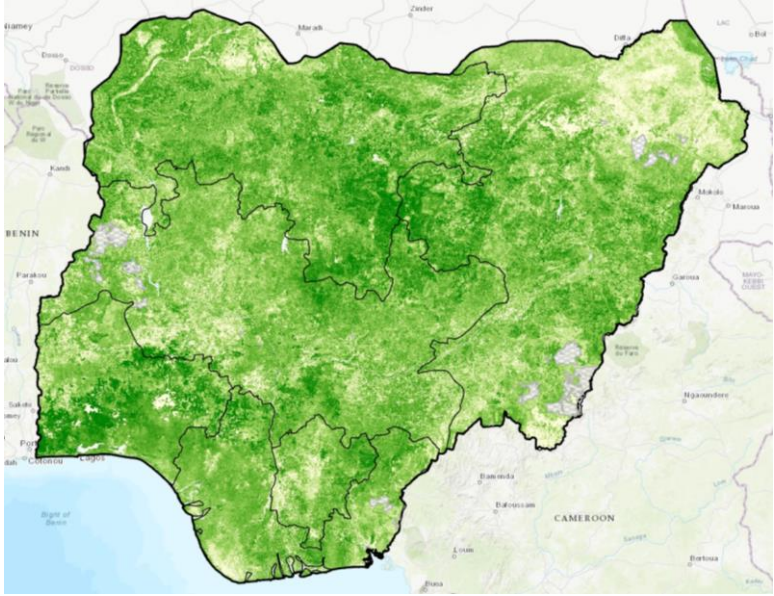
COVERAGE CASCADE

Sugar

Sugar is used to prepare foods at home relatively uniformly throughout Nigeria, by an average of 74% of households[1]. Around 69% of households purchase sugar, and 44% of households report having a branded version.







Household typically uses sugar

0% 100%

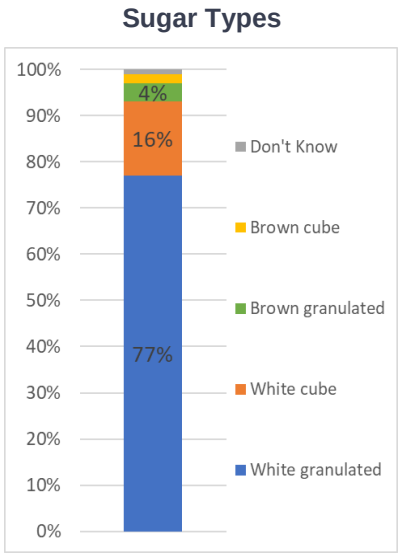
Geopolitical Zone	Proportion of households that typically use sugar
North Central	74%
North East	72%
North West	74%
South East	70%
South South	72%
South West	77%

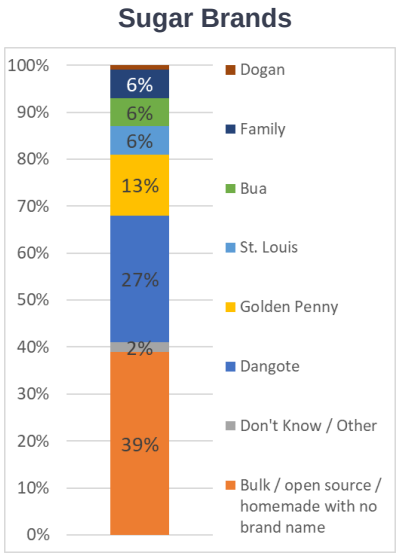
Note 1: Households are asked, "Does your household typically use sugar to prepare foods at home?"
This compares to the NFCMS 2021 and GAIN FACT survey question, "Does your household use [FOOD VEHICLE] to prepare foods at home?"

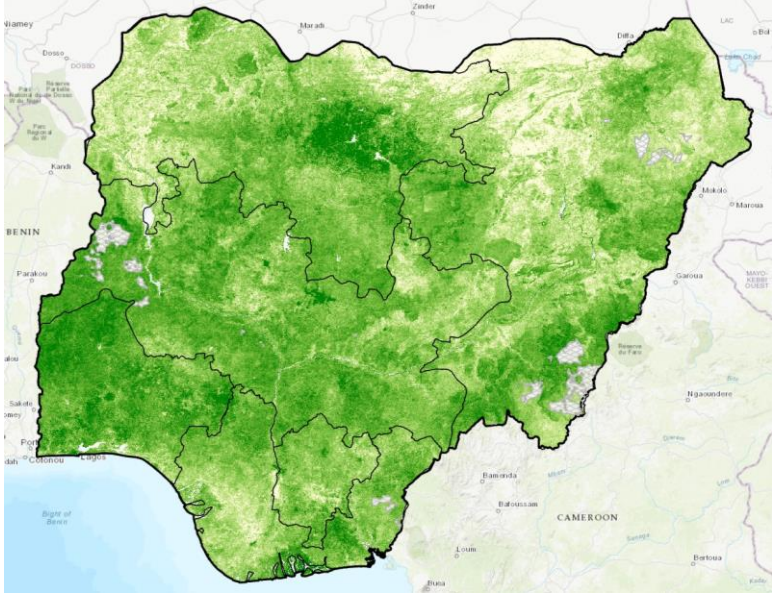
COVERAGE CASCADE

Sugar Brands and Types

Branded sugar usage is relatively high across geopolitical zones. The most common types of sugar used are white granulated and white cubed. The most common brands are Dangote and Golden Penny.







Household uses branded sugar

0% 100%

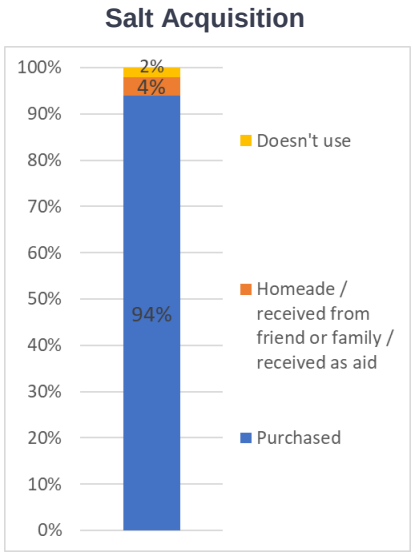
Geopolitical Zone	Proportion of households that use branded sugar
North Central	61%
North East	54%
North West	56%
South East	58%
South South	58%
South West	63%

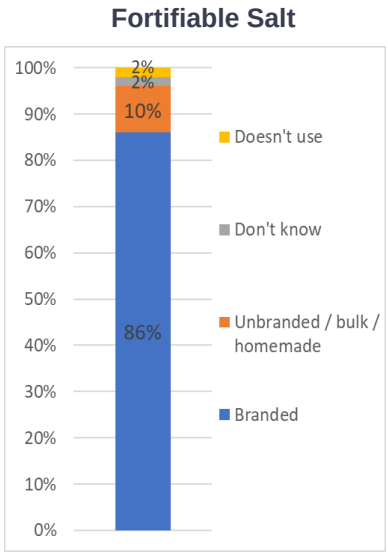
Note 1: Brands included in this variable are Family, Dangote, Bua, Golden Penny, St. Louis, and Dogan.

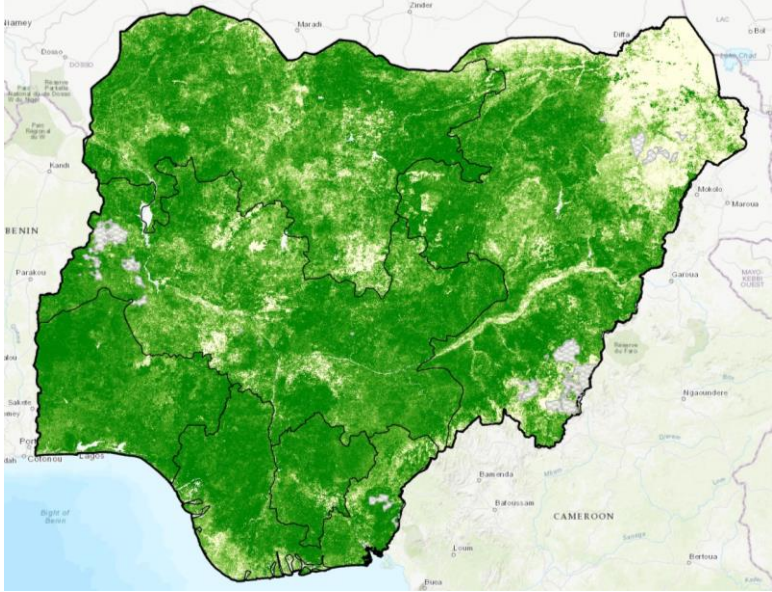
COVERAGE CASCADE

Salt

Salt is used for cooking by around 98% of total households[1]. Many households purchase salt (94%) and 86% report having a branded version.







Household typically uses salt

15% 100%

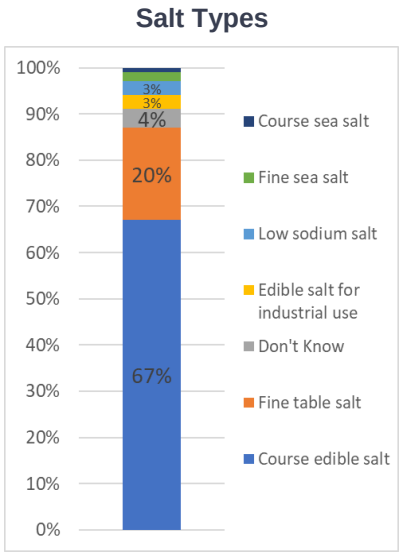
Geopolitical Zone	Proportion of households that typically use salt
North Central	98%
North East	96%
North West	97%
South East	98%
South South	98%
South West	99%

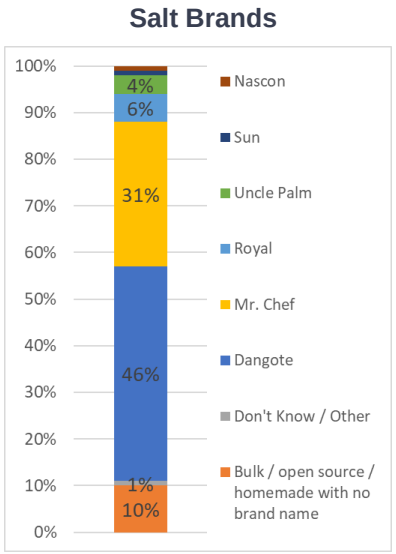
Note 1: Households are asked, “Does your household typically use salt to prepare foods at home?”
This compares to the NFCMS 2021 and GAIN FACT survey question, “Does your household use [FOOD VEHICLE] to prepare foods at home?”

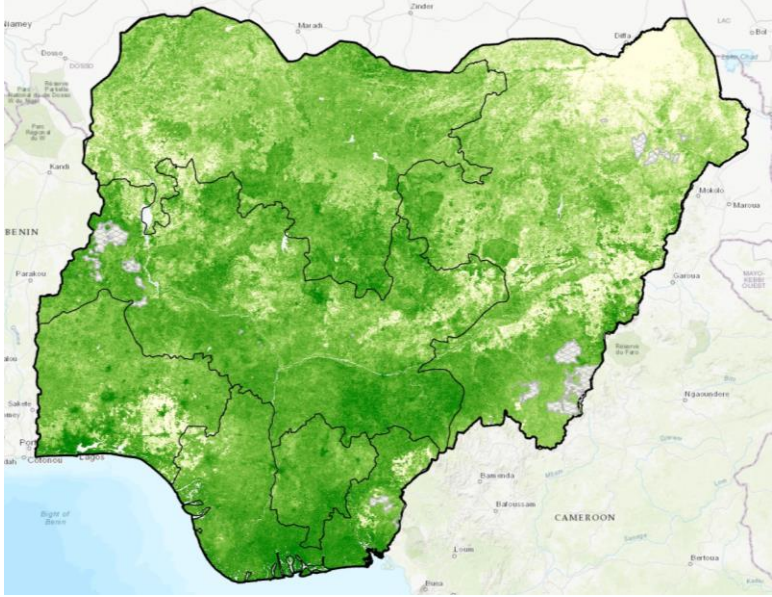
COVERAGE CASCADE

Salt Brands and Types

Branded salt usage is very high across all geopolitical zones. The most common types of salt used are course edible salt and fine table salt. The most common brands of salt are Dangote and Mr. Chef.







Geopolitical Zone	Proportion of households that use branded salt
North Central	88%
North East	81%
North West	85%
South East	90%
South South	92%
South West	91%

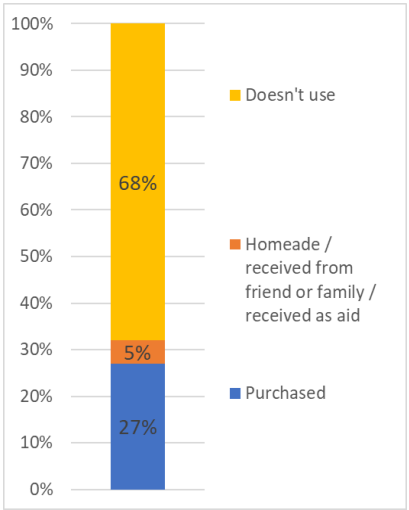
Note 1: Brands included in this variable are Dangote, Royal, Mr. Chef, Uncle Palm, Sun, and Nascon.

COVERAGE CASCADE

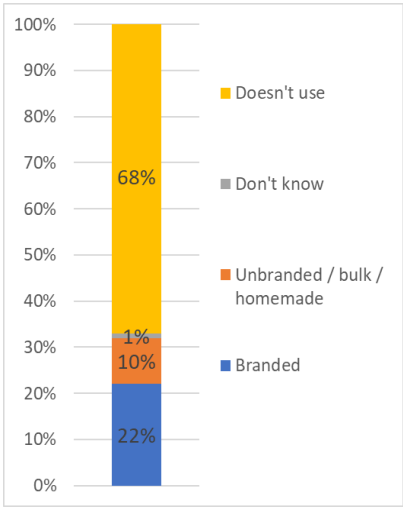
Wheat Flour

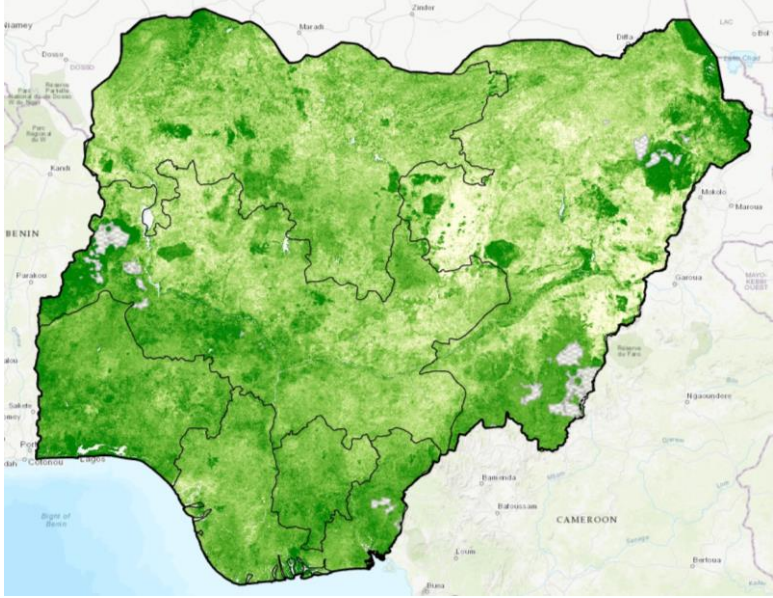
Wheat flour is only used to prepare foods at home by around 32% of households, with higher concentrations in certain areas[1]. Only 27% of these households purchase wheat flour and 22% report having a branded version.

Wheat Flour Acquisition



Fortifiable Wheat Flour





Household typically uses wheat flour

0% 100%

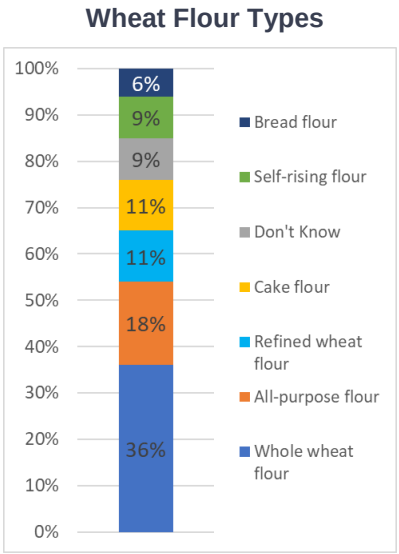
Geopolitical Zone	Proportion of households that typically use wheat flour
North Central	30%
North East	25%
North West	27%
South East	34%
South South	33%
South West	41%

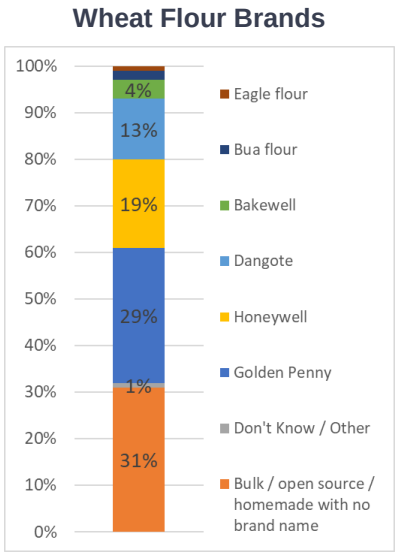
Note 1: Households are asked, "Does your household typically use wheat flour to prepare foods at home?"
This compares to the NFCMS 2021 and GAIN FACT survey question, "Does your household use [FOOD VEHICLE] to prepare foods at home?"

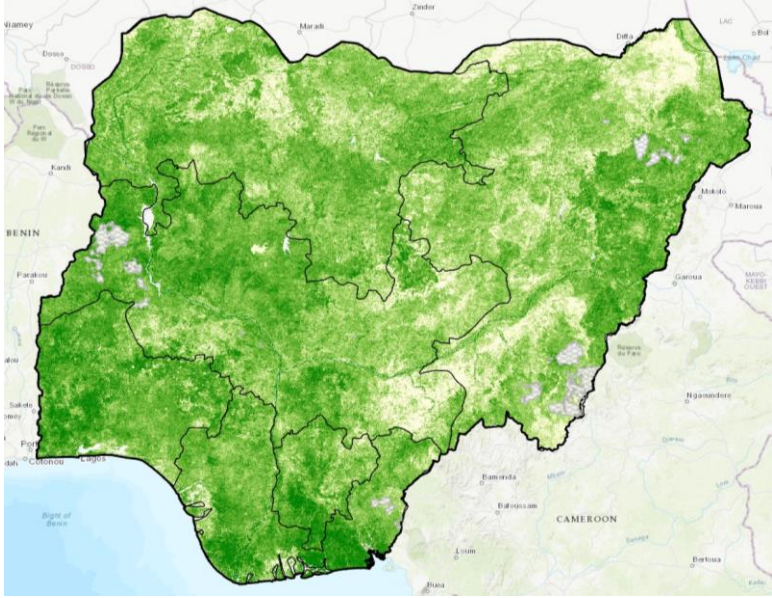
COVERAGE CASCADE

Wheat Flour Brands and Types

Branded wheat flour coverage is highest in the south of the country. The most common types of wheat flour are whole wheat and all-purpose. The most common brands of are Golden Penny, Honeywell, and Dangote.







Household has branded wheat flour

0% 100%

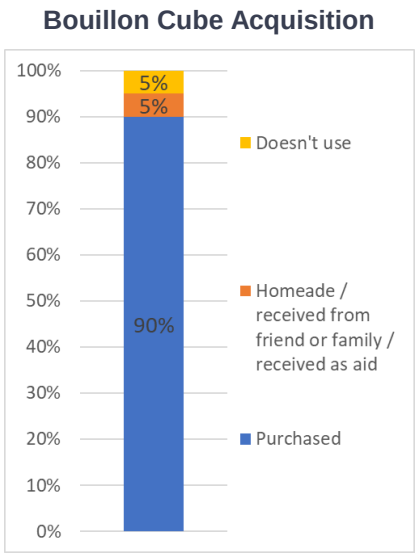
Geopolitical Zone	Proportion of households that use branded wheat flour
North Central	69%
North East	66%
North West	66%
South East	75%
South South	76%
South West	73%

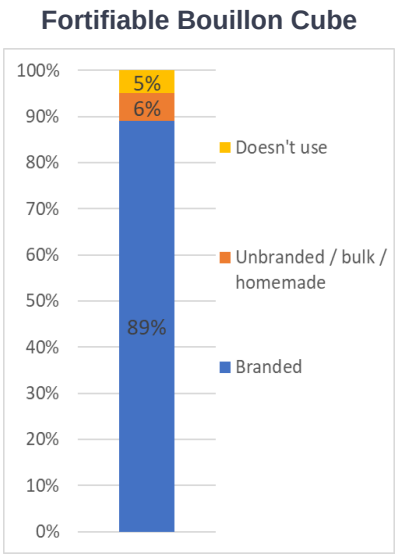
Note 1: Brands included in this variable are Golden Penny, Dangote, Bakewell, Bua flour, Honeywell, and Eagle flour.

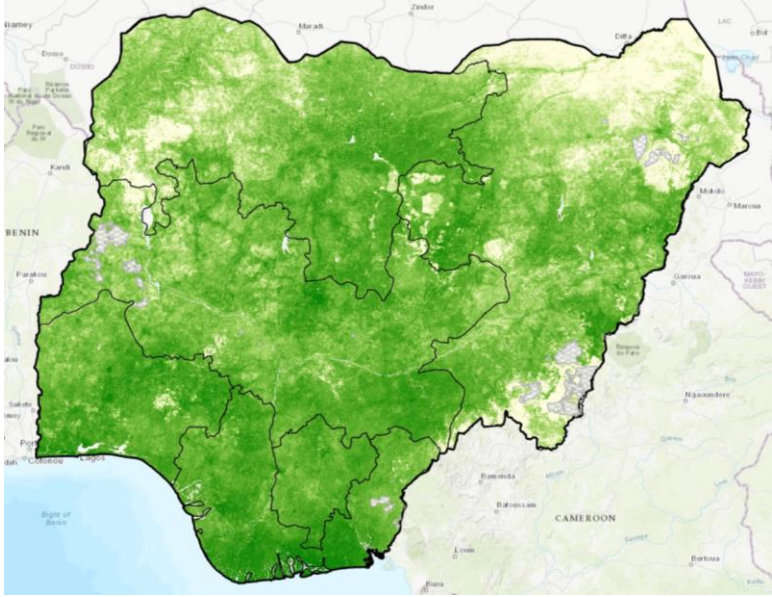
COVERAGE CASCADE

Bouillon Cube

Bouillon cube is used for cooking by around 95% of households[1]. Nine out of ten households purchase bouillon cube with a similar proportion using a branded version.







Household typically uses bouillon cube

15% 100%

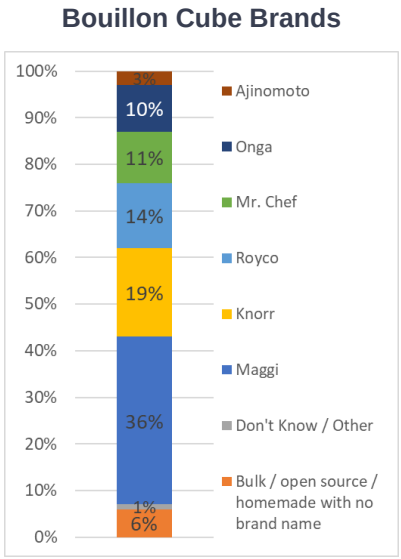
Geopolitical Zone	Proportion of households that typically use bouillon cube
North Central	95%
North East	94%
North West	95%
South East	95%
South South	95%
South West	95%

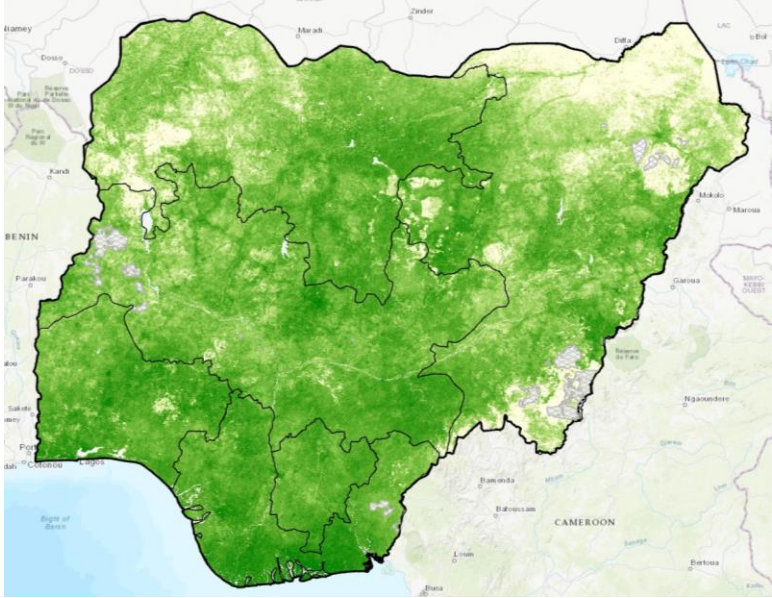
Note 1: Households are asked, "Does your household typically use bouillon cube to prepare foods at home?"
This compares to the NFCMS 2021 and GAIN FACT survey question, "Does your household use [FOOD VEHICLE] to prepare foods at home?"

COVERAGE CASCADE

Bouillon Cube Brands and Types

Branded bouillon cube usage is relatively ubiquitous across all geopolitical zones. The most common brands of bouillon cube are Maggi, Knorr, Royco, Mr. Chef, and Onga.





Geopolitical Zone	Proportion of households that use branded bouillon cube
North Central	94%
North East	90%
North West	91%
South East	94%
South South	96%
South West	95%

Note 1: Brands included in this variable are Maggi, Knorr, Royco, Onga, Mr. Chef, Ajinomoto, Doli, Doyin, Good Pepmam, and Ninido.

Access Index Analysis

ACCESS INDEX ANALYSIS

Household Coverage and Access Drivers

To assess how each indicator of the **Fortified Food Access Index** interacts with coverage, the following table shows the correlation coefficient with an aggregate branded coverage score: 0 = no branded food vehicles in household to 6 = all branded food vehicles in household).

- **Availability:** Households that shop for at least one food vehicle at a supermarket or a market has a good choice of products, are more likely to have a larger number of branded food vehicles.
- **Affordability:** Education and income indicators stand out as the most correlated with the branded coverage score. The higher the household income or educational status of the respondent, the more likely the household is to have branded food vehicles.
- **Agency:** Women earning income and planning the household meals have the strongest association with branded coverage. Female headed households are also more likely to have higher coverage.
- **Awareness:** Many awareness factors are more highly correlated with household branded food coverage. Respondents that read nutritional label information and have heard of fortified foods are more likely to have higher household coverage scores.

Correlation Coefficient with Household Coverage

(Score from 0-6 of whether respondent reported branded version of each food vehicle in household)

AVAILABILITY	
Time to food market is 15 minutes or less	-0.12*
Market opened every day	0.02
Supermarket shopper	0.33*
Market has good choice of products	0.14*
AFFORDABILITY	
Household in top 2 wealth quintiles	0.14*
At least secondary education	0.16*
Food is a small percentage of household spending	-0.02
Household able to afford healthy/nutritious foods	0.06*
Household able to afford variety of foods	0.10*
AGENCY	
Female household head	0.05*
Woman earns income	0.14*
Woman controls her income	-0.03
Woman plans meals	0.13*
Woman does household's shopping	-0.01
AWARENESS	
Heard of fortified foods	0.23*
Knows benefits of fortified foods	0.19*
Nutrition important in decisions of what to buy	-0.02
Willingness to pay higher for fortified foods	0.22*
Would rather purchase brand name staple foods	0.26*
Reads nutritional information	0.33*
Trusts NAFDAC and food producers	0.07*

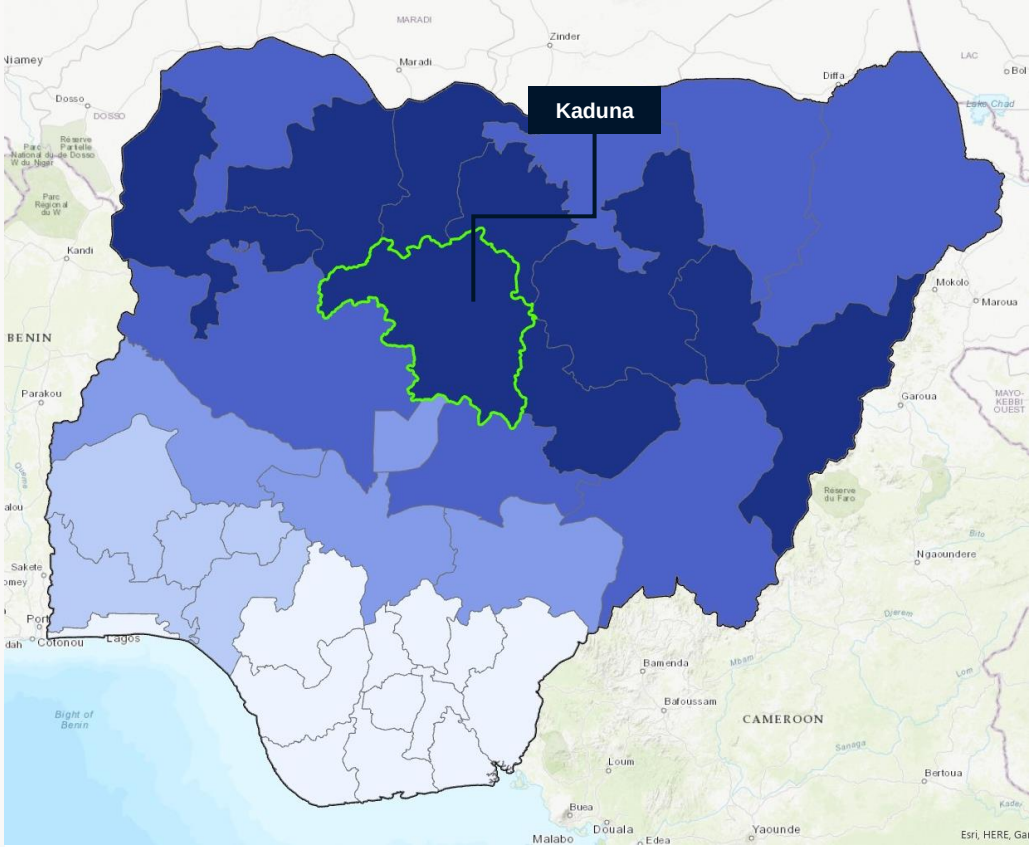
* Pearson's *r* correlation significant at 95% Confidence Level when compared to a null hypothesis of no correlation.

ACCESS INDEX ANALYSIS

Hyperlocal Insight 1: Maize Flour

Suppose a policy-maker in Nigeria wants to understand the current state of fortified maize flour coverage throughout Kaduna state.

We can first compare state-level household maize flour coverage and see that 83% of households typically use maize flour to prepare foods at home compared to the national average of 57%.

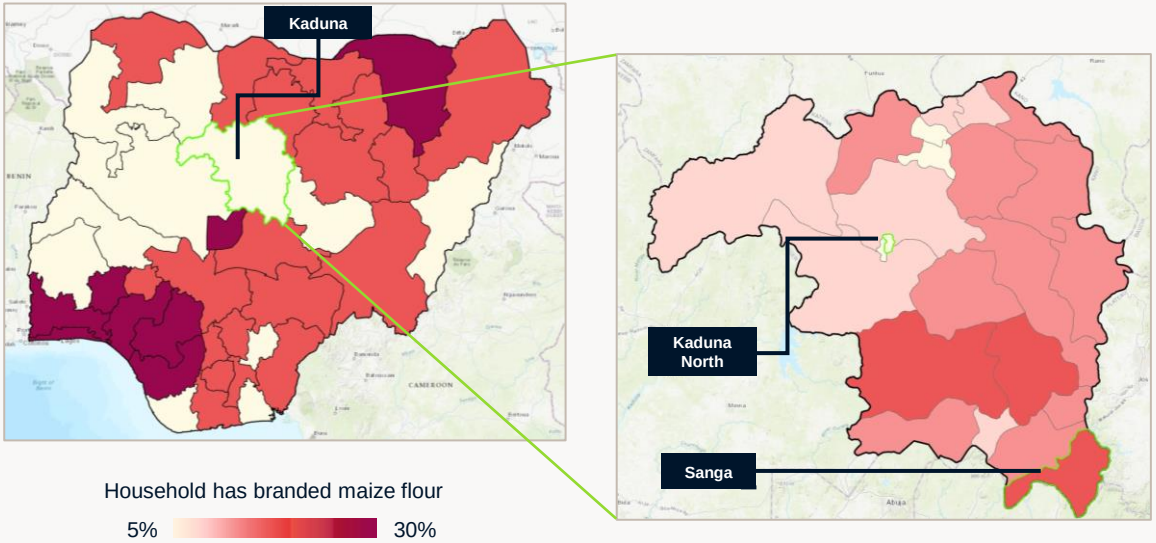


Note 1: Respondent answered that their household typically uses maize flour to prepare foods at home.

Hyperlocal Insight 1: Maize Flour

Next, we can look at household coverage of industrially-produced branded maize flour that is likely to be fortified. Although 83% of households typically use maize flour for cooking in Kaduna, only 16% have a branded version of the food vehicle. For more localized insight, we can zoom into the LGA level to see the extent to which coverage differs throughout the state.

Household Branded Maize Flour Coverage



Additional Insights

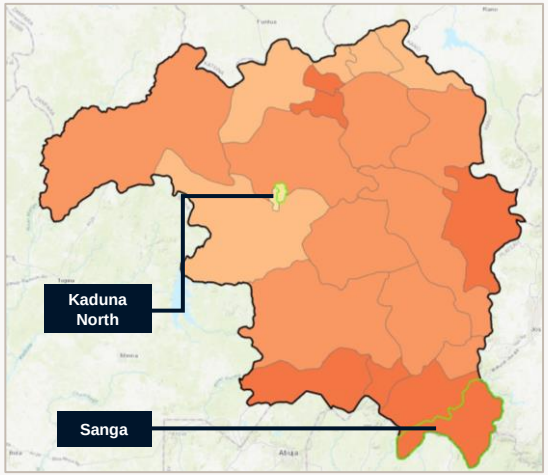
- Kaduna North contains Kaduna city, the capital of the state and a relatively large city, while Sanga is a much less urban LGA. Although we might expect Kaduna North to have a higher rate of branded maize flour coverage, that is not the case.
- Only 8% of households that typically use maize flour in Kaduna North have branded maize flour, while 21% have branded maize flour in Sanga – this compares to the state average of 16%.

ACCESS INDEX ANALYSIS

Hyperlocal Insight 1: Maize Flour

After uncovering local variation in branded maize flour coverage, we can begin to identify what may be driving these differences by incorporating the **Fortified Food Access Index**. Sanga's higher coverage is associated with a higher **Agency Score** than Kaduna North, as well as the state and national averages. Since Sanga has a lower overall Fortified Food Access Score, we can conclude that women's decision-making might be driving this higher rate of coverage. Delving deeper into the indicators of Agency, we can see that Sanga has a higher rate of female-headed households and women are much more likely to plan meals, do the shopping, and control any income that they make. These findings can then help policy-makers develop the best tool to increase the reach of fortified maize flour.

Fortified Food Access: Agency Score



	National	Kaduna (State)	Kaduna North	Sanga
Branded maize flour coverage	19%	16%	8%	21%
Fortified Food Access Score (0-100)	47	45	50	46
Agency Score (0-100)	53	51	43	55

Fortified Food Access Index: **Agency**

(Low) 0 — 100 (High)

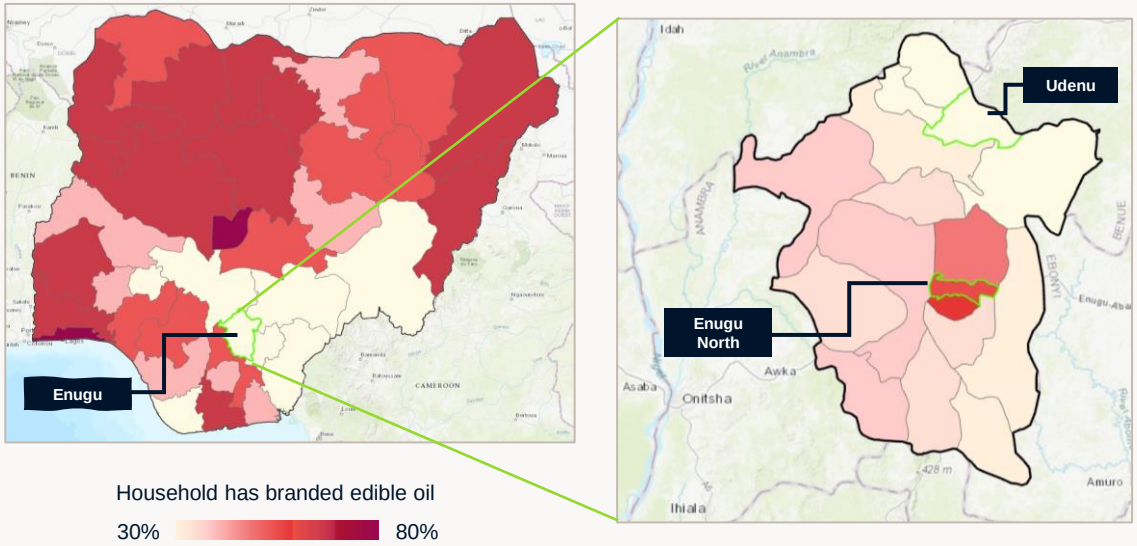
Footer and notes go here.

ACCESS INDEX ANALYSIS

Hyperlocal Insight 2: Edible Oil

Edible oil is used to prepare meals at home by nearly all Nigerian households, although only 51% of households report having branded oil. Focusing on the state of Enugu, we can see that only 43% of the population has branded oil. Further inspecting variation at the LGA level, we can identify differences between some of the wealthier, more densely populated areas.

Household Branded Edible Oil Coverage



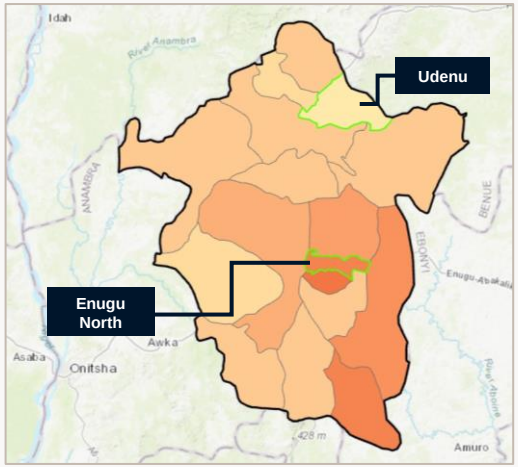
Additional Insights

- Enugu North contains part of Enugu city, the capital of the state, and a relatively large city in southern Nigeria. As expected, Udenu, a slightly less populated LGA farther from the city center has a smaller proportion of households that use branded oil.
- Only 36% of households that use edible oil in Udenu have branded oil, while 55% have branded oil in Enugu North.

Hyperlocal Insight 2: Edible Oil

Since we would expect higher branded oil coverage nearer to a city center, the **Fortified Food Access** can be used to confirm the possible drivers. Enugu North has a higher **Availability** score than Udenu which can account for theses differences. This makes sense as branded products are more likely to be found in city centers due to increased supply and more concentrated food markets. As predicted, households in Enugu North are more likely to report having a large selection of items where they shop, have nearby markets that are open daily, and shop at larger more modern markets like supermarkets. Although it is generally understood that households in city centers have better access to fortified foods, policymakers can see this play out in the data directly in Enugu and use it as evidence to improve supply to less dense areas.

Fortified Food Access: Availability Score



	National	Enugu (State)	Enugu North	Udenu
Branded edible oil coverage	51%	43%	55%	36%
Fortified Food Access Score (0-100)	47	48	53	48
Availability Score (0-100)	46	44	48	40

Fortified Food Access Index: **Availability**

(Low) 0 — 100 (High)

Population Segmentation

Population segmentation is a way to break down populations into groups with similar characteristics. This can help practitioners and on-the-ground implementers utilize community-level data for targeting, outreach, and resource allocation.

POPULATION SEGMENTATION

Population Segments

Fraym segmented the population into four different groups based on their unique combinations of the 4As. Since households face different barriers to accessing fortified foods, these segments will help quantify the total target population for actionable, targeted programming.

	Capacity Constrained	**Supply** Constrained	**Full Access** Constrained	**Not Access** Constrained
Segment **Description**	Fortified foods are available, and they know the benefits. Household dynamics may prevent households from accessing them.	Demand indicators for fortified foods are high, but supply and ability to pay is limited.	Suffer from all access constraints and require government intervention.	Improving access won't increase coverage
Level of **Availability**	Moderate / **High**	**Low**	**Low**	Moderate / **High**
Level of **Affordability**	**Low**	**Low**	**Low**	Moderate / **High**
Level of **Agency**	**Low**	Moderate / **High**	**Low**	Moderate / **High**
Level of **Awareness**	Moderate / **High**	Moderate / **High**	**Low**	Moderate / **High**
Stakeholder **Response**	**In-kind social programs combined with women empowerment initiatives**	**Work with millers and government to improve reach and affordability**	**Government programs to provide fortified foods directly**	**Areas that should already be benefiting from fortified foods**

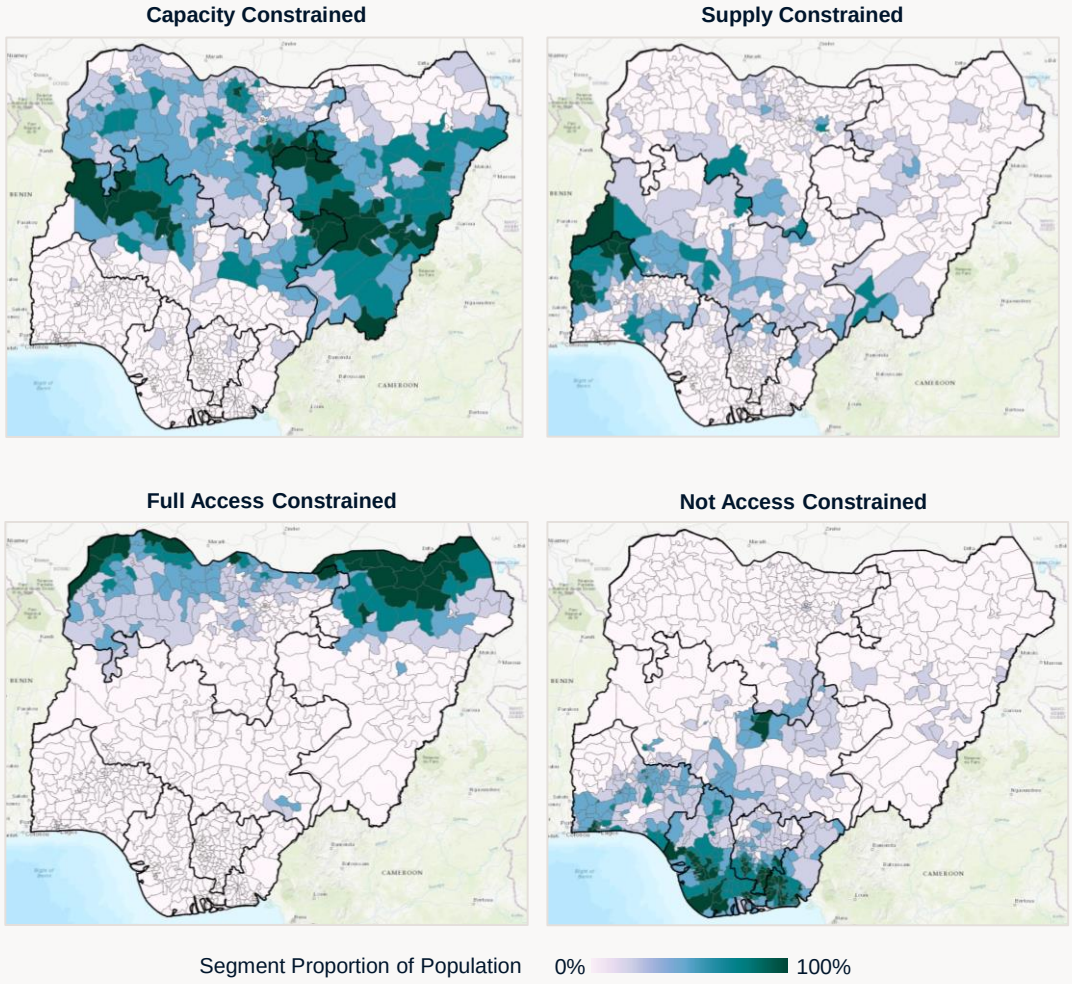
POPULATION SEGMENTATION

Segmentation Methodology

The spatial Principal Component Analysis raster (representing the distribution of the principal component) for each of the 4 As was classified into low, medium, and high based on whether it was more than a half standard deviation below the raster mean, within a half standard deviation of the raster mean, or above a half standard deviation of the mean, respectively.

The distributions and populations of mutually exclusive combinations of classified categories were then exhaustively checked to identify relevant population segments with sufficient population sizes for analysis. Correlation between the As means that there are not significant populations in each cross-section.

Four segments were identified relevant and as having sufficient populations to warrant subsequent analysis: Capacity Constrained, Supply Constrained, Full Access Constrained, and Not Access Constrained.



POPULATION SEGMENTATION

Profile Summaries

Fraym also analyzed demographic characteristics of the population segments to better understand what types of households face similar access constraints.

These insight segment profile summaries provide additional into common characteristics of households in each segment.

Capacity Constrained
Capacity Constrained households are likely to have young children and be of low socioeconomic status. They are also more likely than other groups to live in rural areas. These households would benefit from women's empowerment programs around food and nutrition.

Supply Constrained
Supply Constrained households are more likely than the other groups to have older adults and be of medium socioeconomic status. They are also likely to live in rural areas and would benefit from improved distribution of name-brand staples.

Full Access Constrained
Full Access Constrained households are the most at risk. They are most likely to have intergenerational families and be of low socioeconomic status. They are also most likely to already be beneficiaries of aid programs which can be leveraged to provide fortified foods as direct aid.

Not Access Constrained
Not Access Constrained households are likely to live in urban areas and be of high socioeconomic status. These households do not require as much additional assistance and have the capacity to access fortified foods regularly if they choose to. Low household coverage in these areas would be a causse for concern.

POPULATION SEGMENTATION

Fraym analyzed the demographic characteristics of each segment among households across Nigeria. Below are summary statistics of demographic differences related to urbanicity, household makeup, socioeconomic status, education, and involvement in social protection programs.

	Capacity Constrained	Supply Constrained	Full Access Constrained	Not Access Constrained
Urbanicity				
Urban	34%	36%	41%	72%
Household Demographics				
Household with child(ren) under 5	71%	69%	75%	51%
Household with adult(s) 50+	66%	71%	69%	52%
Household with pregnant or lactating woman/women	32%	32%	38%	24%
Socioeconomic Status[1]				
Low SES	63%	42%	67%	11%
Medium SES	19%	23%	14%	19%
High SES	18%	35%	19%	70%
Education[2]				
No education	25%	25%	26%	20%
At least some primary education	16%	17%	20%	15%
At least some secondary education	44%	40%	42%	41%
At least some higher education	15%	18%	12%	24%
Social Protection				
Beneficiary of food or monetary aid program	11%	9%	14%	5%

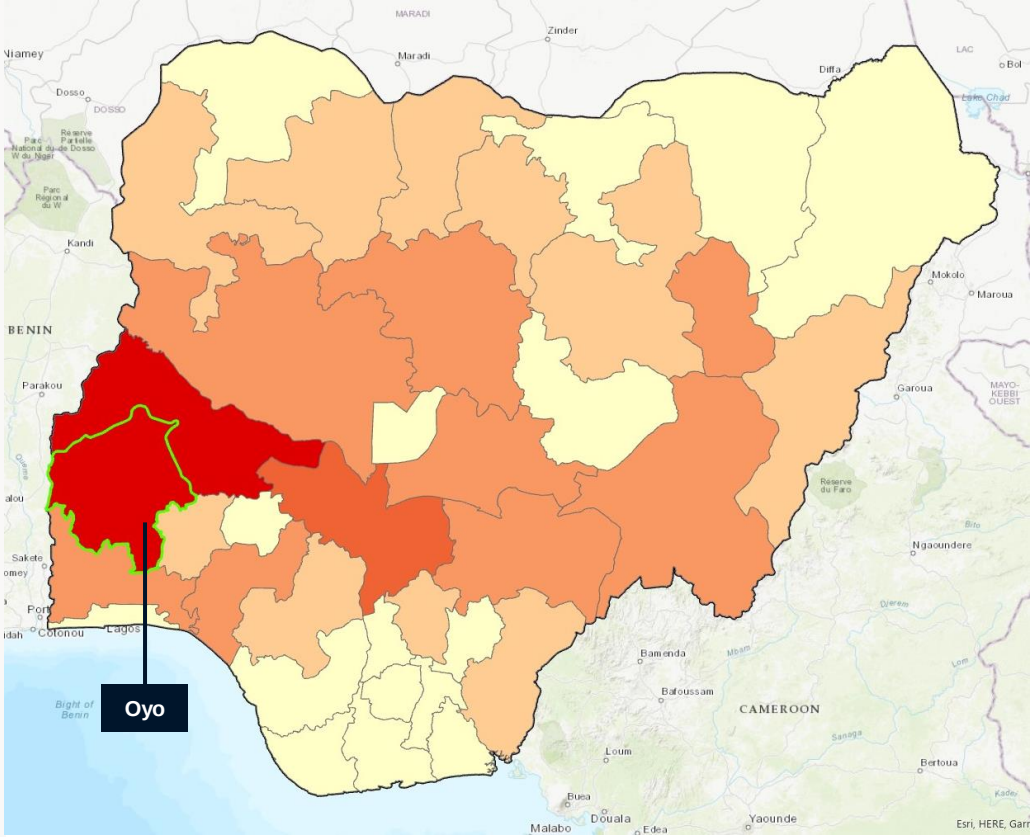
Note 1: From Nigeria 2018 DHS based on wealth quintile variable (high = top 2 quintiles, medium = middle quintile, low = bottom 2 quintiles).
Note 2: From Nigeria 2018 DHS.

POPULATION SEGMENTATION

Hyperlocal Insight 1: Supply Constraints

Suppose a policymaker in Nigeria wants to focus on improving the reach of fortified oil for Supply Constrained households.

We can identify which states have the highest proportion of people that fit the profile of **low affordability** and **low availability**. Around 14% of households are supply constrained in Oyo compared to the national average of 3%.

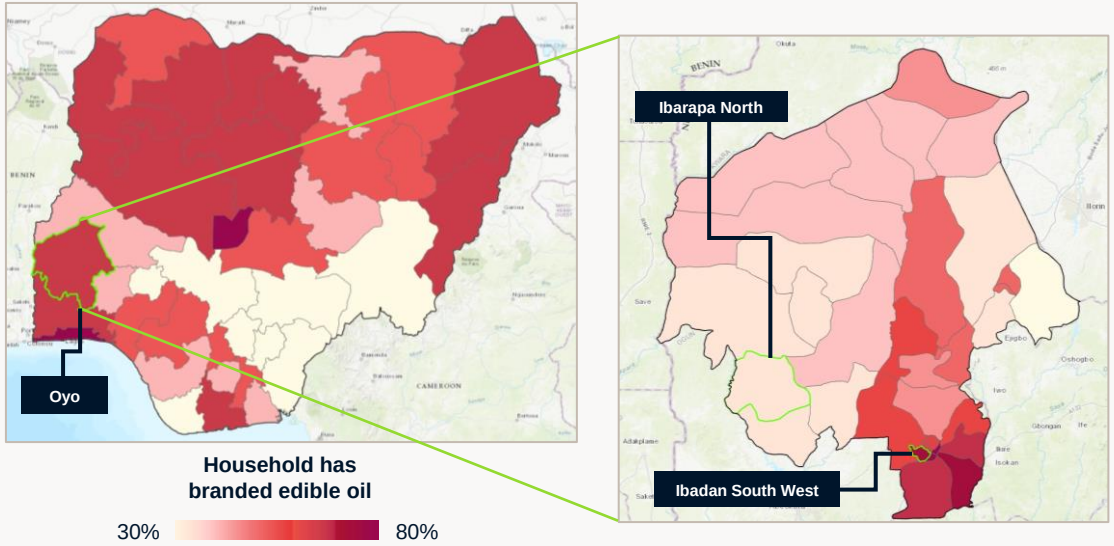


Note 1: Respondent answered that their household typically uses maize flour to prepare foods at home.

Hyperlocal Insight 1: Supply Constraints

Since nearly all Nigerian households use edible oil to prepare foods at home, we can look at household coverage of branded oil that is likely to be fortified. Household branded oil usage is similar to the national average (54% of households compared to the national average of 51%). However, there are clear differences at the LGA level that correspond to where large proportions of supply constrained populations live.

Household Branded Edible Oil Coverage



Additional Insights

- Ibadan South West contains part of Ibadan – the capital and most populated city of Oyo state and the third-largest city by population in Nigeria. In contrast, Ibarapa North is a much less populous LGA where agriculture is the main occupation.
- Only 43% of households that use edible oil in Ibarapa North have branded oil, while 66% have branded oil in Ibadan South West.

Hyperlocal Insight 1: Supply Constraints

After identifying local variation in branded oil coverage, we can examine how coverage relates to supply constraints at the LGA level. For comparison, Ibarapa North has a much higher proportion of supply constrained households than Ibadan South West (61% vs. 1%) which is associated with lower branded sugar coverage (43% vs. 66%).

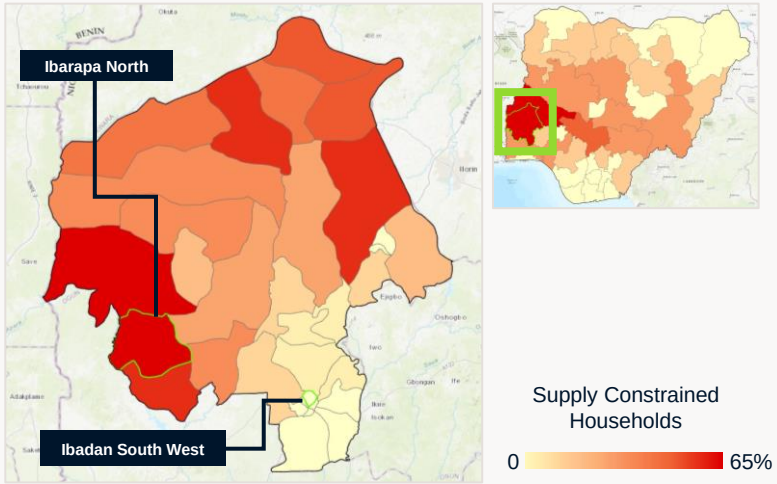
Who are we looking for?

Households with low availability and affordability scores but adequate levels of agency and awareness.

Segment	Supply Constrained
Description	*Demand indicators for fortified foods are high, but supply and ability to pay is limited.*
Availability	Low
Affordability	Low
Agency	Moderate / High
Awareness	Moderate / High

Where do we find them?

Generally, in more rural areas in states such as Oyo and Kwara. Ibarapa North in Oyo has a high proportion of supply constrained households which is associated with a low proportion of branded oil coverage compared to state and national averages.



How do we reach them?

Work with distributers to improve reach and expand aid programs. Around 10% of households in Ibarapa North benefit from a food or cash aid program, which could be leveraged to increase fortified oil reach.

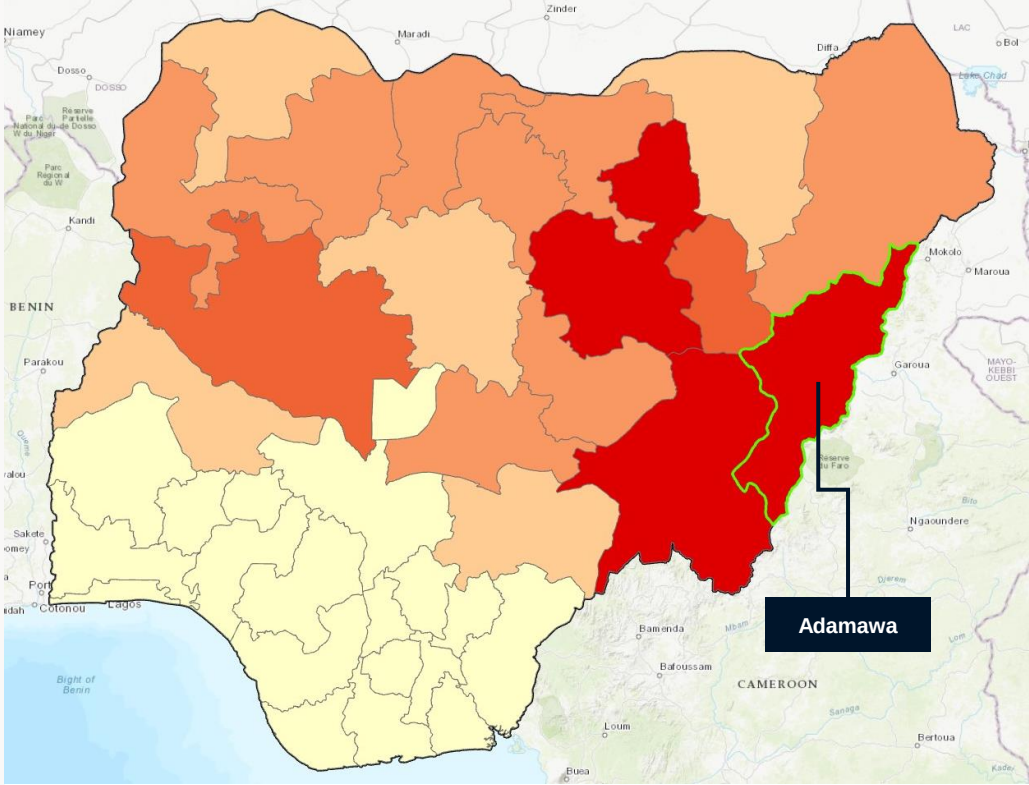
Ibarapa North	Proportion of Population
Supply Constrained	39k (61%)
Heard of Fortified Foods From:	
Health Facility / Clinic	7k (11%)
Radio	7k (11%)
Television	8k (12%)
Social Media	6k (10%)
Top Media Channels for News:	
Friends and Family	13k (20%)
Radio	25k (39%)
Social Media	14k (22%)

POPULATION SEGMENTATION

Hyperlocal Insight 2: Capacity Constraints

Suppose a policy-maker in Nigeria wants to focus on improving the reach of fortified sugar for households experiencing Capacity Constraints.

We can identify which states have the highest proportion of people that fit the profile of **low agency** and **low affordability**. Around 30% of households are capacity constrained in Adamawa compared to the national average of 8%.



Households with Capacity Constraints

Capacity Constrained Households

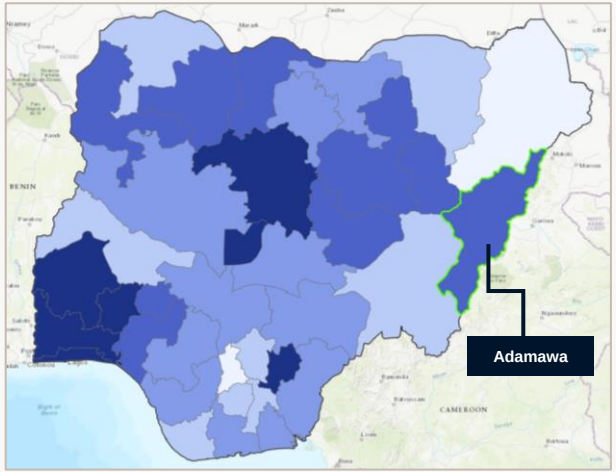
0% 30%

POPULATION SEGMENTATION

Hyperlocal Insight 2: Capacity Constraints

We can then look at sugar use patterns and household coverage of industrially-produced branded sugar that is likely to be fortified. Household sugar use and overall branded household coverage is equal to the national average, with 74% of households using sugar to prepare foods at home and 59% having branded sugar. However, there are differences at the LGA level that correspond to where large proportions of capacity constrained populations live.

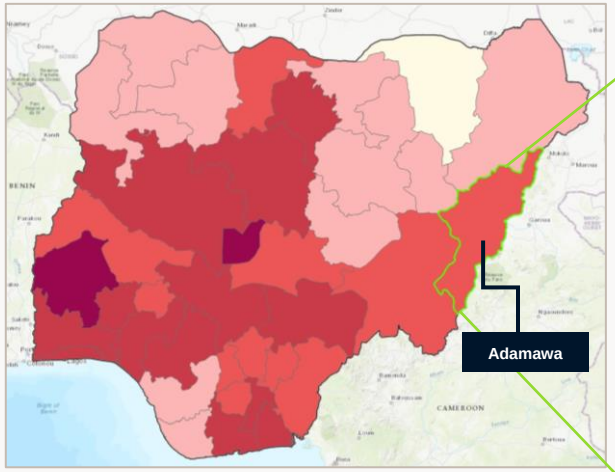
Household Sugar Coverage

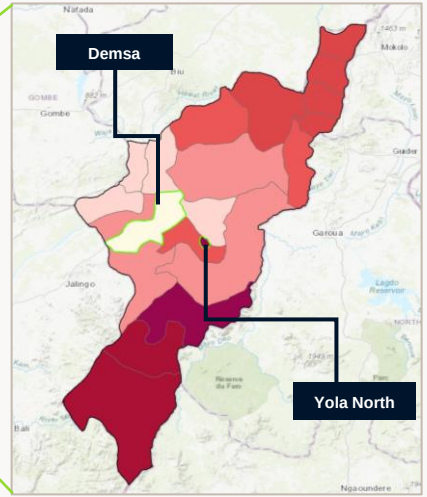


Household typically uses sugar

60% 80%

Household Branded Sugar Coverage





Household has branded sugar

45% 70%

Hyperlocal Insight 2: Capacity Constraints

After uncovering local variation in branded sugar coverage, we can begin to identify what may be driving differences by incorporating results of the segmentation analysis. For example, Demsa has a much higher proportion of capacity constrained households than Yola North (60% vs. 1%) which is associated with lower branded sugar coverage (52% vs. 65%).

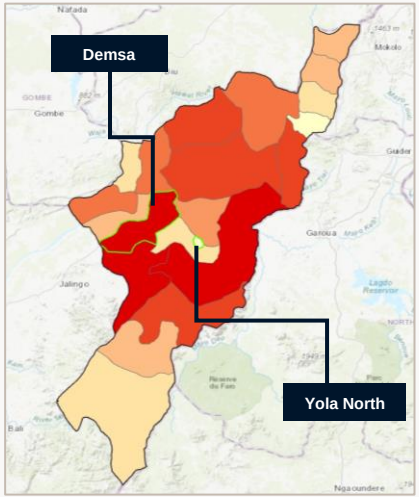
Who are we looking for?

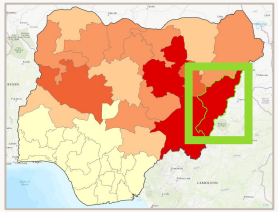
Households with low affordability and agency scores but adequate levels of availability and awareness.

Segment	Capacity Constrained
Description	*Fortified foods are available, and they know the benefits. Household dynamics may prevent households from accessing them.*
Availability	Moderate / High
Affordability	Low
Agency	Low
Awareness	Moderate / High

Where do we find them?

Generally, on the outskirts of urban areas in states such as Adamawa and Bauchi. Demsa in Adamawa has a high proportion of capacity constrained households which is associated with a low proportion of branded sugar coverage.





Capacity Constrained Households

0 — 75%

How do we reach them?

Expand targeted in-kind social programs – around 13% of households in Demsa benefit from a food or cash aid program, which could be leveraged to increase fortified sugar reach.

Demsa	Proportion of Population
Capacity Constrained	29k (60%)
Heard of Fortified Foods From:	
Health Facility / Clinic	6k (13%)
Radio	6k (13%)
Television	5k (10%)
Top Media Channels for News:	
Radio	21k (43%)
Television	8.5k (18%)
Social Media	8.5k (18%)

Annex I

ANNEX I

Quota Framework

Fraym implements nested demographic and geographic sample quotas to ensure a balanced sample across multiple criteria. Nested quotas rely not only on specifying national parameters but exactly how many respondents to target by age and sex in each state. Using population parameters for a country (from a census or DHS), Fraym calculates the proportion of individuals by age, sex, and state as a proportion of the national population of interest, and then multiplies the total minimum sample size for the survey by each nested proportion.

Fraym also calculates socioeconomic/wealth and educational quotas to ensure representativeness across these dimensions and that enough respondents at the bottom of the pyramid are captured. Each of these is also calculated by multiplying national proportions by the minimum sample size. Socioeconomic quotas are based on ownership status of two key country-specific assets. Educational quotas are based on the adult population's attainment of specific thresholds of education according to national distributions of completion of primary, secondary, and tertiary education.

Example:

Total Population by State, Age, Sex from a DHS or Census

State	18-24			25-34		
	Female	Male	Subtotal	Female	Male	Subtotal
ABIA	269475	295732	565207	265983	267605	533588
ADAMAWA	283498	285644	569142	287354	299099	586453
AKWA IBOM	378637	427833	806470	392336	390939	783275
ANAMBRA	416442	454993	871435	419638	419827	839465
BAUCHI	426142	405864	832006	434634	426256	860890
BAYELSA	167194	192316	359510	177610	181225	358835

Total Population Proportions (rounded)

State	18-24			25-34		
	Female	Male	Subtotal	Female	Male	Subtotal
ABIA	0.002	0.003	0.005	0.002	0.002	0.005
ADAMAWA	0.002	0.002	0.005	0.002	0.003	0.005
AKWA IBOM	0.003	0.004	0.007	0.003	0.003	0.007
ANAMBRA	0.004	0.004	0.008	0.004	0.004	0.007
BAUCHI	0.004	0.004	0.007	0.004	0.004	0.007
BAYELSA	0.001	0.002	0.003	0.002	0.002	0.003

Proportions x Sample Size (7,000)

State	18-24			25-34		
	Female	Male	Subtotal	Female	Male	Subtotal
ABIA	16	18	34	16	16	32
ADAMAWA	17	17	34	17	18	36
AKWA IBOM	23	26	49	24	24	47
ANAMBRA	25	28	53	25	25	51
BAUCHI	26	25	50	26	26	52
BAYELSA	10	12	22	11	11	22

ANNEX I

Quota Framework - Asset Selection Process

Assets for socioeconomic quotas are selected by country. The ideal socioeconomic proxy measure(s) would exhibit a linear relationship with the same level of increase or decrease in asset ownership rates for each wealth quintile of the household-level population. Fraym analysts use the most recent Demographic and Health Survey to consider over 20 potential household assets (air conditioner, fan, mobile phone, table, sofa, generator, computer, television, radio, finished floor/roof/walls, etc.) and then select the two that exhibit the most desired distribution of ownership rates. For Nigeria, the two assets most closely correlated to wealth by quintile are television and bank account. Respondents who have neither a bank account nor television are considered “Low SES.” Respondents who have only one of the two assets are considered “Medium SES,” and respondents who own both assets are considered “High SES.”

Another effort to make sure the full range of socioeconomic status is captured is to set education quotas. Fraym has also found this to be highly correlated with wealth and will implement these quotas as an additional step to make sure respondents at the bottom of the pyramid are properly represented.

Asset Ownership Status (Socioeconomic) - Nigeria	Quota
Both television and a bank account	2,207
Either television or a bank account	1,609
Neither television nor a bank account	3,184

Educational Level - Nigeria	Quota
Completed university education	573
Completed secondary education, or incomplete higher education	2,664
Started but did not complete secondary education	608
Completed primary education	1,007
No education, or incomplete primary education	2,148

ANNEX I

Data QA/QC

The survey vendor used for the sample adheres to industry best practices. These include: (i) regularly testing/validating on a rolling basis to ensure participants and their responses are real/accurate; (ii) comparing answers from respondents to pre-collected information on the same respondents for consistency, such as same age, sex, socio-economic status, and geography; (iii) using automated natural language processing (NLP) on open-ended responses to detect non-sensical language etc.; (iv) check for straight lining (e.g. answering "C" for all questions); and (v) checking speed of completion rates, (e.g. flagging anyone who spends 1/3 or less of the median time to complete the questionnaire). Responses that fail any one of these tests were automatically removed from the data and possibly lead to the removal from the vendor's sample pool as well.

The data is designed to be nationally representative. Post-hoc weights are created to correct for these differences. An iterative proportional fitting process is used to simultaneously balance the distributions of the following parameters: sex, age, and the population in each of Nigeria's 36 states.

Below is an illustrative example of weekly updates from the vendor for a geographic and demographic quota:

Region Gender Age		Limit	Total	Need	Quota Completion	
Lagos	Male 18-24	6	2	4	33%	93%
	Male 25-34	9	7	2	78%	
	Male 35-44	11	11	0	100%	
	Male 45-54	13	13	0	100%	
	Male 55-70	19	19	0	100%	
	Female 18-24	6	6	0	100%	
	Female 25-34	9	7	2	78%	
	Female 35-44	12	12	0	100%	
	Female 45-54	14	14	0	100%	
	Female 55-70	22	21	1	95%	

ANNEX 1

Data-Driven Teams Rely on Fraym

Have any questions? Contact us:

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