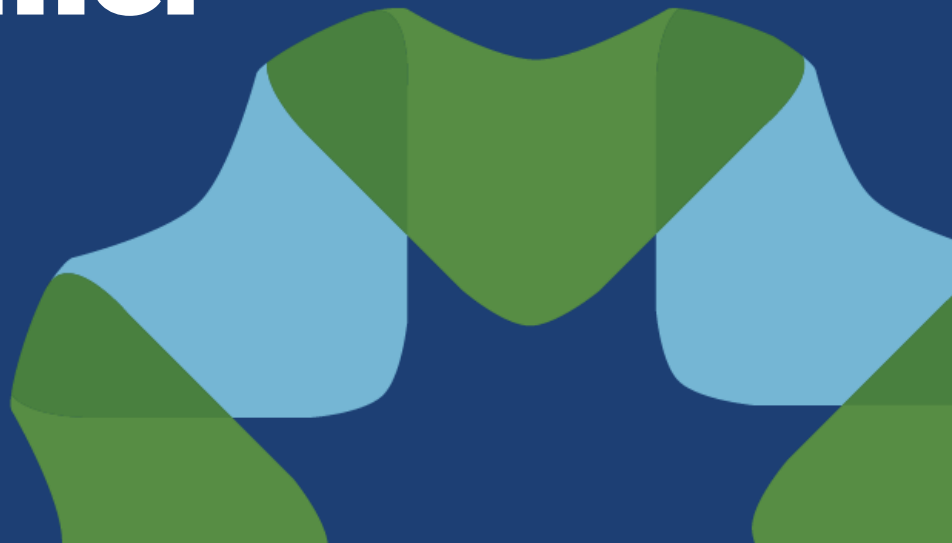




# Nigeria Consumer Segmentation

Prepared by Fraym

July 2021





# Table of Contents

---

**01** **Scope of Work**

---

**02** **About Fraym**

---

**03** **National Context**

---

**04** **Mapping Target Consumers**

---

**05** **Data Sources & Methodology**

01

---

# Scope of Work



# Scope of Work

---

**Fraym supported the Clean Cooking Alliance by producing consumer segmentations for Kenya, Nigeria, Ghana, Ethiopia, Rwanda, and Uganda.**

Assessments include an overview of demographic and socioeconomic characteristics and use of energy at the national and urban/rural level, national maps of four consumer segments, and market sizing and hyperlocal mapping at the subnational level for each consumer profile.

Fraym worked with the Clean Cooking Alliance to identify four target consumer groups: urban early-adopters, peri-urban and rural early-adopters, fast-followers, and secondary-followers.

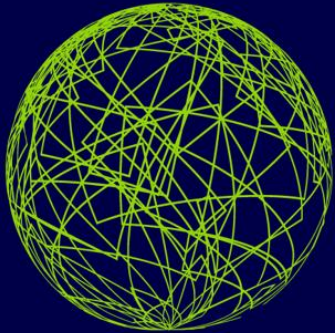
Fraym then identified where there are pockets of high demand within the country by generating hyperlocal maps of the four target consumer segments. Initially, these maps can provide a snapshot understanding of where different customers and overall demand are concentrated.

02

---

# About Fraym





*fraym*

# 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<sup>2</sup> even in remote areas.

# How it works



## ACQUIRE DATA

Geo-tagged household surveys  
Satellite imagery  
Partner datasets



## HARMONIZE DATA

Validate  
Clean  
Geospatially enable



## MACHINE LEARNING

Proprietary algorithms  
Human-centric QA/QC  
Automation



## GEOSPATIAL INSIGHT

Predictive modeling  
API enabled  
Analytic services  
Front-end tools

03

---

# National Context





# Household Characteristics

**There are roughly 49 million households in Nigeria, with nearly 31 percent residing in urban areas and 69 percent in peri-urban and rural areas.<sup>1</sup>**

There is a large urban-rural gap in financial inclusion, with urban households being twice as likely as rural households to have a formal bank account.

Mobile money is largely untapped nationwide. Only 3 percent of Nigerian adults have a mobile money account, although nearly one in five adults have access to a smartphone.

**Note 1:** Urban areas were defined using the EU Global Human Settlement Layer (GHSL). Urban centers, dense urban clusters, and semi-dense urban clusters are classified as urban. Suburban or peri-urban and all rural areas are classified as peri-urban and rural.

**Note 2:** The source of all population data in this report is WorldPop.

**Note 3:** High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor.

**Source:** Fraym, Nigeria 2018 DHS, Nigeria 2017 FII

## Nigeria Snapshot

### Demographics

	National	Urban	Rural
Population <sup>2</sup>	217M	59M	158M
Number of households	49M	15M	34M
Female headed household	20%	23%	17%
Household head completed at least primary education	70%	81%	58%
Household head completed at least secondary education	47%	59%	33%
Household head completed higher education	10%	15%	4%
All high-quality housing material <sup>3</sup>	69%	87%	49%
Bank account	54%	70%	35%
Mobile money account	3%	4%	3%
Smartphone	19%	31%	14%

# Cooking Fuels

**Less than 20 percent of households nationwide use clean cooking fuel.**

On average, households using LPG for clean cooking spend 2,800 Naira per month on the fuel.

Clean cooking fuels are rare in rural areas, with 80 percent of rural households using wood to cook. These households spend an average of 1,100 Naira per month on wood for cooking.

Kerosene is the second most common cooking fuel after wood. About one quarter of all urban households use kerosene for cooking, spending an average of 1,200 Naira per month for the fuel.

**Note 1:** Clean cooking fuel is defined as LPG, natural gas, electricity, and biogas.

**Note 2:** Other solid cooking fuels include coal, straw, agricultural crops, and dung.

**Note 3:** Spending data is in 2019 Naira and includes spending on the fuel only for cooking purposes.

**Source:** Fraym, Nigeria 2018 DHS, Nigeria 2019 GHS

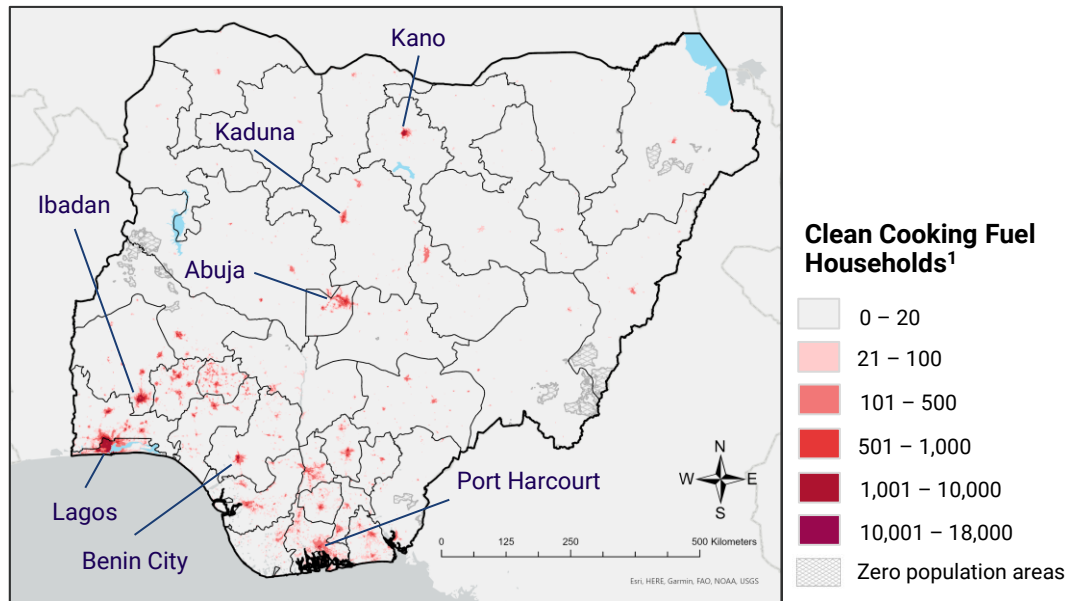
## Nigeria Snapshot

### Household energy use

	National	Urban	Rural
Primarily use clean cooking fuel <sup>1</sup>	18%	29%	5%
Primarily use LPG to cook	15%	25%	4%
Primarily use natural gas or biogas to cook	1%	2%	< 1%
Primarily use electricity to cook	< 1%	< 1%	1%
Primarily use wood to cook	56%	35%	80%
Primarily use charcoal to cook	6%	9%	3%
Primarily use kerosene to cook	18%	26%	9%
Primarily use other solid fuels to cook <sup>2</sup>	1%	2%	1%
Average monthly spending on LPG for cooking (Naira) <sup>3</sup>	2,800	2,700	3,000
Average monthly spending on kerosene for cooking (Naira) <sup>3</sup>	1,100	1,000	1,500
Average monthly spending on wood for cooking (Naira) <sup>3</sup>	1,000	1,500	900
Average total monthly spending (Naira) <sup>3</sup>	46,000	62,000	39,000
Access to electricity	64%	84%	42%

# Clean Cooking Fuel

The roughly 9 million households that use clean cooking fuels are concentrated in urban areas and overwhelmingly rely on LPG as their primary cooking fuel.



**Note 1:** This map shows the estimated number of households that use clean cooking fuel per 1km<sup>2</sup>. Clean cooking fuel includes electricity, LPG, natural gas, and biogas.

**Source:** Fraym, Nigeria 2018 DHS

**9M** Households use clean cooking fuel

**21%** of households are headed by a woman

**3.5** Average household size

**85%** of household heads have completed secondary education

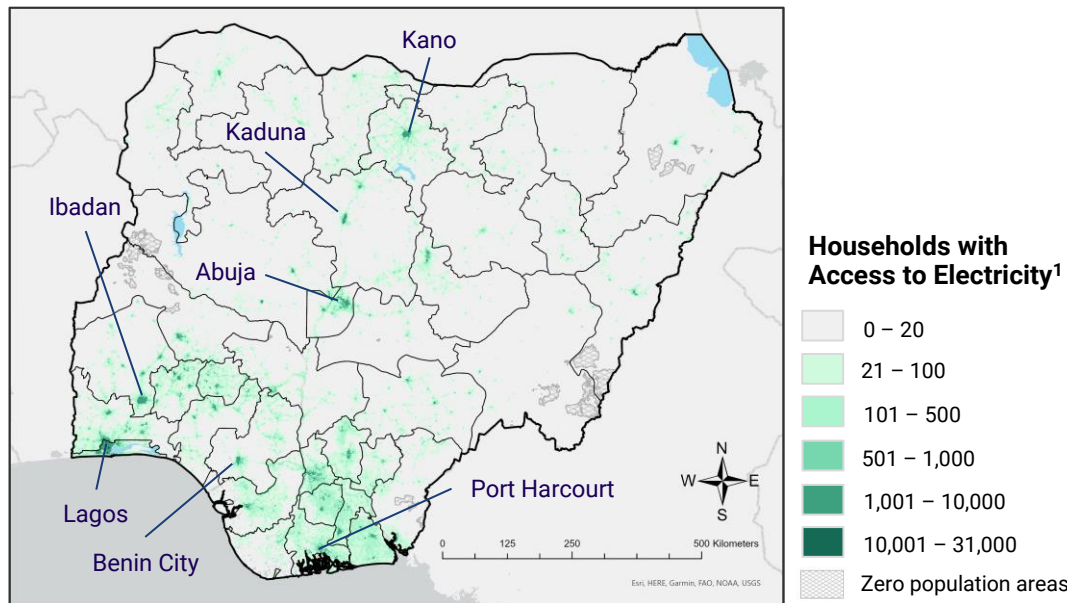
**88%** use LPG as their primary cooking fuel

**7%** use natural gas as their primary cooking fuel

**4%** use electricity as their primary cooking fuel

# Electricity Access

Around 64 percent of all households in Nigeria have access to electricity. Roughly two out of five electrified households still use wood as their primary cooking fuel.



**Note 1:** This map shows the estimated number of households that have electricity access per 1km<sup>2</sup>. Estimates in Ebonyi, Kogi, Kwara, Nasarawa states failed to pass Fraym standard quality checks and should thus be interpreted with caution.

Source: Fraym, Nigeria 2018 DHS

**31M** Households with access to electricity

**22%** of households are headed by a woman

**4.2** Average household size

**59%** of household heads have completed secondary education

**39%** use wood as their primary cooking fuel

**25%** use kerosene as their primary cooking fuel

**23%** use LPG as their primary cooking fuel

# Identifying key characteristics

**Over 90% of households that use clean cooking fuel have high quality housing, own a high-cost asset, and have access to electricity and a bank account.**

Clean cooking fuel households are also primarily urban and have more educated household heads.

About half of solid cooking fuel households own high-cost assets, live in households constructed with all high-quality materials, and have access to bank accounts and electricity. These indicators are suggestive of relatively high consumption power.

**Note 1:** Clean cooking fuel households are households that use liquified petroleum gas (LPG), electricity, natural gas, or biogas as the primary cook fuel.

**Note 2:** Bank account ownership is defined as any household member having a formal bank account. Mobile money accounts are not included. Data from Nigeria 2018 DHS.

**Note 3:** High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor.

**Note 4:** A high cost asset is defined as a television, refrigerator, or car.

**Source:** Fraym, Nigeria 2018 DHS



## Nigeria Snapshot

### Characteristics by cooking fuel type

	Clean Cooking Fuel Households <sup>1</sup>	Solid Cooking Fuel Households
Number of households	9M	40M
Urban	87%	46%
Female headed household	21%	20%
Access to electricity	96%	58%
Primary cooking fuel	LPG (88%) Natural gas (7%) Electricity (4%) Biogas (1%)	Wood (69%) Kerosene (22%) Charcoal (7%)
Bank account <sup>2</sup>	94%	46%
All high-quality housing material <sup>3</sup>	97%	64%
Own at least 1 high cost asset <sup>4</sup>	94%	49%
Own a radio	80%	59%
Household head has completed secondary education	85%	39%

# Communications

**Radio and television are the most common media outlets used by Nigerian adults.**

In rural areas, communication access is much more limited. Radio is the most common media outlet, with just under a half of rural households listening at least once a week.

Most urban households use both their television and radio frequently. About two-thirds of households tune into these two media outlets at least once a week.

While radio and television ownership varies by location, mobile phone ownership is high in both urban and rural areas.

## Nigeria Snapshot

### Household communications access<sup>1</sup>

	National	Urban	Rural
Television ownership	55%	72%	34%
Radio ownership	63%	70%	54%
Mobile phone ownership	89%	95%	83%
Regular print media readership	20%	28%	11%
Regular television viewership	50%	67%	32%
Regular radio listenership	56%	67%	45%

**Note 1:** Regular use of a media form is defined as the adult household head (age 15-49) using the media at least once a week.

**Source:** Fraym, Nigeria 2018 DHS

# 04

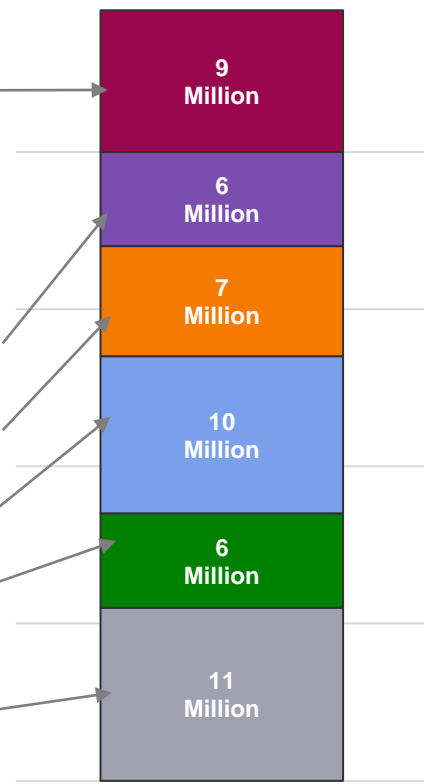
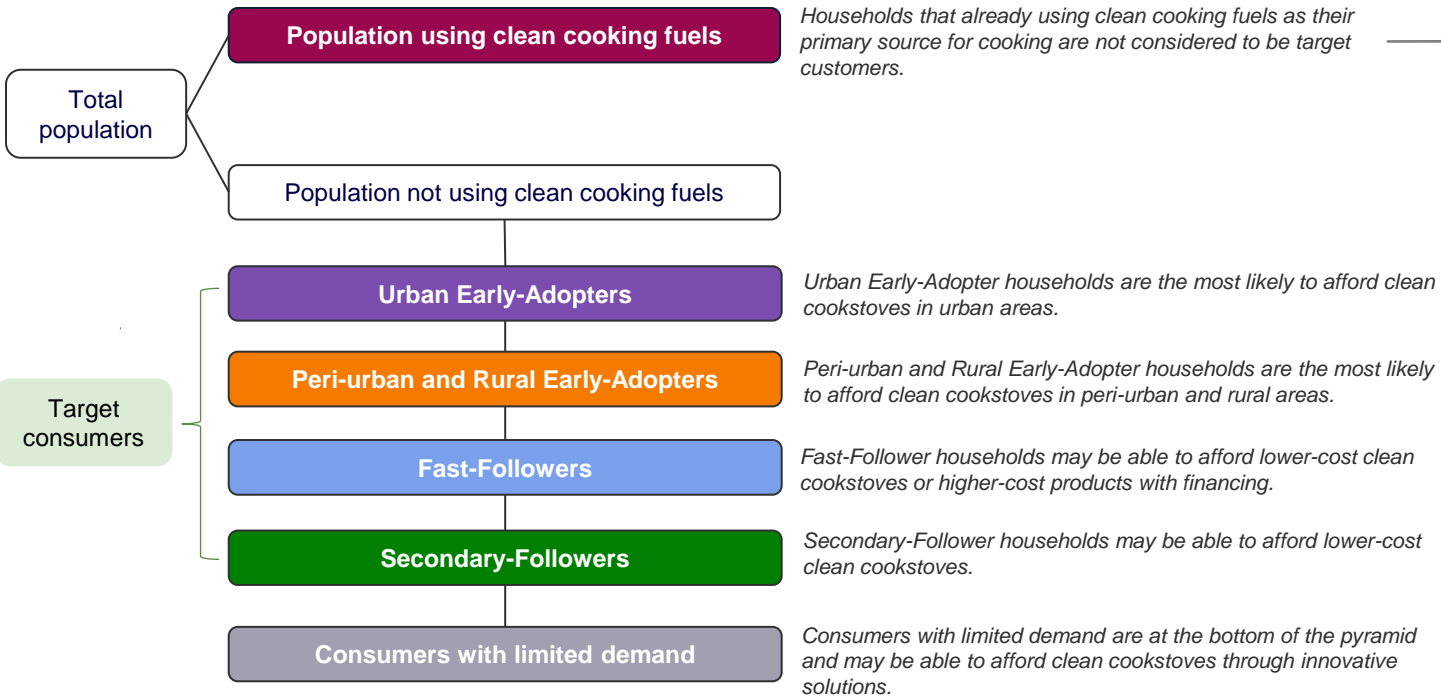
---

## Mapping Consumer Segments



# The total population is segmented into six groups, with four target consumer segments.

Total number of households in Nigeria



**Note 1:** The same segment criteria was applied across the six countries examined by Fraym, which resulted in significant variations in segment sizes across countries.  
**Source:** Fraym





# Overview of Target Consumers

**Urban Early-Adopter Households** are those with the highest ability to afford clean cooking technologies. Only households that live in urban areas were included in this group. They own high-cost assets, live in homes made of high-quality materials, and have access to electricity. These households are expected to be the consumer segment most able to afford clean cooking technologies.<sup>1</sup> There are an estimated 6 million urban early-adopter households in Nigeria.

**Peri-urban and Rural Early-Adopter Households** are wealthy households with a high ability to afford clean cooking technologies. These households own high-cost assets, live in households made of high-quality materials, and have access to electricity. Only households that live in peri-urban or rural areas are included in this consumer group.<sup>1</sup> There are nearly 7 million peri-urban and rural early-adopter households in Nigeria.

**Fast-Follower Households** are any remaining households that own high-cost assets that did not fit the early-adopter profiles. Also included in this group are households with homes partially constructed from high-quality materials and with formal bank accounts, making these households better positioned to maintain savings and/or take out loans for the purchase of household assets. Roughly 10 million households in Nigeria are fast-followers.

**Secondary-Follower Households** are any remaining households that own high-cost assets that did not fit the early-adopter profiles and fast-follower profile. They have homes partially constructed from high-quality materials and own radios, suggesting modest consumption power and some ability to afford clean cooking technologies. Their lack of access to services, like electricity and bank accounts, suggests a lower-middle class in both urban and rural markets. These households are mostly found in rural areas but have some presence in urban markets as well. There are about 6 million secondary-follower households in Nigeria.

**Note 1:** High-cost assets are defined as televisions, refrigerators, and cars. High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor. Urban areas were defined using the EU Global Human Settlement Layer (GHSL). Urban centers, dense urban clusters, and semi-dense urban clusters are classified as urban. Suburban or peri-urban and all rural areas are classified as peri-urban and rural.

**Source:** Fraym, Nigeria 2018 DHS

6M Early-Adopter households

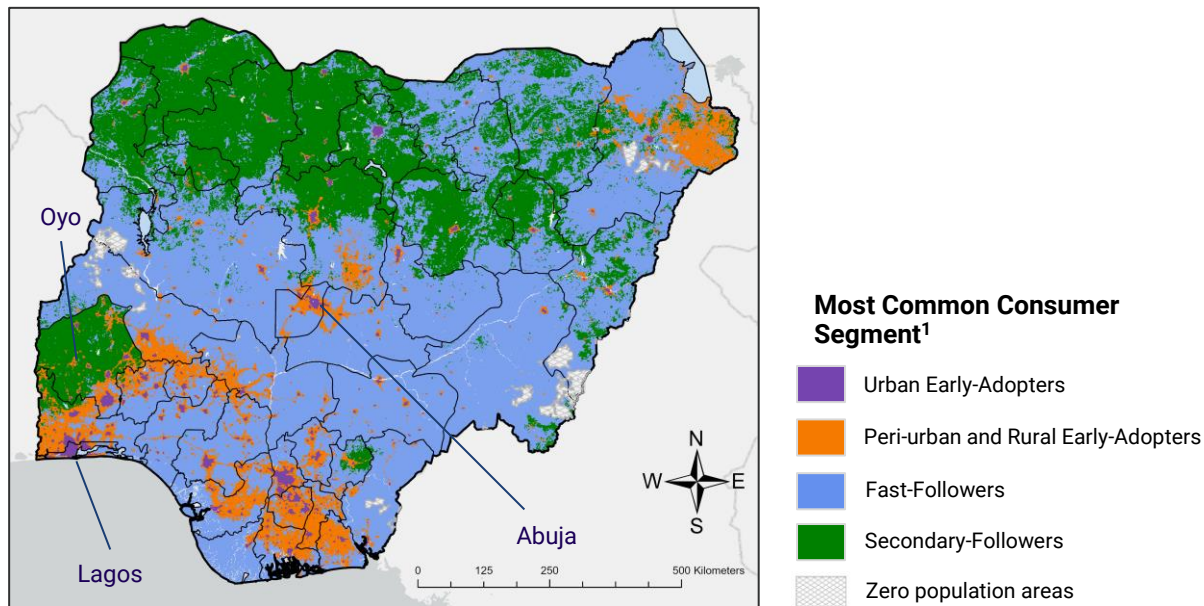
7M Peri-urban and Rural Early-Adopter households

10M Fast-Follower households

6M Secondary-Follower households

# Consumer Segment Distribution

Consumer segments are clustered within different areas of Nigeria, indicating that strategies for market entry will differ by location.



**Urban early-adopters** are most common in large cities like Lagos and Abuja.

**Peri-urban and rural early-adopters** are most common in the Southwest and in the areas surrounding large cities.

**Fast-Followers** are the most common in less dense areas, giving it a more widespread distribution.

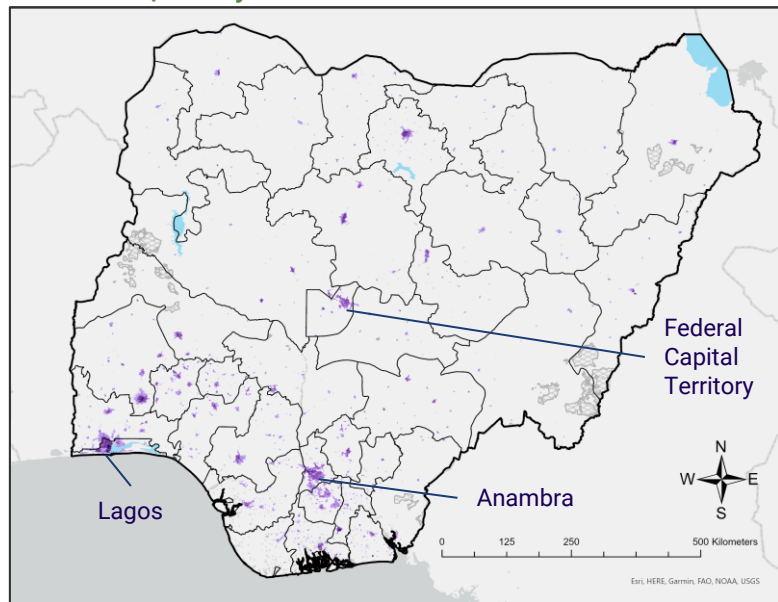
**Secondary-Followers** are most common in the North and in rural areas of Oyo State.

**Note 1:** This map shows the most common consumer segment among all households per 1km<sup>2</sup> area. Each 1km<sup>2</sup> area vary in population density.

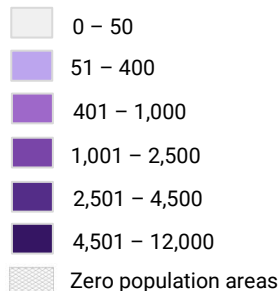
**Source:** Fraym, Nigeria 2018 DHS

# Urban Early-Adopters

There are about 6 million urban early-adopter households, representing around 12 percent of all households in Nigeria. They are concentrated in Lagos, Anambra, and Oyo states.



## Urban Early-Adopter Households<sup>1</sup>



**Note 1:** This map shows the estimated number of urban early-adopter households per 1km<sup>2</sup>. Urban early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live in urban centers, dense urban clusters, and semi-dense urban clusters according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

Source: Fraym, Nigeria 2018 DHS

**6M** Urban Early-Adopter households

**20%** of households are headed by a woman

**4.6** Average household size

**62%** of household heads have completed secondary education

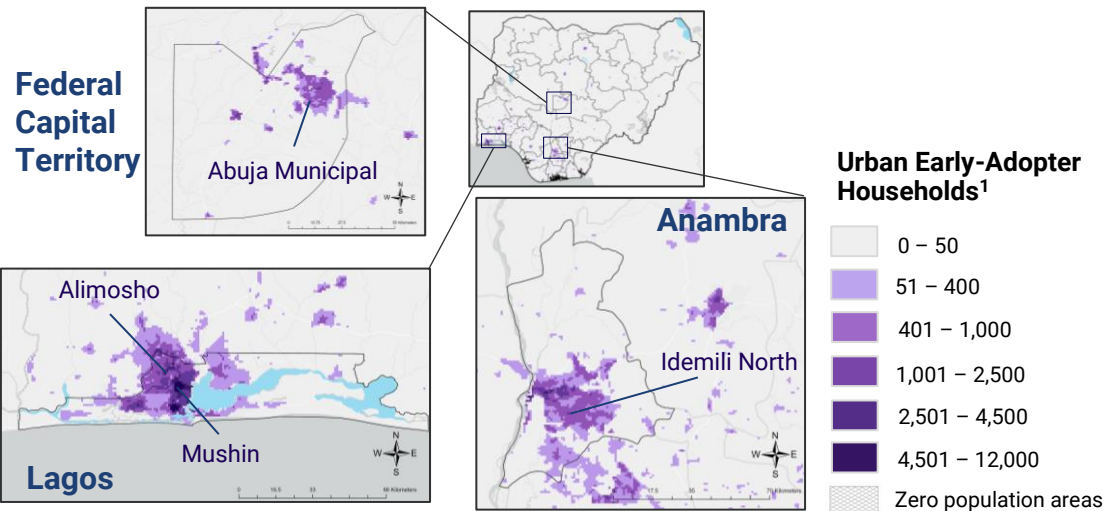
**50%** use kerosene as their primary cooking fuel

**34%** use wood as their primary cooking fuel

**15%** use coal and charcoal as their primary cooking fuel

# Urban Early-Adopter

Over a quarter of all urban early-adopter households are in Lagos and Anambra states. Roughly 41 percent of all households in Anambra are urban early-adopters and 30 percent of households in Lagos are urban early-adopter.



**Note 1:** This map shows the estimated number of urban early-adopter households per 1km<sup>2</sup>. Urban early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live in urban centers, dense urban clusters, and semi-dense urban clusters according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

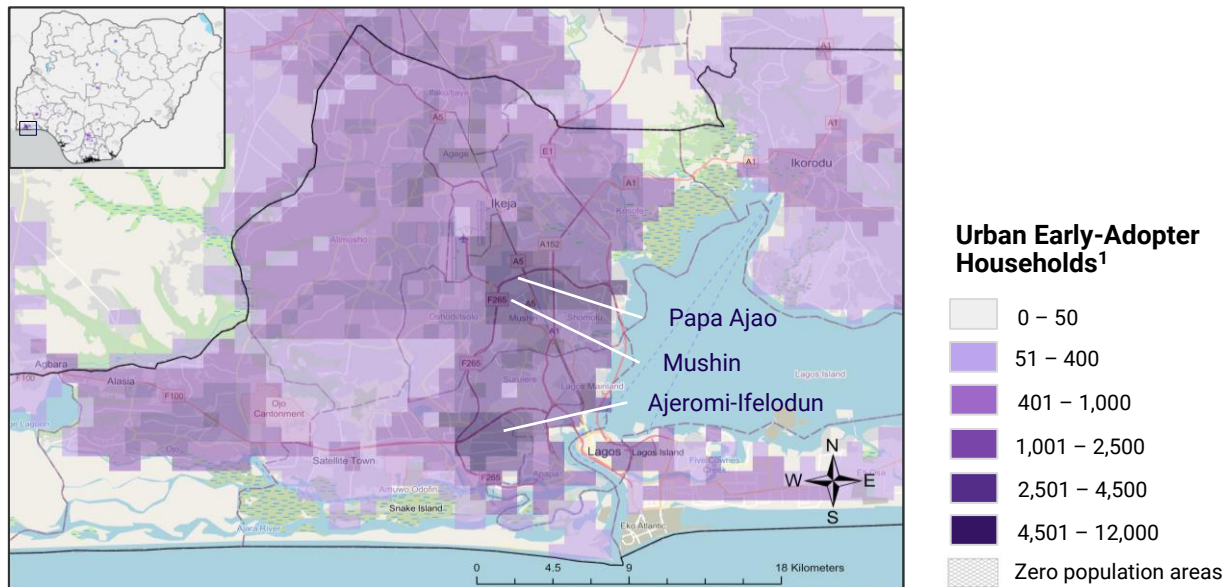
Source: Fraym, Nigeria 2018 DHS

## Top Local Government Areas with Urban Early-Adopters

State	Local Government Area (LGA)	Number of Early-Adopter Households
Federal Capital Territory	Abuja Municipal	213,000
Lagos	Alimosho	162,000
Anambra	Idemili North	114,000
Lagos	Mushin	99,000
Abia	Aba South	99,000
Lagos	Oshodi-Isolo	88,000
Lagos	Ikeja	84,000
Lagos	Ojo	82,000
Anambra	Idemili South	81,000
Lagos	Ajeromi-Ifelodun	79,000

# Urban Early-Adopter

Neighborhoods in the center of Lagos have the highest density of urban early-adopters.



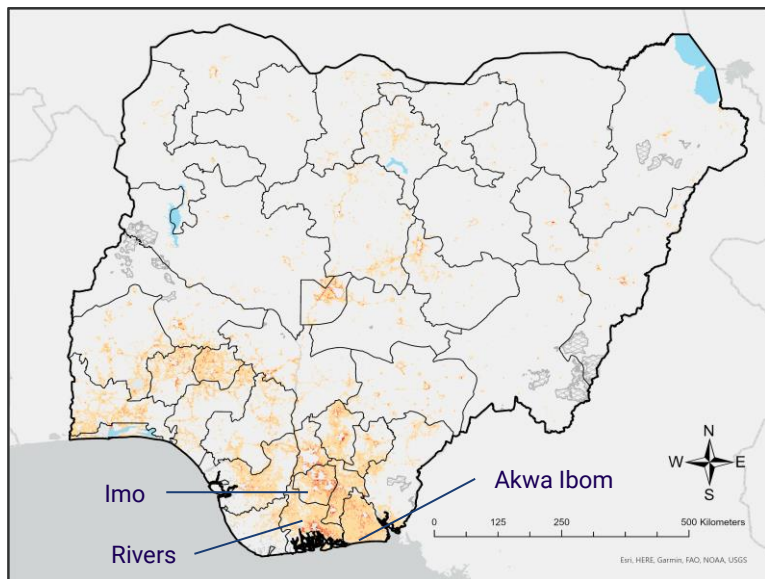
High density neighborhoods in the center of Lagos, like Papa Ajao, Mushin, and Ajeromi-Ifelodun have the highest concentrations of urban early-adopters.

**Note 1:** This map shows the estimated number of urban early-adopter households per 1km<sup>2</sup>. Urban early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live urban centers, dense urban clusters, and semi-dense urban clusters according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

**Source:** Fraym, Nigeria 2018 DHS

# Peri-urban and Rural Early-Adopters

There are around 7 million peri-urban and rural early-adopter households, representing 14 percent of all households in Nigeria. Many of these households are concentrated in the southeast of the country.



**Note 1:** This map shows the estimated number of peri-urban and rural early-adopter households per 1km<sup>2</sup>. Peri-urban and rural early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live in suburban or peri-urban rural areas according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

**Source:** Fraym, Nigeria 2018 DHS

**7M** Per-urban and Rural Early-Adopter households

**19%** of households are headed by a woman

**4.5** Average household size

**54%** of household heads have completed secondary education

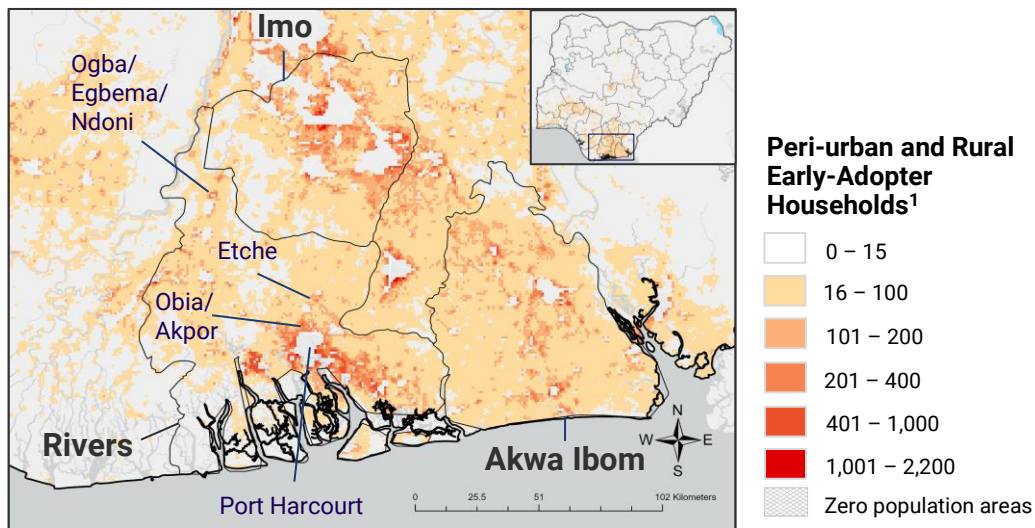
**65%** use wood as their primary cooking fuel

**27%** use kerosene as their primary cooking fuel

**7%** use coal, charcoal, or straw as their primary cooking fuel

# Peri-urban and Rural Early-Adopters

Roughly one fifth of peri-urban and rural early-adopter households are in Rivers, Akwa Ibom, and Imo states. Around 30 percent of households in these three states are peri-urban and rural early-adopters.



**Note 1:** This map shows the estimated number of peri-urban and rural early-adopter households per 1km<sup>2</sup>. Peri-urban and rural early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live in suburban or peri-urban rural areas according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

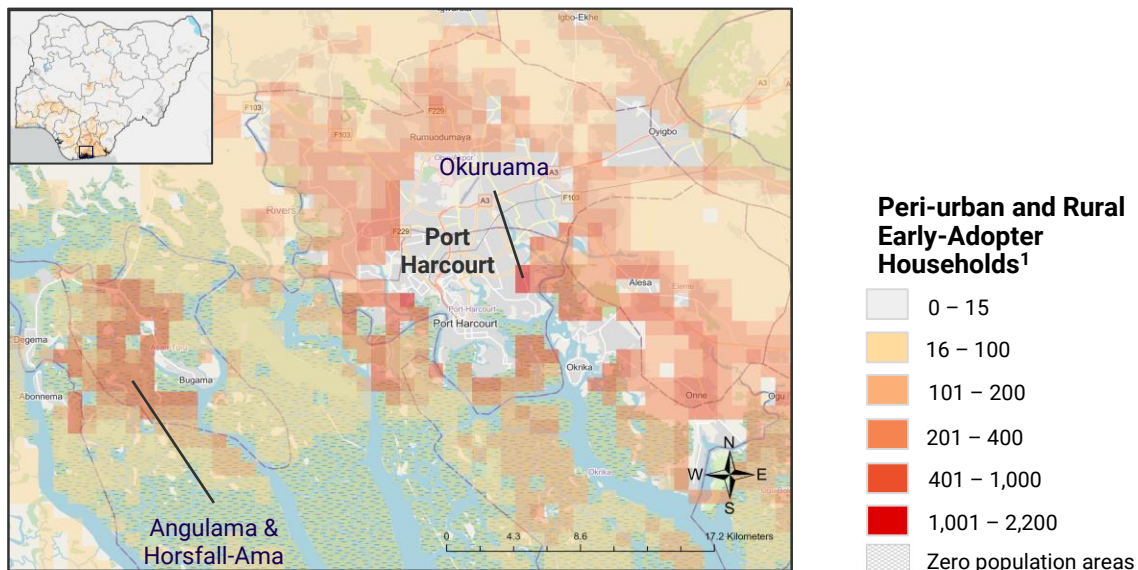
Source: Fraym, Nigeria 2018 DHS

## Top Local Government Areas with Peri-urban and Rural Early-Adopters

State	Local Government Area (LGA)	Number of Peri-urban and Rural Early-Adopter Households
Federal Capital Territory	Abuja Municipal	95,000
Rivers	Etche	43,000
Rivers	Obia/Akpor	41,000
Delta	Ughelli North	39,000
Rivers	Ogba/Egbema/Ndoni	37,000
Rivers	Khana	37,000
Imo	Mbaitoli	37,000
Edo	Akoko-Edo	35,000
Federal Capital Territory	Bwari	34,000
Rivers	Ahoada West	33,000

# Peri-urban and Rural Early-Adopters

In Rivers state, neighborhoods on the outskirts of Port Harcourt have the highest concentrations of peri-urban and rural early-adopters.



Neighborhoods outside of Port Harcourt like Okuruama have dense pockets of peri-urban and rural early-adopters.

Angulama and Horsfall-Ama are small towns around the Asari Toru River with high densities of peri-urban and rural early-adopters.

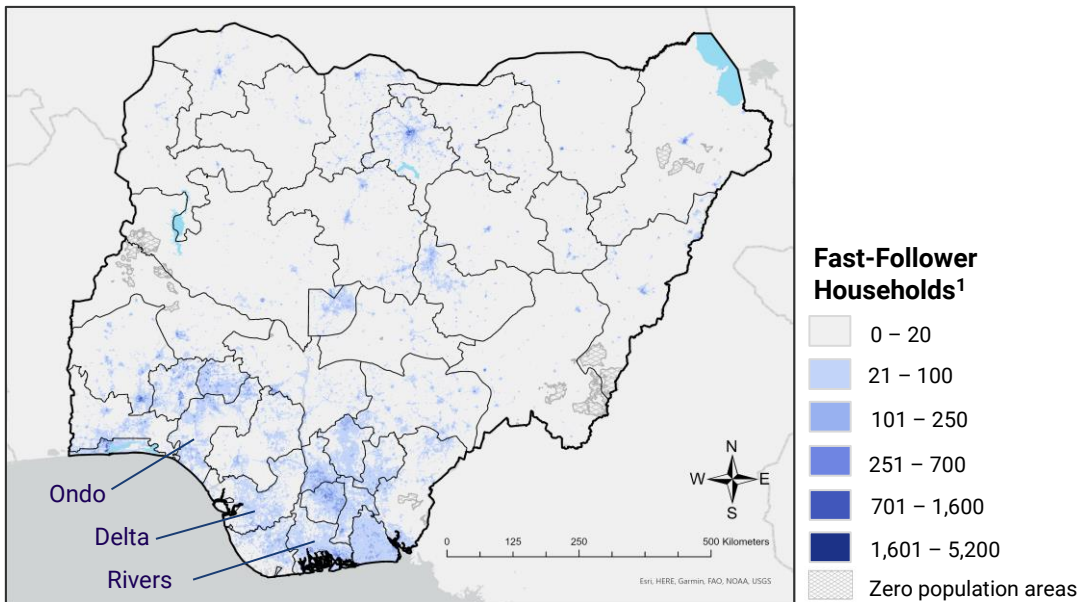
**Note 1:** This map shows the estimated number of peri-urban and rural early-adopter households per 1km<sup>2</sup>. Peri-urban and rural early-adopter households own at least one high-cost asset, have housing made of all high-quality material, have access to electricity, and live in suburban or peri-urban rural areas according to the EU Global Human Settlement Layer. Estimates in Abia, Kogi, Nasarawa, Rivers states failed to pass standard Fraym quality checks and should thus be interpreted with caution.

Source: Fraym, Nigeria 2018 DHS



# Fast-Followers

There are about 10 million fast-follower households, representing around 21 percent of all households in Nigeria. Ondo, Delta, and Rivers states have the largest concentrations of fast-follower households.



**Note 1:** This map shows the estimated number of fast-follower households per 1km<sup>2</sup>. Fast-Follower households own at least one high-cost asset or have access to a bank account and have housing made of at least one high-quality material.

**Source:** Fraym, Nigeria 2018 DHS

**10M** Fast-Follower households

**14%** of households are headed by a woman

**4.8** Average household size

**33%** of household heads have completed secondary education

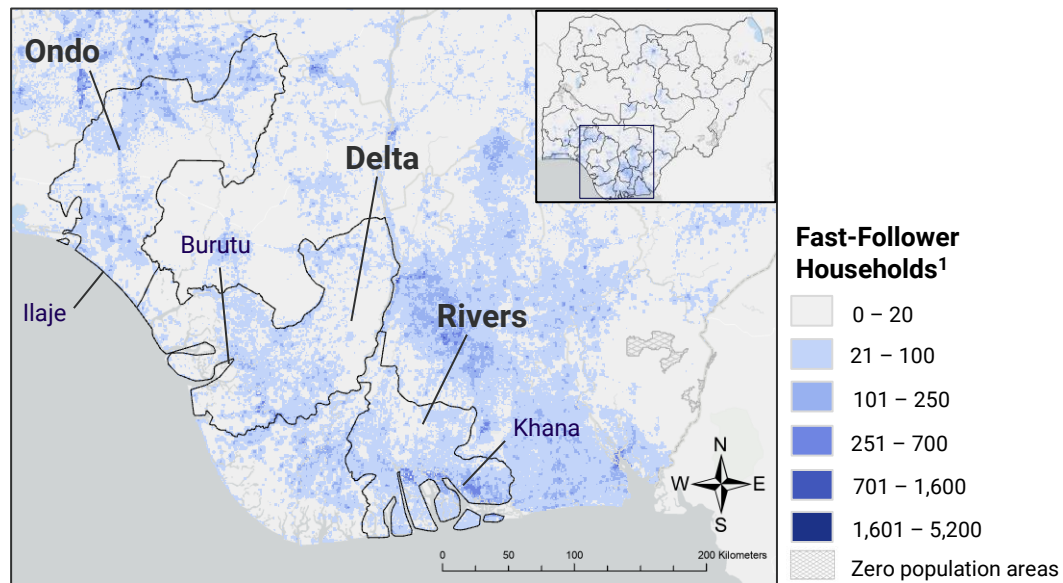
**75%** use wood as their primary cooking fuel

**17%** use kerosene as their primary cooking fuel

**8%** use coal, charcoal, straw, or dung as their primary cooking fuel

# Fast-Followers

About 14 percent of all fast-follower households live in Rivers, Ondo, and Delta states. Around 25 to 30 percent of households in these three states are fast-followers.



**Note 1:** This map shows the estimated number of fast-follower households per 1km<sup>2</sup>. Fast-Follower households own at least one high-cost asset or have access to a bank account and have housing made of at least one high-quality material.

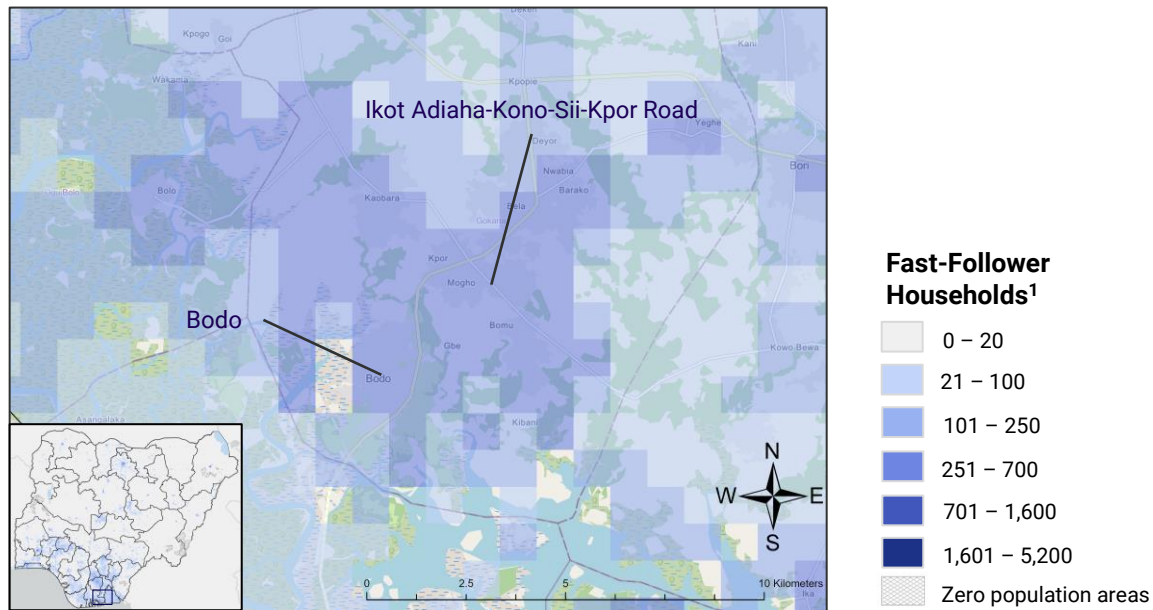
**Source:** Fraym, Nigeria 2018 DHS

## Top Local Government Areas with Fast-Followers

State	Local Government Area (LGA)	Number of Fast-Follower Households
Federal Capital Territory	Abuja Municipal	74,000
Bayelsa	Southern Ijaw	71,000
Bayelsa	Ekeremor	64,000
Rivers	Khana	51,000
Delta	Burutu	49,000
Rivers	Akuku Toru	45,000
Rivers	Abua/Odual	43,000
Ondo	Ilaje	41,000
Ondo	Ondo West	41,000
Plateau	Jos South	40,000

# Fast-Followers

There is a high density of fast-follower households in Khana Local Government Area, particularly in small towns along the Ikot Adiaha-Kono-Sii-Kpor Road.



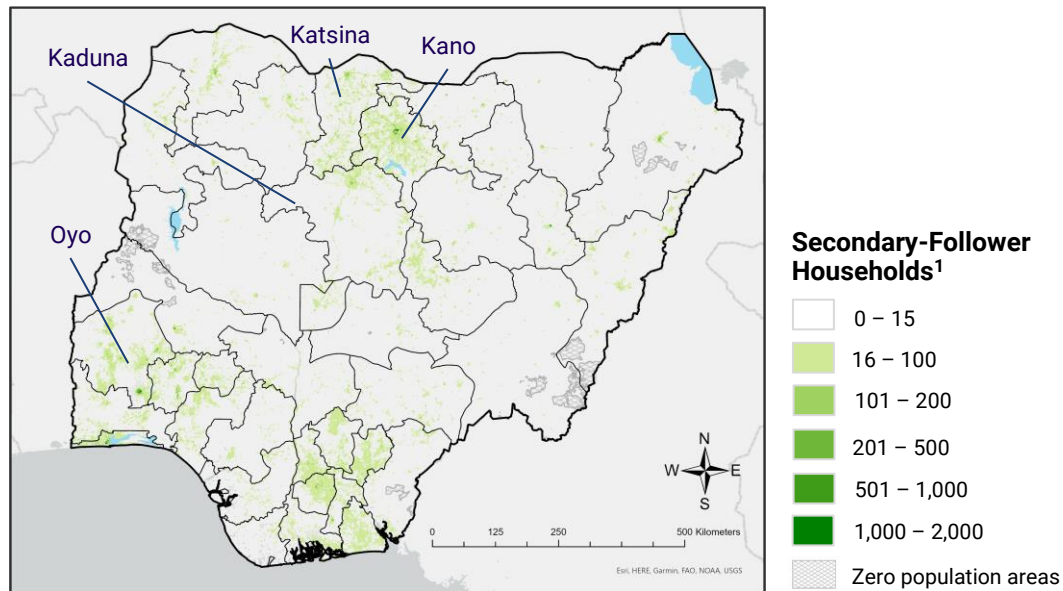
Small towns along the Ikot Adiaha-Kono-Sii-Kpor Road, such as the fishing village of Bodo, have a high density of fast-followers.

**Note 1:** This map shows the estimated number of fast-follower households per 1km<sup>2</sup>. Fast-Follower households own at least one high-cost asset or have access to a bank account and have housing made of at least one high-quality material.

**Source:** Fraym, Nigeria 2018 DHS

# Secondary-Followers

There are about 6 million secondary-follower households, representing 12 percent of all households in Nigeria. There are large concentrations of secondary-followers in northern Nigeria.



**Note 1:** This map shows the estimated number of secondary-follower secondary households per 1km<sup>2</sup>. Secondary-Follower households own at least one high-cost asset or own a radio and have housing made of at least one high-quality material.

**Source:** Fraym, Nigeria 2018 DHS

**6M** Secondary-Follower households

**18%** of households are headed by a woman

**4.8** Average household size

**19%** of household heads have completed secondary education

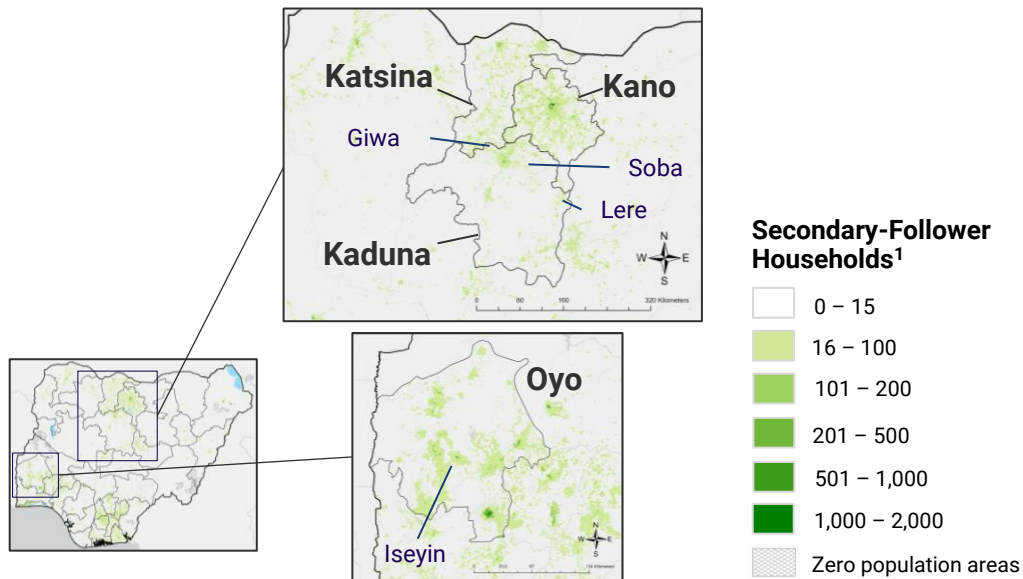
**84%** use wood as their primary cooking fuel

**9%** use kerosene as their primary cooking fuel

**7%** use coal, charcoal, straw, crops, or dung as their primary cooking fuel

# Secondary-Followers

Around 28% of secondary-followers live in Kano, Oyo, Katsina, and Kaduna states. Around 20 to 25 percent of all households in these states are secondary-follower.



**Note 1:** This map shows the estimated number of secondary-follower households per 1km<sup>2</sup>. Secondary-Follower households own at least one high-cost asset or own a radio and have housing made of at least one high-quality material.

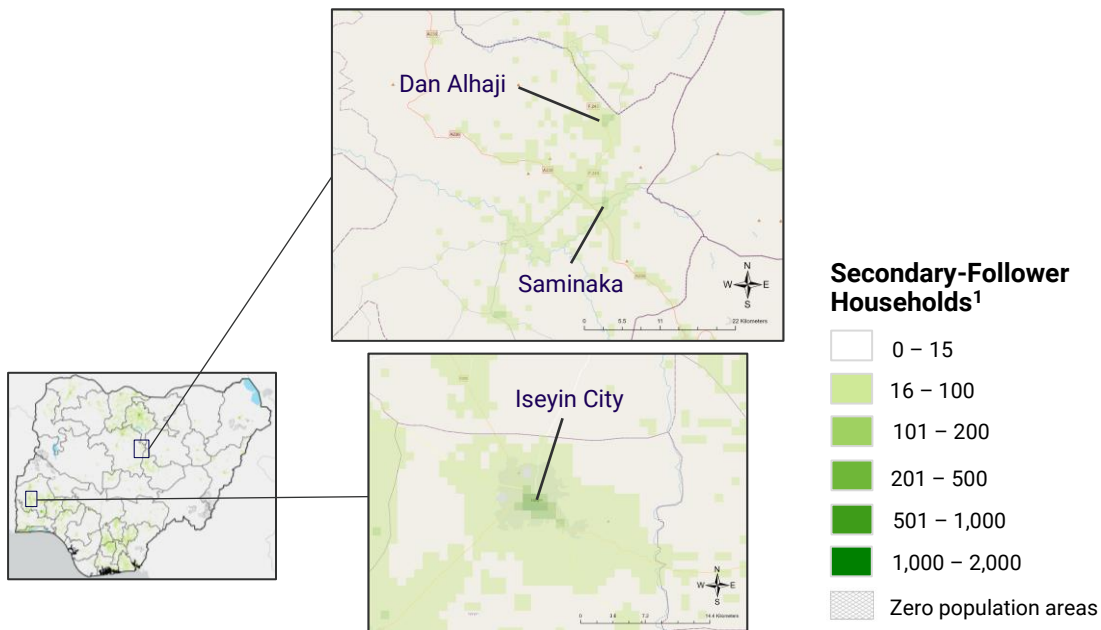
**Source:** Fraym, Nigeria 2018 DHS

## Top LGAs with Secondary-Followers

State	Local Government Area (LGA)	Number of Secondary-Follower Households
Oyo	Iseyin	36,000
Oyo	Atigbo	31,000
Gombe	Yamaltu/Deba	28,000
Oyo	Atiba	27,000
Kaduna	Lere	27,000
Kaduna	Soba	26,000
Kaduna	Giwa	25,000
Kaduna	Igabi	25,000
Plateau	Mangu	23,000
Oyo	Kajola	23,000

# Secondary-Followers

**Secondary-Follower households are more dispersed than other consumer segments and concentrated in small towns and rural areas.**



In Oyo, the city of Iseyin and the surrounding areas have many secondary-followers.

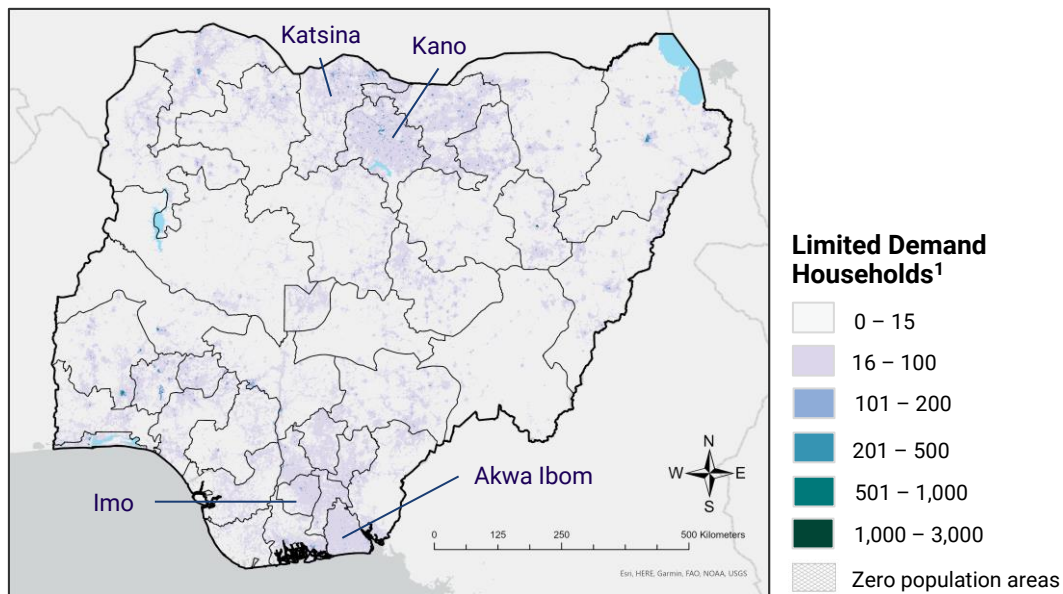
In Kaduna state, small towns in Lere such as Dan Alhaji and Saminaka along the F243 and A236 highways have relatively high concentrations of secondary-followers.

**Note 1:** This map shows the estimated number of secondary-follower households per 1km<sup>2</sup>. Secondary-Follower households own at least one high-cost asset or own a radio and have housing made of at least one high-quality material.

**Source:** Fraym, Nigeria 2018 DHS

# Limited Demand

There are about 11 million limited demand households, representing 22 percent of all households in Nigeria. There are large concentrations of limited demand households in the North and Southwest of Nigeria.



**Note 1:** This map shows the estimated number of limited demand households per 1km<sup>2</sup>. Limited demand households do not fit any of the four core consumer profiles due to their limited consumption ability.

Source: Fraym, Nigeria 2018 DHS

**6M** Limited Demand Households

**24%** of households are headed by a woman

**4.6** Average household size

**13%** of household heads have completed secondary education

**90%** use wood as their primary cooking fuel

**4%** use kerosene as their primary cooking fuel

**4%** use charcoal as their primary cooking fuel

05

---

# Data Sources and Methodology





# Asset-Based Consumer Segmentation

---

**Improving upon previous studies of African consumers, Fraym fills two critical gaps by offering reliable market estimates and sub-national specificity. Consumer segments provide a useful framework for thinking about different markets for clean cooking technologies. The goal of this effort is to understand different levels of consumption power within each group of potential clean cooking fuel consumers.**

To understand the potential market for different types of clean cooking technologies, Fraym segmented households that primarily use solid cooking fuels into four groups. Instead of basing the profiles on consumers' income and spending, which can be susceptible to seasonal fluctuations, Fraym used a composite measure that classifies households based upon key characteristics such as asset ownership, household building material, and access to services. Each consumer segment only includes households not currently using clean cooking fuel, and each of these groups are mutually exclusive, with each household being classified into the highest tier for which it is eligible.

**Early-Adopter households** are those with high consumption power, as evidenced by their ownership of high-cost assets, access to electricity, and homes made from high-quality materials.<sup>1</sup> Early-Adopter households were segmented into two groups: *Urban Early-Adopters* and *Peri-urban and Rural Early-Adopter households*.

**Follower households** have moderate consumption power as evidenced by asset ownership, home construction material, and financial inclusion. Follower households were segmented into two groups: *Fast-Followers* are households with bank accounts suggesting some access to financial tools to facilitate larger purchases, and *Secondary-Followers* are households that own a radio, suggesting some discretionary spending power. Both groups can be found in both urban, peri-urban, and rural areas.

The remaining solid cooking fuel households were categorized into a limited demand profile, with very low consumption ability. There are about 11 million limited demand households in Nigeria.

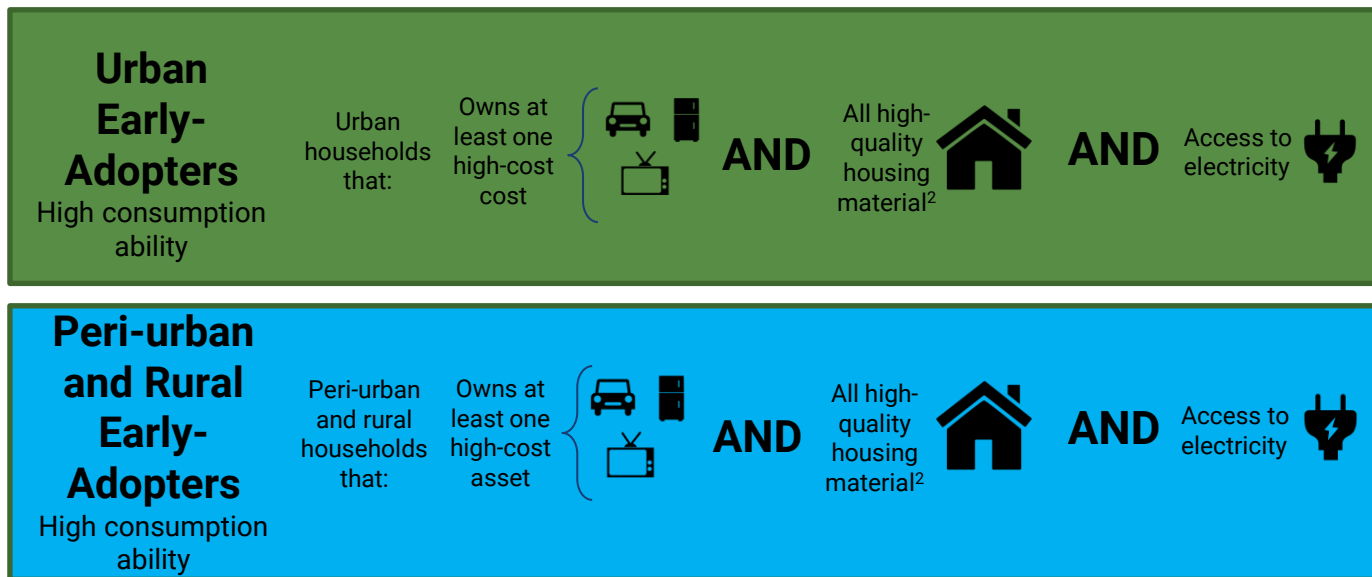
**Note 1:** High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor.

Source: Fraym



# Identifying Early-Adopters

Fraym segmented solid cooking fuel households into early-adopter groups based on high-cost asset ownership, housing quality, and electricity access, which are all indicative of wealth. These households were then further segmented based on urbanicity into Urban and Peri-urban and Rural Early-Adopter households.<sup>1</sup>



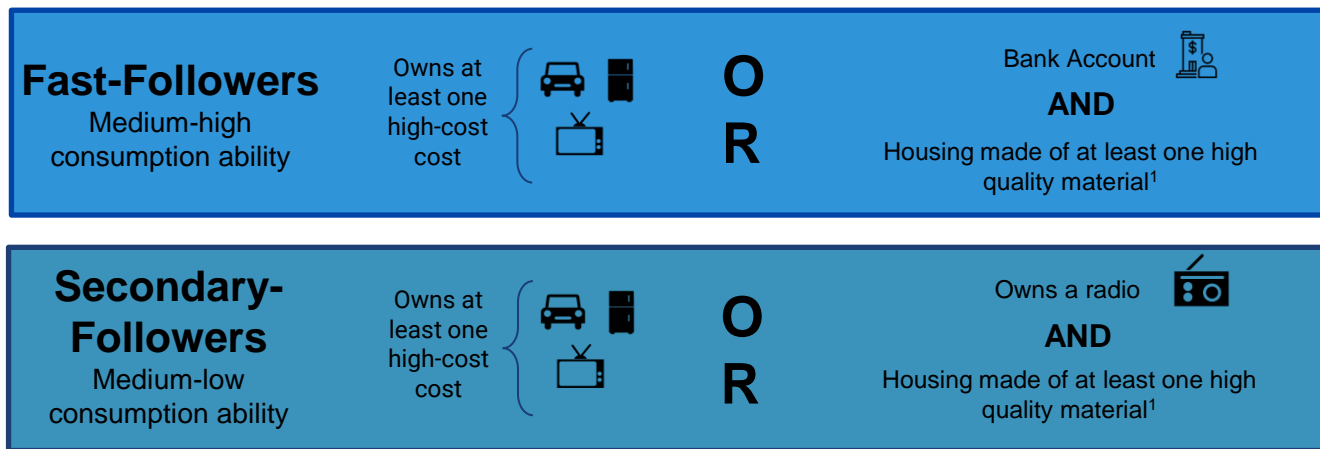
**Note 1:** Urban areas were defined using the EU Global Human Settlement Layer (GHSL). Urban centers, dense urban clusters, and semi-dense urban clusters are classified as urban. Suburban or peri-urban and all rural areas are classified as peri-urban and rural.

**Note 2:** High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor.

Source: Fraym

# Identifying Followers

**Fraym identified follower consumers from the remaining solid cooking fuel households as households with medium to moderate consumption ability, as suggested by some high-cost asset ownership and some high-quality housing materials. While predominantly rural, there are significant numbers of follow consumers in urban areas, especially among fast-follower households.**



**Note 1:** Urban areas were defined using the EU Global Human Settlement Layer (GHSL). Urban centers, dense urban clusters, and semi-dense urban clusters are classified as urban. Suburban or peri-urban and all rural areas are classified as peri-urban and rural.

**Note 2:** High quality housing materials are defined as durable materials like concrete, metal, brick, or finished wood. All housing refers to the roof, wall, and floor.

Source: Fraym

# Fraym Data

---

**The Fraym database combines satellite imagery and existing household surveys that are harmonized and re-weighted based on population data from third-party sources like multilateral and bilateral development actors, ensuring that indicators are comparable across countries and over time.**

For this study, indicators at the individual and household levels were sourced from the 2018 Nigeria Demographic and Health Survey (DHS), the 2017 Financial Inclusion Insights survey (FII), and the 2019 General Household Survey (GHS). These surveys are designed to be nationally representative and use a stratified two-stage sample design. The 2018 DHS data were enumerated between August and December 2018, with a total sample size of 40,427 households. The FII data were enumerated between August 2017 and December 2017, with a total sample size of 6,042 Individuals. The GHS data were enumerated between July 2018 and September 2018, with a total sample size of 30,346 Individuals.

Fraym data scientists closely examine representativeness, sampling frames, questionnaire coverage, periodicity, and a range of other factors. Fraym obtains microdata, e.g. individual rows of responses of survey data, in order to avoid any manipulation that could potentially occur during the analysis phase. After data collection, Fraym creates post-hoc sampling weights to account for any oversampling and ensure survey representativeness. The weights and resulting population proportions were triangulated with independent, third-party sources, such as the UN Population Division and the World Bank's World Development Indicators.

Additionally, granular population distribution data comes from WorldPop, a publicly available and detailed population distribution and composition data source that leverages existing census data to produce 100m x 100m resolution estimates of population density. In order to build its datasets, WorldPop relies on census data as the main primary data input, and large geotagged household surveys when they are not available. In order to project into the future from the latest census of a given country, WorldPop uses subnational and urban rural growth rates that are reconciled with UN estimates. For this report, population estimates from 2020 were used.

# Fraym's Interpolation Process

---

**Fraym has built an artificial intelligence / machine learning (AI/ML) software that weaves together high-quality household survey data with satellite imagery to create localized population information (1 km<sup>2</sup>).**

The primary data input is data from existing 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. Fraym has collected, cleansed, and harmonized more than 1,000 of these surveys from around the world. Sample sizes are normally 10,000+ households with information for 50,000+ respondents. Response rates are very high, normally higher than 95 percent.

The second major data input is satellite imagery and related derived data products, including earth observation (EO) data, gridded population information i.e. human settlement mapping, and biophysical surfaces like soil characteristics. As with the survey data, Fraym data scientists ensure that the software only uses high-quality imagery inputs. Derived products are carefully assessed for model metrics, contextual checking, and pedigree within the geospatial data science community.

To create spatial layers from household survey data, Fraym leverages machine learning to predict an indicator of interest at a 1 square kilometer 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 pioneered by USAID's Demographic and Health Surveys program in 2015 and since improved upon by Fraym and others.<sup>1</sup>

Once the spatial layer is produced, Fraym performs a series of quality checks including the comparison of the spatial layer's output to the survey at its level of representativeness (national and/or first level administrative division). This survey mean is compared against the implied mean of the surface when all grids are appropriately aggregated through population weighted zonal statistics.

**Note 1:** Gething, Peter, Andy Tatem, Tom Bird, and Clara R. Burgert-Brucker. 2015. Creating Spatial Interpolation Surfaces with DHS Data DHS Spatial Analysis Reports No. 11. Rockville, Maryland, USA: ICF International. Other notable, relevant work includes: Weiss DJ, Lucas TCD, Nguyen M, et al. Mapping the global prevalence, incidence, and mortality of Plasmodium falciparum, 2000–17: a spatial and temporal modelling study. Lancet 2019; published online June 19. DOI: [10.1016/S0140-6736\(19\)31097-9](https://doi.org/10.1016/S0140-6736(19)31097-9) and Tatem A, Gething P, Pezzulo C, Weiss D, and Bhatt S. 2014. Final Report: Development of High-Resolution Gridded Poverty Surfaces. University of Southampton. <https://www.worldpop.org/resources/docs/pdf/Poverty-mapping-report.pdf>

Source: Fraym





---

**Marina Tolchinsky**  
**[m.tolchinsky@fraym.io](mailto:m.tolchinsky@fraym.io)**

Lead Analysts: Carlos Chua, Sean Walsh