USAID GLOBAL HEALTH SUPPLY CHAIN PROGRAM

PROCUREMENT AND SUPPLY MANAGEMENT

BIG DATA FOR FAMILY PLANNING

PILOT STUDY ON A DATA WORKBENCH & PREDICTIVE ANALYTICS FOR FAMILY PLANNING COMMODITIES

USAID
FROM THE AMERICAN PEOPLE

Contents

ACRONYM LIST

SDP: Service Delivery Point

CRISP-DM: Cross-Industry Standard Process for Data Mining

LGA: Local Government Area

USAID: United States Agency for International Development

GHSC-PSM: Global Health Supply Chain – Purchasing (Procurement) and Supply Management

CYP: Couple-Years of Protection

DHS: Department of Health Survey

LARC: Long Acting Reversible Contraceptives

LGA: Local Gouvernement Area

IUD: Intrauterine Device

GIS: Geographic Information System

OSS: Open Source Software

PEPFAR: President's Emergency Plan for AIDS Relief

EXECUTIVE SUMMARY

Using data for decision making has only increased with the growth and availability of big data. At GHSC-PSM we have been looking at ways to take advantage of big data to better target actions to support the use of family planning. In managing supply chains with 100s or 1000s of service delivery points (SDPs) and limited resources, there is a need to target resources. As such, there is a potential of using big data in a repeatable way to better target actions for more effective use of limited resources.

KEY FINDINGS

The patterns of relationships between supply and demand indicate the need for targeted actions

It highlights the importance to develop a logical flow from data to the decision.

In this case the team looked at combining supply chain, population, and family planning data to prioritize and target specific actions. The supply chain data identified the actions, based on the flow of commodity through the supply chain. The main indicator was the inventory turnover. If commodities were moving faster than planned, then the action was to increase commodity flow. If commodities were moving as planned, then there was no action. If commodities were moving slower than planned, then we looked to increase advocacy for family planning. The next step was to prioritize locations to be targeted first. A weighted index based on population and family planning indicators set the prioritization. The actions and prioritization were then combined to provide insights on what, when, and where to prioritize the LGA actions, defined as increase product, no action (adequate), or increase advocacy. Finally, the design of the method was to be both repeatable and adaptable to data availability.

Design of this approach used the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology. The data used was supply chain data for family planning commodities from Nigeria. The data represented six states where GHSC-PSM was the primary public provider from May 2016 to Oct 2017. The Population data came from Worldpop and Geopode. The family planning indicators were from the Nigeria 2013 USAID-funded Demographic and Health Survey (DHS). Unmet need and demand satisfied metrics were the main indicators used to generate the priority index.

The team also analyzed ways to measure method mix among family planning commodities. The goal was to determine the method mix and if it was stable or changing (skewing), not to find or suggest the "best" method mix. The main purpose was to see if supply chain data could give further insights into the state of the method mix.

In Nigeria, for the three main family planning methods, the major finding was there were different patterns of need for action. This highlighted the value of targeted actions. Implants had all three action categories (Increase Supply, No Action, and Increase Advocacy). Kogi state's main action was to increase supply of Implants. Injectable actions were skewed towards increasing advocacy. This indicates that product was not moving through the supply chain as planned. Condoms were located in the southern states and demand indicated an action of increase supply. Within these patterns, specific LGAs were prioritized based on their demographic characteristics.

The outcome of the study was an approach that takes advantage of increased digital data to identify where to target what kind of actions. Another critical part of this study was to ensure that the approach was repeatable. For this reason, the analysis was developed in an open source analytical workbench (Orange) that could be reused. The final outcome was to learn how to use data in decision making. A key takeaway from this exercise is the importance of developing a logical flow from the data to the decision.

INTRODUCTION

With USAID acting as one of the world's largest bilateral donors of family planning commodities, the USAID GHSC-PSM project plays a critical role in meeting targets for reproductive health and family planning. To meet goals such as "120 by 20" – there will be an addition of 120 million more users of modern contraceptive methods between 2012 and 2020. To assist in this goal GHSC- PSM will leverage the growth and availability of digital data. By using this data, we can better target actions to increase the availability of family planning commodities to meet the demand for family planning.

Access to high resolution demographics data has been an area that has increased with the advent of digital data. For example, the population data at 100m2 resolution is now available for Africa, Asia and Latin America (Worldpop). Another example is the spatial modeled surfaces of demographic and health data available from the Demographic Health Survey (DHS program). Beforehand, this level of granularity at this breadth of data was not available, and thus now provides a unique opportunity.

With this data it is possible to study the patterns and relationships between demographics and supply chain data at finer levels of granularity. The value of this analysis is the ability to create questions and pinpoint actions at higher levels of specificity. Questions that could not be answered, can now be investigated. For example, are we delivering to the right locations with the most need? Will adjusting the targeting of distribution improve coverage? Based on this analysis, GHSC-PSM will be able to determine how to best leverage this growing wealth of data to improve supply chain actions.

This project therefore had the following objectives:

- To determine how to leverage and integrate digital data sources within country supply planning actions
- Understand the patterns and relationships at a finer granularity between demographic data and supply chain data. Then determine the applicability of this information in supply chain forecasting and in-country supply planning.
- Promote the use, awareness and value of digital data across global health supply chains

PROJECT BACKGROUND & SCOPE

Our goal was to generate a repeatable analytical process that identifies patterns between the supply of family planning commodities and the demand for family planning. The level of analysis incorporated the use of disaggregated data to support the ability to target specific actions at particular locations. The purpose was to increase the availability of family planning commodities and match supply with the demand for family planning.

COMMODITIES: FAMILY PLANNING

An important consideration in family planning commodities is providing a range of options to meet women's demand for modern contraception – from condoms to IUDs. Methods were gauged by the amount of Couples Years Protection (CYP) provided. Those providing higher CYP per unit are considered Long-Acting Reversible Contraceptives (LARCs). Figure 1 below describes the methods and their associated CYP which are provided in Nigeria.

Figure 1: CYP by Type and Commodity

Type	Method	Product	Couples Years Protection
Short Term	Condoms	Male Condom (pieces)	0.01
		Female Condoms (pieces)	0.01
	Pills	Exluton/Microlut (cycles)	0.07
		Microgynon (cycles)	0.07
		Lo-femenal	0.07
	Injectables	Noristerat (amps)	0.17
		Depo Provera (vial)	0.25
		Sayana Press	0.25
Long-Acting	Implants	Implanon Implants (pieces)	2.50
		Jadelle Implants (pieces)	3.80
	IUD	IUCD (pieces)	4.60
Other	Other	Cycle Beads	1.50

COUNTRIES: NIGERIA

Nigeria was selected for the pilot based on a selection matrix of all 24 designated priority countries for USAID maternal and child health. The matrix used a weighted score on the status of family planning in the country and the availability of detailed digital logistic and demographic data. Nigeria's availability of digital and demographic data made it a top candidate and thus, was selected for the pilot study.

Additionally, the country provided interesting comparison points in location, religion and average fertility rates. Nigeria has a diversity of patterns regarding the use of family planning products from 38% in South West to 3% in North East. [2013 DHS] Therefore, understanding patterns at a disaggregated level is needed. For example, in the case with LARC, Thanel et. al 2018 notes that 7% of family planning outlets have implants available in Nigeria, concluding that this low level of LARC availability "restricts contraceptive choice and makes it difficult for women to adopt and use modern contraception consistently."[1] Using the decision tree in this environment would help determine where to best target increasing the availability of LARCs that would have a high likelihood of impact on the adoption and use of modern contraceptives.

PROJECT APPROACH & METHODOLOGY

The project team undertook 4 key steps:

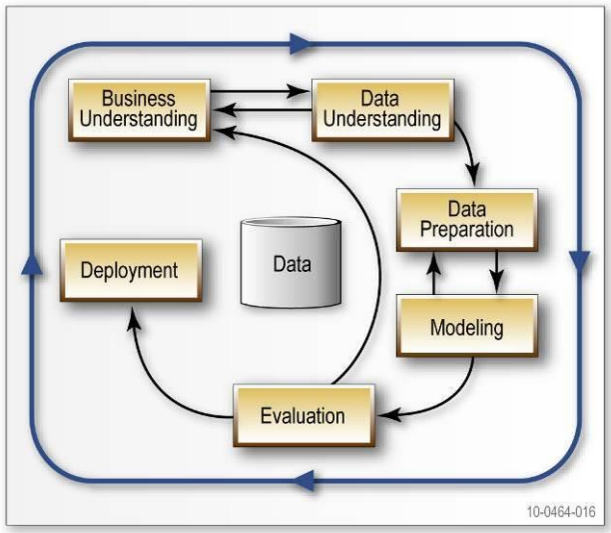
- Analyze one country dataset (Nigeria) with detailed a issues data at the facility level (or consumption data) across a large geographical area (Region, LGA).
- Analyze one country dataset (Nigeria) with detailed demographic data and indicators at disaggregated levels at or below the 2nd Administrative level (LGA in Nigeria).
- Review identified patterns with key stakeholders to determine actionable ways to support more effective distribution of family planning products.
- Based on the findings, identify repeatable processes to enable the findings to be easily repeated in other countries.

Our analytic methodology used the CRoss Industry Standard Process for Data Mining (CRISP-DM). This is a well-established and comprehensive industry framework for data mining development. Created in 1996 by a tripartite group representing data mining software developers (ISL), data mining and data warehouse specialists (NCR), and industry users (Daimler-Benz), CRISP-DM was then validated by a consortium of users over several years. It now represents the most widely utilized methodology, employed on innumerable projects.

CRISP-DM is a method and reference model, guiding the data analysis and mining process from start to finish. At a high level, the entire lifecycle is covered by six phases, as shown in Figure 2. These phases, and the steps within them, can be iterative. The first phase of the modeling process establishes the business objective. After codifying the objectives, the next step is the technical tasks. The key steps are understanding the data and building and evaluating the models.

Business Understanding focuses on understanding the project objectives and requirements. In this phase, we studied the relationships between supply and demand for family planning products. Second, we focused on understanding how the Nigeria supply chain operated. For example, the delivery cycle is every 2 months; based on this we prioritized what data to target, as well as devised a preliminary analysis plan to meet the overall objectives.

Figure 2: CRISP-DM Methodology



Data Understanding included reviewing available data and discussing the preliminary analysis with key stakeholders. This allowed us to determine both the key datasets and identify alternative sources followed by the level of data preparation needs and methods for integration. For example, in Nigeria the selection of LGA as the unit of analysis was the lowest point of integration.

Data Preparation focused on establishing a semi-automated to automated method for data cleaning. This was achieved using the analytical workbench. The preparation was linked with the modeling phase to ensure the cleaning process worked with the analysis. For example, the supply chain data might contain small gaps, by which an imputation process is used to fill these gaps to then be used in the modeling process.

Modeling involved reviewing the data and applying various analytic techniques that were repeatable and provide actionable insights. This was an iterative process to determine the most effective models for analyzing the data. The initial approach was to leverage machine learning functionality in the analytical workbench. However, after review, using a simple logic decision tree was identified as a more effective mechanism.

Evaluation throughout the analysis process involved key stakeholders who provided feedback to ensure that the objective, or the ability to find actions and adjust the prioritization based on the available data, had been met.

Deployment of the analytical workbench was designed from the beginning to be a repeatable process. The next step is the deployment of the analysis within a country and refining the tool to meet their context.

POINT OF ANALYSIS AND INTEGRATION USING GIS

The majority of the analysis is in the Orange Analytical Workbench. However, one key element outside of the workbench was preparing the different datasets to have a common point of analysis, the LGA. For the supply chain data, individual facility data were aggregated to the LGA level. The Population and DHS demographic data was prepared using GIS zonal statistics. In QGIS (Open Source GIS platform) the gridded population and DHS surfaces indicators were overlaid with the LGA boundaries. Using zonal statistics, the sum or average value of the population/indicator was applied to each LGA. This would not provide an actual measure of the indicator for the DHS metrics. The purpose was to provide a relative indication as to whether the population was high or low compared to other LGAs. This met the desired use of the population and DHS indicators in providing a method to prioritize LGAs, rather than a method to measure population or DHS data within the LGA. The overall aim was to provide a level of analysis that allowed for finer targeting of actions within the context of the available data.

DATA SOURCES

In this section, we describe in more detail the project data sources, construction of the Work bench and findings.

OVERVIEW OF DATA SOURCES

This study brings together three main data types.

Figure 3: Data Sources by Type

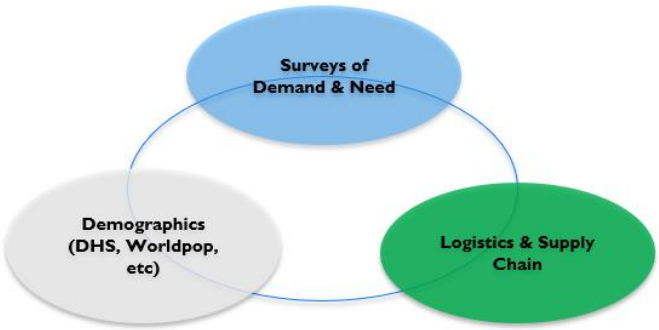


Figure 4: Primary Predictive Variables by Source

Primary Data Sources		
Demographics	**Surveys of Demand & Need**	**Commodity Orders**
• Total Population: • Total (Male, Female) • Age 15-49 (Male, Female) • Population Density (K) • Poverty Percentage • Contraceptive Population	• DHS - Unmet Need Percentage (2013) • DHS Demand Satisfied Percentage (2013) • DHS - Contraceptive Prevalence Rate (2013)	• Total CYP value by LGA over 12 month period (2016-2017) • CYP / Percentage provided by each commodity group (Condoms / Pills / Injectables / Implants & IUD) • Inventory Turns by Method by LGA • CPR Target (Hypothetical)

Additional data that would be highly desired includes the drivers of family planning use and fertility decision making, such as the number of children, wealth, years of schooling, television and radio use. The degree of gender decision making in the family are common predictors identified by the literature. This data can be added to enhance the prioritization score for where to target actions.

1. Demographic Data

WorldPop: Worldpop is a project that was initiated in 2013. Its goals of providing an open access archive of spatial demographic datasets for Central and South America, Africa and Asia to support development, disaster response and health applications. Datasets include high spatial resolution, contemporary data on human population distributions. For more information on the source WorldPop refer to the link: WorldPop

GeoPode: GeoPode is an open-source, public data repository for geospatial reference demographic data datasets. It is funded through the Gates Foundation and currently has a limited number of country datasets including Afghanistan, Demographic Republic of Congo and Nigeria. The metadata and notes provided with each dataset identify the data collection organization(s), the methods and timeframe used, use limitations, and whether the data has been authorized by the host government. For more information on GeoPode refer to the link: GeoPode

2. Surveys of Demand & Need

DHS Program: The Demographic and Health Survey are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. Data used from the Modeled Surfaces generated by the DHS Program were on Family Planning – knowledge and use of contraceptives. The key indicators from Nigeria 2013 DHS were Unmet Need Percentage and DHS Demand Satisfied Percentage. For more information on the DHS Program refer to the link: DHS Program

Other demographic data used in the workbench were contraceptive prevalence rates, poverty percentages, and contraceptive populations. These variables were from the DHS Survey and WorldPop and were used during the modeling and evaluation stage. For more information on source or method of variable construction, refer to the data dictionary.

3. Commodity Consumption Data

Public sector consumption and supply data were provided through the GHSC-PSM Project in Nigeria for 9 cycles of distribution, where a cycle is 2 months (from May-Jun 2016 to Sept/Oct 2017).

We calculated a number of features for the supply chain data.

***Method Ratio* by Commodity,** as a measure of skew. For example, if half of the total CYP provided by the Area was from Injectables, we would have an Injectables Ratio of 0.50.

Inventory Turns. An inventory turn ratio reflects how often commodity is turning over, rather than being held in the warehouse. The formula is for a set period:

$$\frac{Total\ Consumption}{Average\ Inventory}$$

When Inventory Turnover is close to the number of periods (in our dataset, 9) then commodity is being turned over regularly as planned. Where Inventory Turns are lower (less than 6), inventory is accumulating without being distributed. If Inventory Turns are high (greater than 11)

then inventory was moving faster than planned. The outcome is the sites are consistently entering the safety stock and there is a greater risk of a stock out.

LIMITATIONS

The project has several limitations that affect the analysis based on data availability and quality.

First, commodity data is limited to PEPFAR-funded commodities and Global Fund-provided commodities (Nigeria). Family planning can be obtained on the private market or through other major donors, such as Marie Stopes International. We were not able to obtain data within the timeframe of the study.

Second, our estimation of demand is an approximate. We rely solely on the DHS data, which has several important limitations.

The last DHS survey was completed in 2013, which is now 4 years behind the frame for commodity data. Over that time, campaigns and services improvement likely increased the provision of commodities.

- DHS is only representative at the DHS region level. While we have imputed values to the LGA level from GIS topographical files, these are not statistically representative at the LGA level, and were only used as a relative indictor within the prioritization score.

- DHS data on Unmet Need and Demand Satisfied covers only married women and women in union. Therefore, it may understate demand from unmarried women. Also, Demand Satisfied only represents the demand for modern contraceptive methods.

- Nonresponse bias may understate the demand in northern Nigerian households, as suggested in a recent study. Some populations are reticent to express demand for family planning.[1]

ANALYTIC WORKBENCH

To preprocess, clean, and run analysis a workbench was created using OSS Orange. The aim was to create a replication & reusability process. Input data passes through a process flow that performs the necessary selection, cleaning, and feature variable creation to generate a standardized dataset used for data analysis. Data preprocessing and analysis can then be replicated with another country by changing the source of the input data (eg.: Nigeria to Mali). Some review and adjustment will be needed to account for data issues specific to the new data. However, using the flow allows for a repeatable and automated data cleaning process which produces a standardized dataset. This saves time and effort for other countries to explore demand/supply of family planning commodities.

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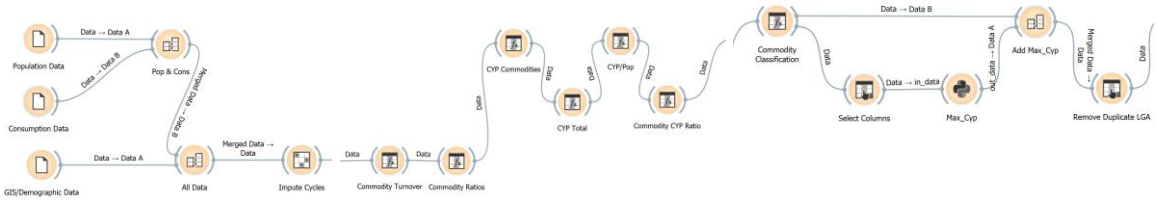
[1] See further Health Communication Capacity Collaborative, Assessment of Family Planning Use in Bauchi and Sokoto States, Nigeria. July 2015. http://healthcommcapacity.org/wp-content/uploads/2015/08/HC3-FP-Assessment-in-Nigeria-Revised-24_Jul15.pdf

There are 3 categories of input data used in the workbench: Consumption, Demographic, and Population data. Figure 5 below contains the data sources and the input data loaded into the workbench.

Figure 5: Input data/feature variable construction



DESCRIPTIVE FINDINGS

At the outset of the project, our goal was to document relationships between Supply and Demand. We began by comparing these two approximations in a matrixed format – comparing demand Indicators (DHS survey results) to CYP-adjusted Commodity Distribution along a continuum of low to high. In Nigeria, we did that at the Region and LGA level as illustrated in Figure 1.

Figure 6: Data Sources by Type

Under Ordering Relative to Demand: LGAs that fall in the bottom right hand corner will have Low Distribution and High Demand. This shows it is unlikely that the potential for family planning need is being fully met by the current supply chain. This may be due to the sheer volume of commodities or suboptimal method mix. The outcomes are a greater risk of stockouts and continuing unmet need.

Over Ordering Relative to Demand: LGAs that fall in the top left-hand corner will have High Distribution and Low Demand. This represented a different scenario, since commodity exceeded the measures of demand. It is possible there is an oversupply or change in demand. The likely outcomes are greater chances of expiry and the potential need for advocacy actions for family planning.

Additionally, we reviewed two ways to classify LGA's method mix. What is the current method mix and is the method mix changing? Identifying the current method mix was based on CYP to determine if a dominant method existed. We reviewed two measures – one adjusted by the traditional CYP and another adjusted CYP to be within the timeframe of the analysis period (May 2016 to Oct 2017). The adjustment was for long lasting methods that had a CYP value that would continue beyond the analysis period. It is recognized that this approach has limitations. However, the goal was to understand the impact of the dispensed commodities within the period of analysis. The impact is that the second measure softens the sharp distinction in LARC vs. short term commodities.

The second way we classified method mix was by pairing method mix with inventory turnovers. Inventory turnover helped to identify which of the four major methods were being utilized the most. If one commodity had a higher turnover rate than the other commodities, this would indicate that the method mix is skewed toward the method with the higher turnover rate. If all methods had the same turnover then supply is matched demand across methods, indicating that

the method mix is stable. Note that if the mix is already skewed then the mix will remain skewed. This method identifies whether the method mix is changing or remaining stable.

Our analysis is presented in a series of business questions below.

1. Which LGAs have the prioritization?

Supply chain data was the source for determining actions based on inventory turnover, CYP ratios, and primary method classifications. Data from demographic and family planning indicators were utilized to prioritize where to target actions. The method used was a weighted ranking system. The external data included in the ranking system was demand satisfied percentages, unmet need percentages, and modern contraceptive age (15 – 49) population.

The indicators were categorized ranging from very low to very high. This was done using natural breaks from a frequency distribution of each indicator. Indicators and the categories were then given different score weights. All the scores were added to produce a total LGA score of a particular LGA. The higher the score for an LGA the greater the importance should be placed on the actionable decision associated with the LGA. Figure 7 below shows the categories for demand satisfied, unmet need, and contraceptive age population.

Figure 7: LGA Score weighted categories

	< 15,000	15,000 – 50,000	50,000 – 100,000	> 100,000
	Very Low	**Low**	**Moderate**	**High**
15 – 49 Pop	1	2	3	4

	< 12%	12 – 18%	18 – 22%	22 – 26%	> 26%
	Very Low	**Low**	**Moderate**	**High**	**Very High**
Unmet Need	1	2	3	4	5

	< 15%	15 – 30%	> 30%
	Low	**Moderate**	**High**
Demand Satisfied	1	0	-1

Total Score = 15-49 Female Pop + Unmet Need + Demand Satisfied

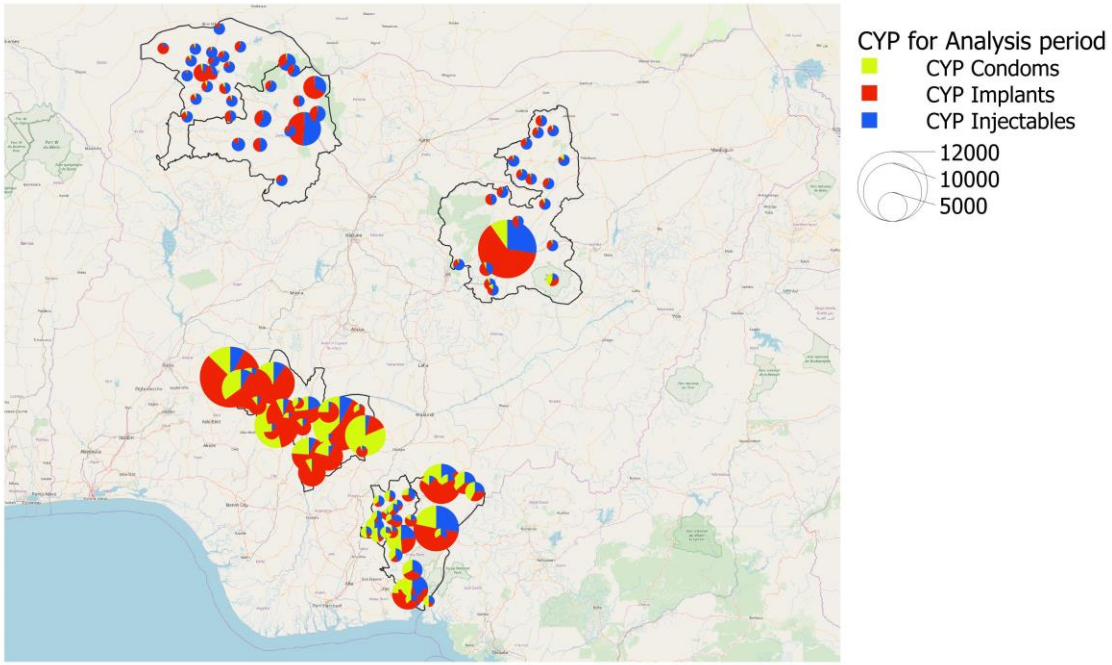
An example of an LGA with a modern contraceptive population of less than 15,000 people, an unmet need of less than 12 percent and a demand satisfied greater than 30 percent would result in a total score of 1 (or 1 + 1 – 1). An LGA score of 1 is the lowest possible score and would result in this LGA being prioritized last in making an actionable decision. A smaller population, low unmet need percentages, and a high demand satisfied indicates a lesser likelihood of impact as compared to other LGAs with a higher total score. Total scores are representative of the culmination of weighted categories. A low score translates to an LGA which has a lower prioritization than other LGAs with a higher score while a high score LGA takes precedence over lower score LGAs. The weighted scores assigned to each category are adjustable by the user, to better represent the weight of each variable in determining the prioritization.

2. How does this distribution vary by method mix?

The mapping of method mix distributions reveals clusters of LGAs with ratios of family planning commodities. In Figure 8 we show levels of CYP for the analysis period among the top 3 methods and their distribution. The notable patterns show implants are evenly distributed across the 6 states and injectables are more prevalent in the northern states while condoms are more prevalent in southern states.

Additionally, the use of CYP commodity ratio variables (calculated as CYP provided by commodity/Total CYP) identifies which family planning methods are contributing the highest percentage of CYP in each LGA.

Figure 8: CYP Distribution (3 major methods Condoms, Implants and Injectables)



2. Is distributed inventory moving quickly to the Customer?

While CYP ratios are great indicators of determining what modern contraceptive commodities are providing the most protection/value towards CYP, it does not provide information on the velocity at which health commodities are moving to and from the shelves of health facilities. Inventory Turnover determines the velocity of health commodity movement and if consumption is at pace with supply (stock on hand) the result of the equation should be a number close to the number of cycles. If demand is greater than stock on hand the result is a number greater than the number of cycles while if demand is less than stock on hand the result is a number less than the number of cycles. Figure 9 below shows a frequency distribution of Implants Turnover grouped by state.

Figure 9: Frequency Distribution of Implants Turnover grouped by State

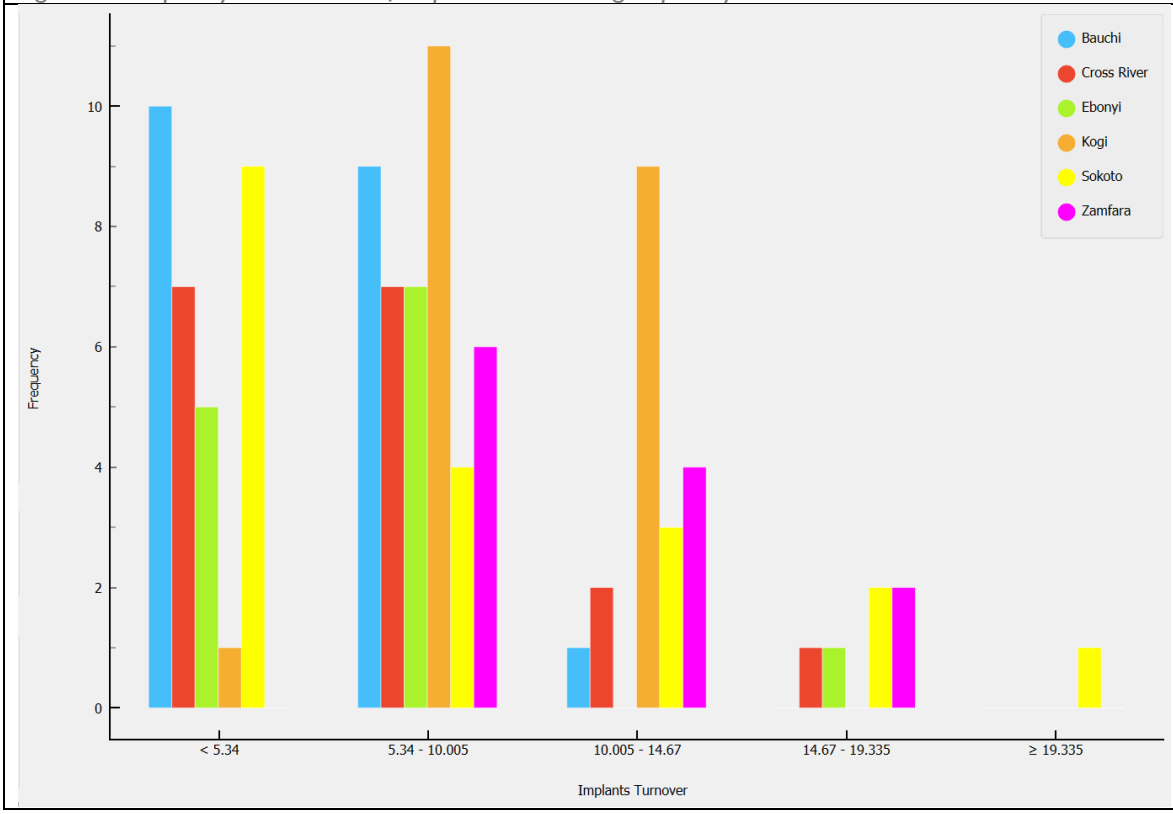


Figure 9 shows the frequency distribution for implant turnover rates. Implants turnover rates were roughly distributed from 5 to 14. Where inventory turnover is greater than 14 the data should be verified. This would indicate a possible data issue as the commodity is moving far greater than planned. In general, Bauchi has a lower turnover indicating that implants are not moving in Bauchi while Zamfara has a higher movement of Implants, followed by Kogi. Sokoto has LGAs with high and low distribution. Both Cross River and Ebonyi are predominately areas where the movement of implants are low or as planned.

Figure 10: Frequency Distribution of Injectables Turnover grouped by State

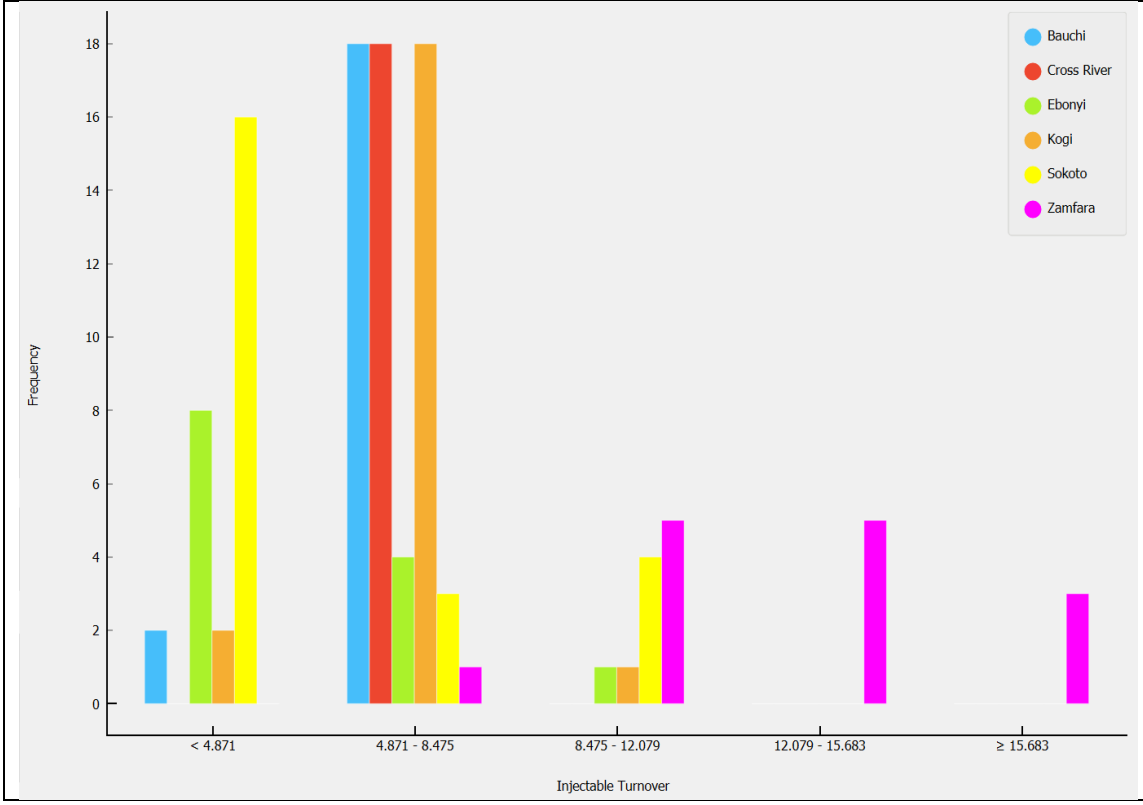


Figure 10 shows the frequency distribution of injectable turnover rates. Injectable turnover rates on average were lower than implants turnover rates. Zamfara has the highest turnover with higher rates of injectable turnover than Sokoto, even though they are neighboring states. The higher rates of inventory turnover for injectables are mainly present in Northern states such as Sokoto and Zamfara, while southern states have lower injectable turnover rates.

Figure 11: Frequency Distribution of Condoms Turnover grouped by State

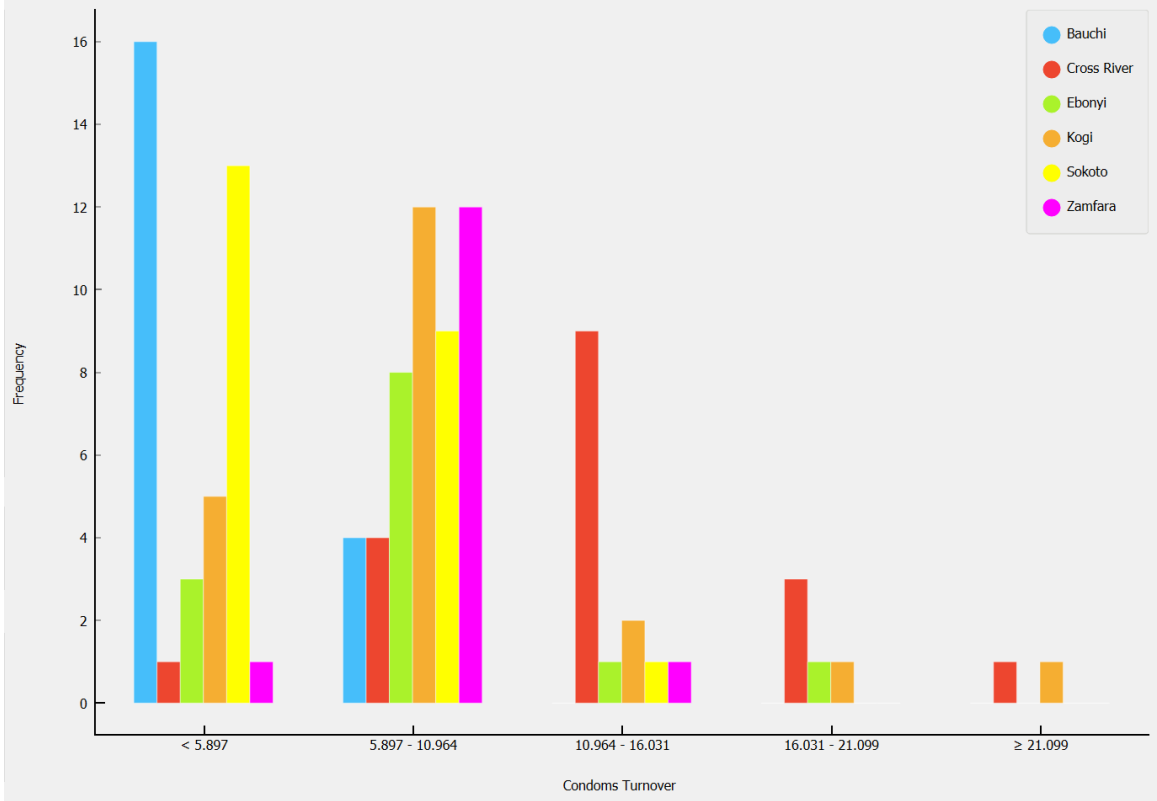
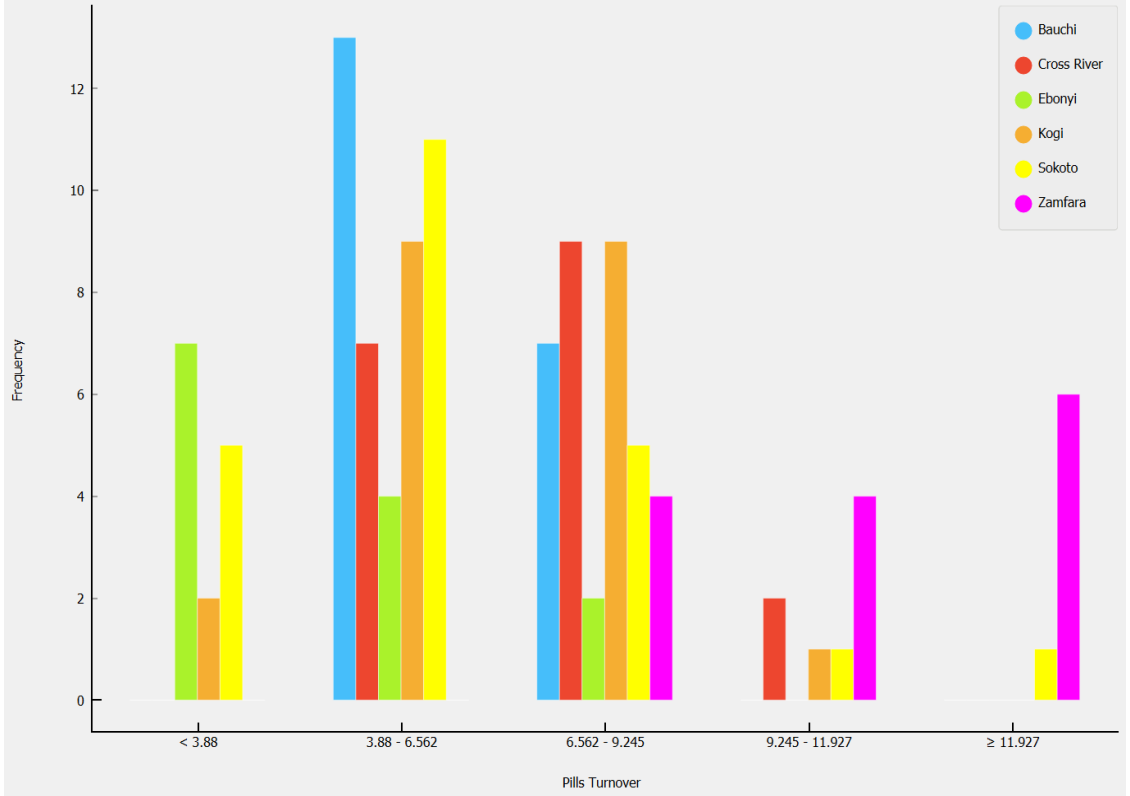


Figure 11 show the frequency distribution of condoms turnover rates. The northern states of Bauchi and Sokoto have low condom turnover, while Zamfara had a more planned distribution. High condom turnover rates are largely confined to Cross River while Zamfara, Kogi, and Ebonyi had a moderate or as planned condom turnover ratio. Bauchi and Sokoto had relatively low turnover rates.

Figure 12: Frequency Distribution of Oral Contraceptive Turnover grouped by State



The last method inventory turnover rates were calculated for was oral contraceptives/pills. In general, oral contraceptive pills had the lowest average inventory turnover rates compared to all other types of commodities. High inventory turnover rates for pills were very similar to injectable turnover rates, with Zamfara having the highest. The remaining states inventory turnover rates were close to planned or low. Ebonyi had the lowest inventory turnover rates.

RECOMMENDED ACTIONS

Both supply chain data and demographic data were utilized to transform informative data into prioritized actionable opportunities to support data driven decision-making. The actionable decisions were divided into three categories: Increase Advocacy, No Action, or Increase Product. These three decision categories were then ranked on a prioritization scale based on demographic and family planning indicators that informed on which LGAs to prioritize.

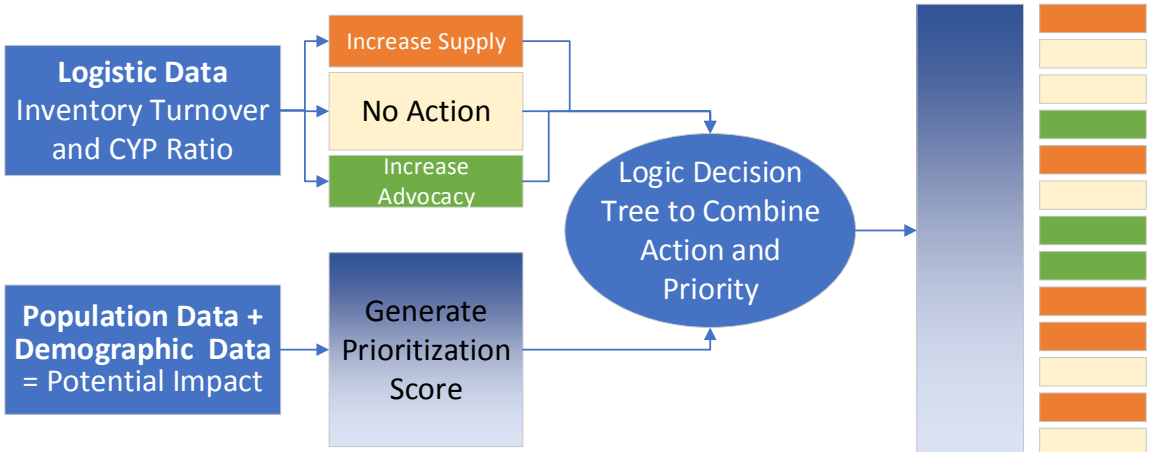
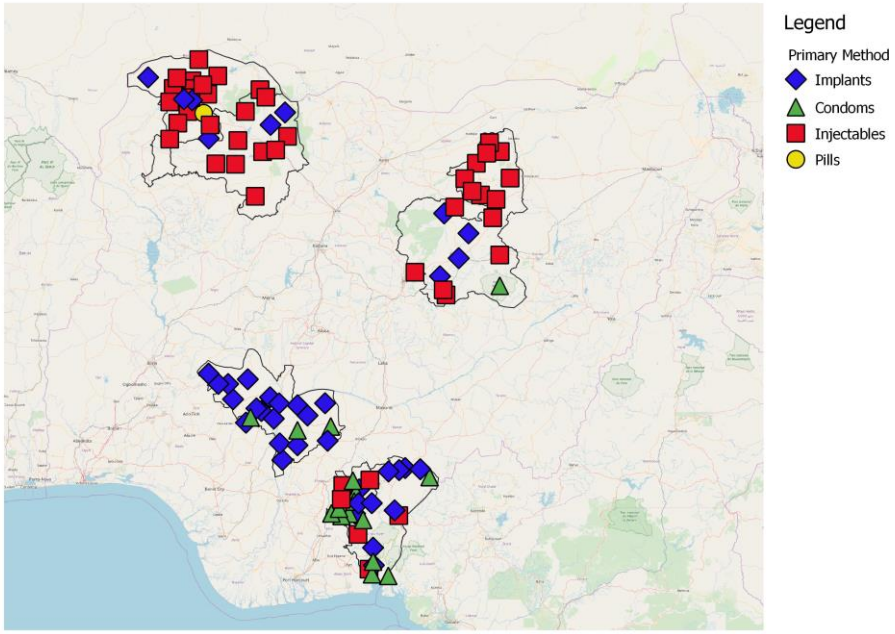


Figure 13: Action and Prioritization Logic Tree

In this pilot study the focus within LGAs was to determine the primary contraceptive method for each LGA. The primary method was the method with the highest CYP ratio/percentage of total CYP value within the LGA. The contraceptive methods identified were condoms, implants, injectables, and oral contraceptive pills. However, pills were the only primary method in one LGA, and thus the focus for the pilot was on implants, injectables and condoms. Figure 14 below represents the primary method for each serviced LGA. The same analysis could be done for the secondary methods.

Figure 14: Primary method of each LGA



Inventory turnover rates for the primary product were determined in each LGA. The turnover rates were classified from Very low, Low, Moderate, and High. These classifications, based around the expected inventory turnover rate of 9, are shown in figure 15 below.

Figure 15: Inventory Turnover Classification Chart

	Very Low	Low	Moderate	High
Inventory Turns	<= 4	<= 7	<= 10	> 10

With nine supply cycles of data, categorical bins represent inventory turnover rate groups. An inventory turnover rate less than or equal to four were considered very low. This indicates little to no consumption in comparison to supply (i.e. product sitting on shelves). Less than or equal to seven turns implied consumption/demand of commodity but still at a slower pace than supply. Moderate or less than or equal to 10 turns demonstrated movement of commodities at a pace that is consistent with supply (i.e. the ideal category). Greater than 10 turns displayed high amounts of commodity movement, in which the commodity was consumed at a rate faster than it was being supplied (i.e. consistently using safety stock and risk of stock outs). As stated earlier, if turnover rates were over 14 then the data should be verified, as this would indicate commodity is moving at a far greater pace than planned.

Once inventory turns are classified, actions are determined for each LGA which are dependent on inventory turns for commodities as well as the primary method. As mentioned above the actions include increase advocacy: slow inventory turn rates for primary commodity translating to a greater advocacy for family planning, Adequate: inventory turn rates for the primary method are consistent with the number of cycles, suggesting the flow of commodity is meeting demand and no additional action is needed, and Increase Product: inventory turn rates for the primary method are greater than the number of cycles suggesting demand/consumption is greater than supply and product should be increased. Figure 16 below shows an example of hypothetical LGAs with inventory turn classifications, actions, and primary commodities surrounded in red brackets.

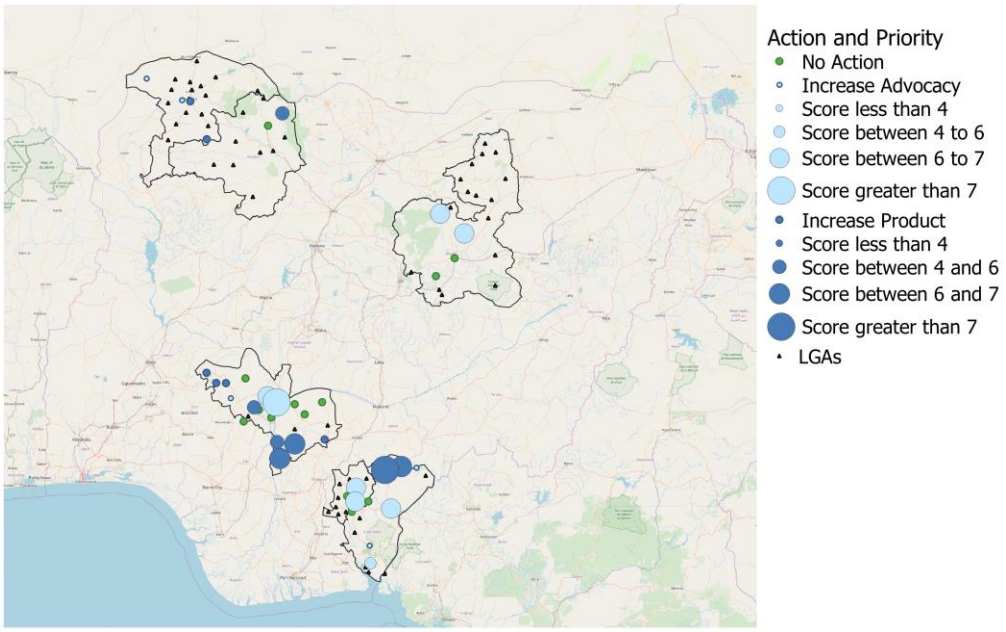
Figure 16: Example Action Classification Chart

LGA	Condoms	Oral	Injectables	Implants	Action
LGA 1	Low	Low	High	Low	Increase Advocacy
LGA 2	Moderate	Moderate	Moderate	Moderate	Adequate
LGA 3	High	High	High	Moderate	Increase Product

40 out of the109 LGAs had implants as the primary method. Within these 40 LGAs, the three actions were evenly split. The increase product action was prioritized for Belwarra, Yala LGAs (Cross River) and Lgalamela Odola (Kogi). Kogi state had eight of the 13 LGAs labeled as increase product. For increase in advocacy Lokoja in Kogi had the highest priority. A total of seven out of 13 LGAs marked for increase advocacy were also high priority LGAs. This indicated that in some LGAs, implants were not moving as quickly as they were demanded. Finally, eight out of the 14 LGAs labeled no action were also high priority. This indicates that the supply chain is working as planned and is meeting the demand for implants in high priority areas.

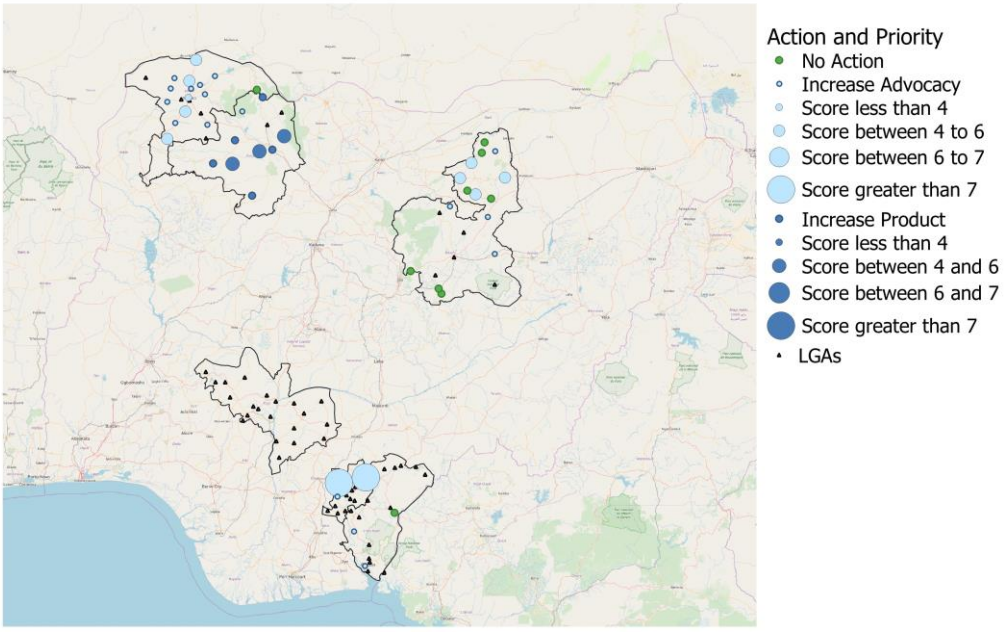
There is a diversity in needed actions as well as where the actions are needed. See Figure 17 for the distribution of suggested LGAs for targeted actions by implants.

Figure 17: Action Items and LGA scores (Implants)



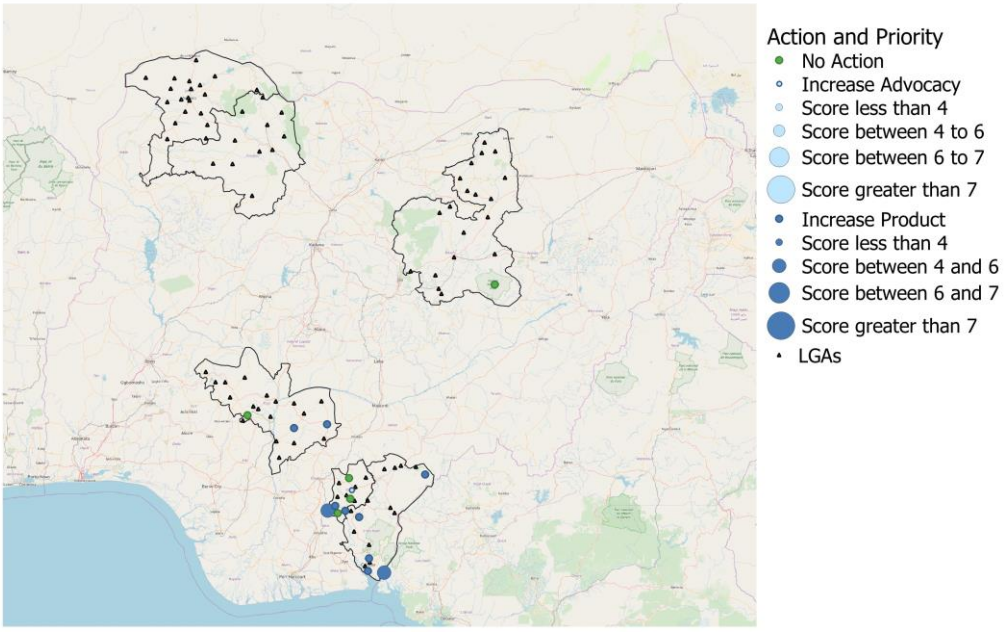
Injectables were the primary method for 45 of the 109 serviced LGAs. Within the 45 LGAs there was a skew to increase advocacy. Increase product was only found in Zamfara prioritizing for Bukkugum, Gusa and Maru LGAs. For increase in advocacy Sokoto had 14 of the 28 LGAs. This is interesting given that Sokoto and Zamfara are neighboring states. The high priority LGAs for Increase advocacy were Darazo (Bauchi), Biase (Cross River) and Ishielu and Izzi (Ebonyi). Finally, only nine LGAs were labeled as no action with only one being labeled as high priority. This indicates that other than Zamfara, many LGAs have a low injectables turnover rate. See Figure 18 for the distribution of suggestion LGAs for targeted actions.

Figure 18: Action Items and LGA scores (Injectables)



Where condoms were the primary method, the analysis identified the primary method was condoms for 16 of the 109 LGAs. Within these 16 LGAs there was a skew to increase product. Increase product was labeled for 10 LGAs all of which were found in three southern states including Cross River, Ebonyi and Kogi. Odukpari, Yakurr (Cross River), and Aukpa (Kogi) were the prioritized LGAs. Only 1 LGA was labeled Increase Advocacy which was Ezza North (Ebonyi). 5 LGAs were labeled as no action with three being labeled as high priority. This indicates condoms are mostly present in the southern states and are moving faster than planned. As identified earlier some of the inventory turnover rates might be too high and need to be verified. See Figure 19 for the distribution of suggestion LGAs for targeted actions by condoms.

Figure 19: Action Items and LGA scores (Condoms)



CONCLUSION

The findings of the study were two-fold, showing that the pattern of need for actions within the supply chain indicated the value of a targeted approach and that combining different data sources which provide different contexts assists in targeting actions. In this case, the supply chain data helped to identify the action and the demographic data prioritized the action. The purpose of the study was to identify a repeatable way to help decision makers better target their limited resources and aim to increase their impact on improving the family planning supply chain.

The next step would be to further validate results with field participants to determine how findings are turned into actionable actions on the ground. Beyond Nigeria, this project will provide a reusable Analytic Workbench – a set of code and analyses - that can be applied in other countries. This will allow for better targeting of actions to improve effectiveness of in-country supply chains. Additionally, this approach can be used to monitor the impact of actions over time and assist in determining where future actions are needed.