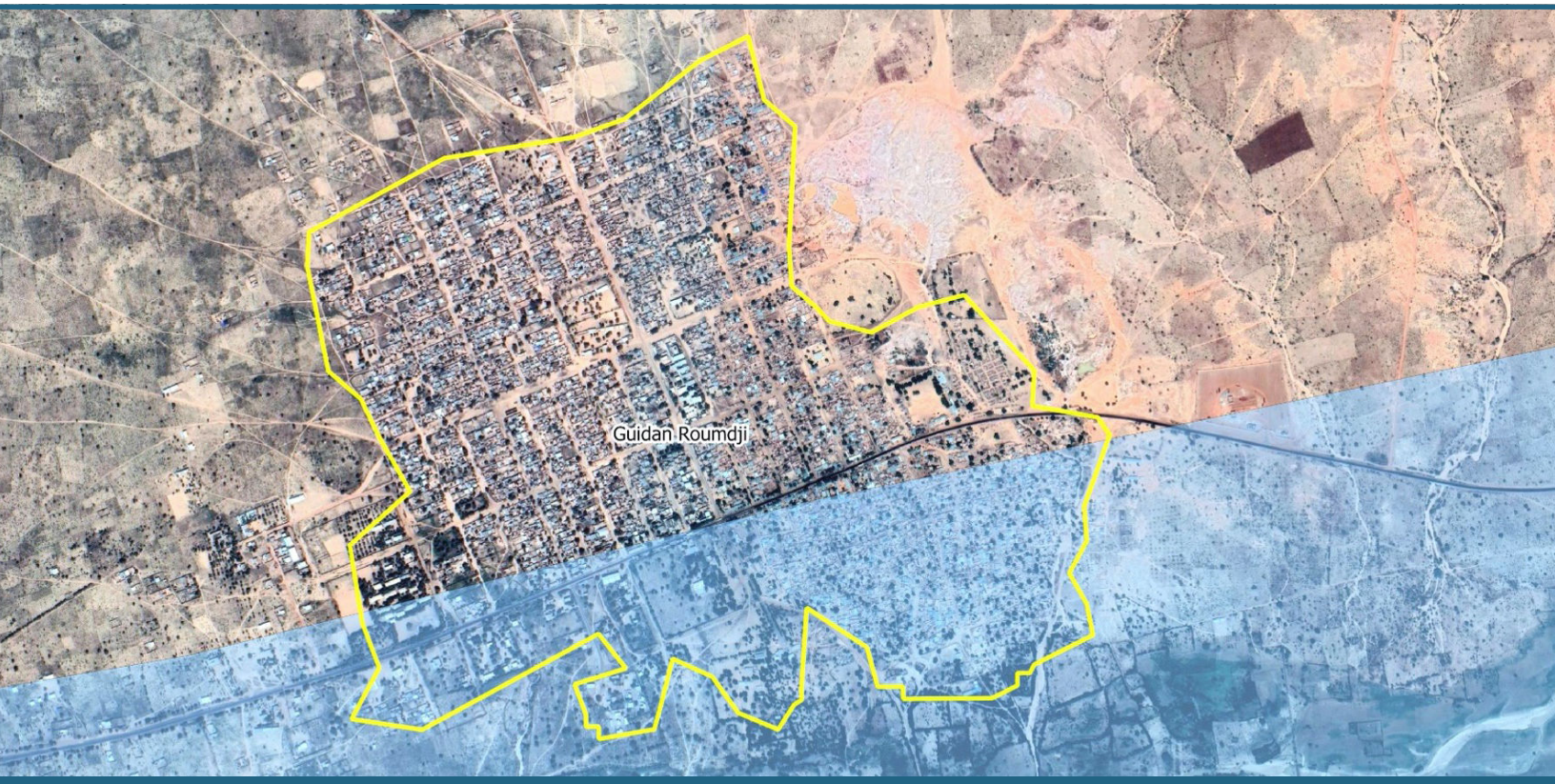


How to Strengthen Market-Based Sanitation Strategies Using a Geographic Information System

DECEMBER 2021

This learning note was developed as part of an applied research project initiated by the USAID Bureau for Humanitarian Assistance (BHA)-funded Practices, Research and Operations in Water, Sanitation and Hygiene (PRO-WASH) Activity and carried out by Population Services International (PSI) and the PRACTICA Foundation. This project aimed to support the BHA-funded Resilience Food Security Activities in Niger to develop a comprehensive market development strategy focused on the availability and supply of improved latrines and handwashing-related products in the Maradi and Zinder regions of Niger. More information and additional learning briefs are available here.

INTRODUCTION

Market research is a vital step in the process of sanitation market development. Market research provides an understanding of the current context and how the systems of supply and demand function. This research also enables the development of appropriate segmentation for around which products and services will be designed.

This learning note presents the main ideas behind a basic approach to using a geographic information system (GIS) to establish geographic segmentation as part of a market-based sanitation (MBS) strategy. Use of a GIS assumes that the most densely populated, most accessible zones are characterized by a more dynamic economy, making them easier to tap into to develop a sanitation market that is currently nonexistent or, at best, barely exists. A GIS facilitates the task of differentiating those dynamic, accessible zones, allowing partners to more accurately target and prioritize their actions.

GIS modeling involves compiling various types of georeferenced data (associated with Global Positioning System [GPS] coordinates) in the form of GIS layers that enable map views and computerized spatial analysis.

In practice, GIS modeling is very useful to diagnostic studies, making it possible to effectively characterize and quantify a situation and communicate certain results in condensed form. GIS modeling also helps with the design of MBS actions, for which the definition of target segments and strategies must account for geographic constraints that have an impact on demand and on supply chains.

All of the tools and data sources presented here are open-source and accessible, including for people who have no prior experience with GIS.

REQUIRED RESOURCES

As using GIS has become simpler in recent years, anyone who has a basic understanding of the process, knows how to use spreadsheets (**Google Sheets**), and is prepared to learn to use basic GIS software (**QGIS** and **Google My Maps**), can now develop GIS models. Many **tutorials** are available online to help people learn the basics of these intuitive, user-friendly tools. In particular, PRO-WASH has created tutorials on using mapping functions to develop the sanitation market (such as **Creating Sales Zones and Locate Points on MyMaps**).

The following equipment is required, at a minimum:

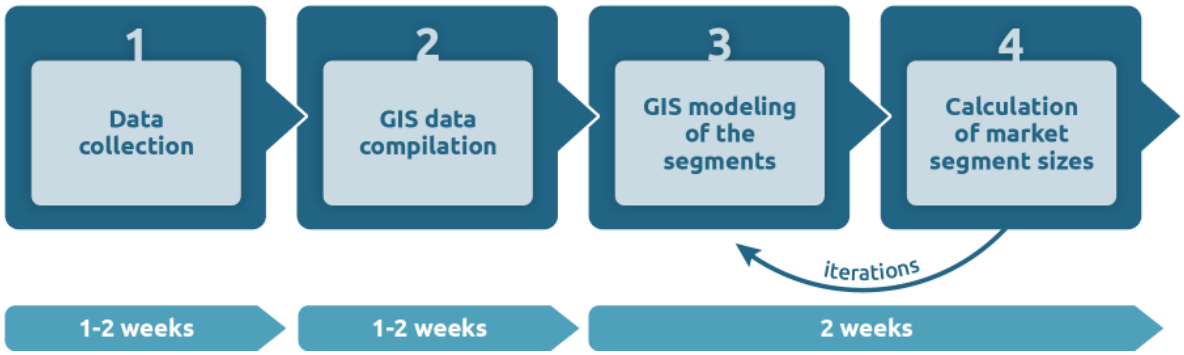
- A computer that is powerful enough to run QGIS (minimum configuration: Intel Pentium 4 or compatible / Intel Dual Core or compatible, NVIDIA or ATI OpenGL graphics card, 4 GB RAM, 2 GHz processor)
- A conventional 4G or ADSL/Fiber internet connection, for exchanges of potentially very large data layers

Producing relevant maps requires contacting local partners (NGOs, decentralized technical services, etc.) that can facilitate access to source data and confirm or refine the different GIS layers based on their practical knowledge.

STAGES

Creating a GIS model involves four stages, potentially with a few iterations. The process should lead to a definition of market segments, with their sizes assessed as a number of individuals or sales units. The entire process will take place over a period ranging from four to eight weeks (figure 1), depending on data availability and quality.

FIGURE 1. Market mapping stages



Stage 1: Data Collection

The purpose of this stage is to compile a series of reliable data for the study area. This will at least involve (1) population centers (codes, names, locations, buildings, and population); (2) types of topsoil; (3) flood zones; and (4) characterized roads (paved, drivable, and non-drivable). Ideally, these data will be presented in the form of GIS layers (a format that allows data sets to be superimposed on top of one another), although spreadsheets and maps can also be compiled.

To begin data collection, organizations that are likely to have useful data should be contacted first. For the research conducted in Niger, Resilience Food Security Activities and the TerresEauVie Activity were of great assistance. It should be noted that actors who work in other areas beyond sanitation, such as energy, health, the environment etc. may have useful data. It will be essential to contact entities that are active in the geographical zone being studied, because they are the ones most likely to have reliable data, especially with regard to the names and population data for smaller population centers. Whenever possible, data that are incorporated should be consistent with locally accepted information.

At the same time, an internet search can yield useful GIS layers. Many of them are freely available on websites such as Google (satellite views, landmarks, etc.), OCHA (administrative boundaries and roads), **WorldPop** (population distributions), **OpenStreetMap** (roads and buildings) and **ISRIC** (World Soil Information). These sources are constantly evolving and should be checked regularly for the latest updates.

» **At the end of Stage 1, data files have been sorted, referenced, and organized and are ready for GIS processing.**

Stage 2: GIS Data Compilation

Using QGIS will allow the compilation of available GIS layers and produce additional layers by using the available GPS data and maps from a variety of sources (including maps from PDF reports once they have been **georeferenced**).

The goal will be to produce a layer of inhabited areas (with a code or name and population by sex and by age range, if possible) that can be superimposed on top of other layers such as administrative areas, soil types, flood zones, roads, and so on. In QGIS, a layer of populated areas can be superimposed on top of other layers to produce population counts for different categories that are relevant to sanitation issues.

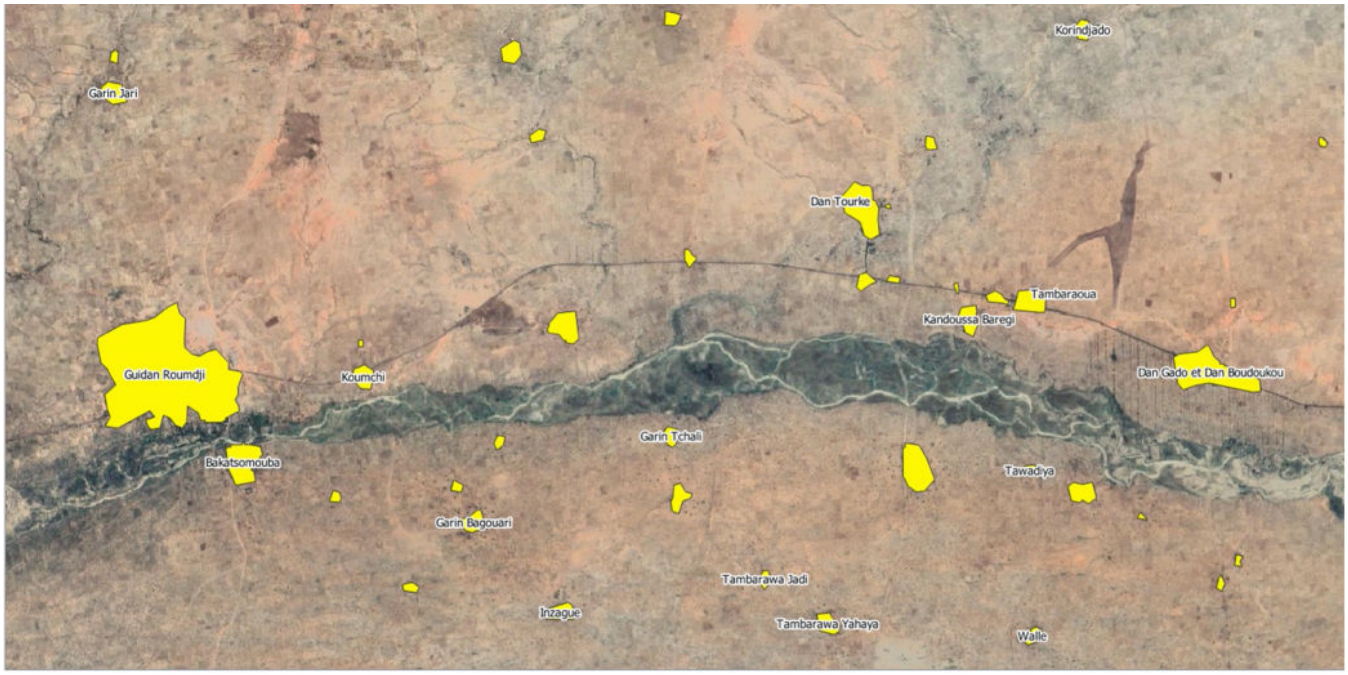
It should be noted that the layers to be considered will vary, depending on the context. In rural areas, where community-led total sanitation has been implemented, the locations of open defecation-free villages will be

relevant. In highly urbanized areas, neighborhoods dominated by homeowners might be differentiated from those dominated by renters. Methods of access to water, which will determine appropriate toilet types, should also be considered.

In practice, it will be essential to prioritize layers that are likely to yield relevant segmentation to prevent the model from becoming too scattered. Considerable time is required to develop reliable GIS layers, so that work should only be initiated when the expected results have the potential to be meaningful.

In some cases it may be helpful to georeference all local hardware stores and distributors of inputs in the areas of study. Later on, this type of layer could facilitate the development of sales areas around those potential partners.

FIGURE 2. Example of a layer of populated areas (in yellow) on top of a Google satellite view



» **At the end of Stage 2, the GIS layer of populated areas and superimposable GIS layers can be used to count populations based on a variety of criteria that are key to the development of the sanitation market.**

Stage 3: GIS Market Segmentation Modeling

A market segment is a group of individuals who are expected to behave similarly in response to a given product or service.

While behavioral segmentation is usually the starting point for developing MBS actions (differentiating households without toilets from those with unimproved or improved but shared toilets), geographic segmentation can serve to supplement and refine the initial behavioral segmentation. It can be useful in two ways:

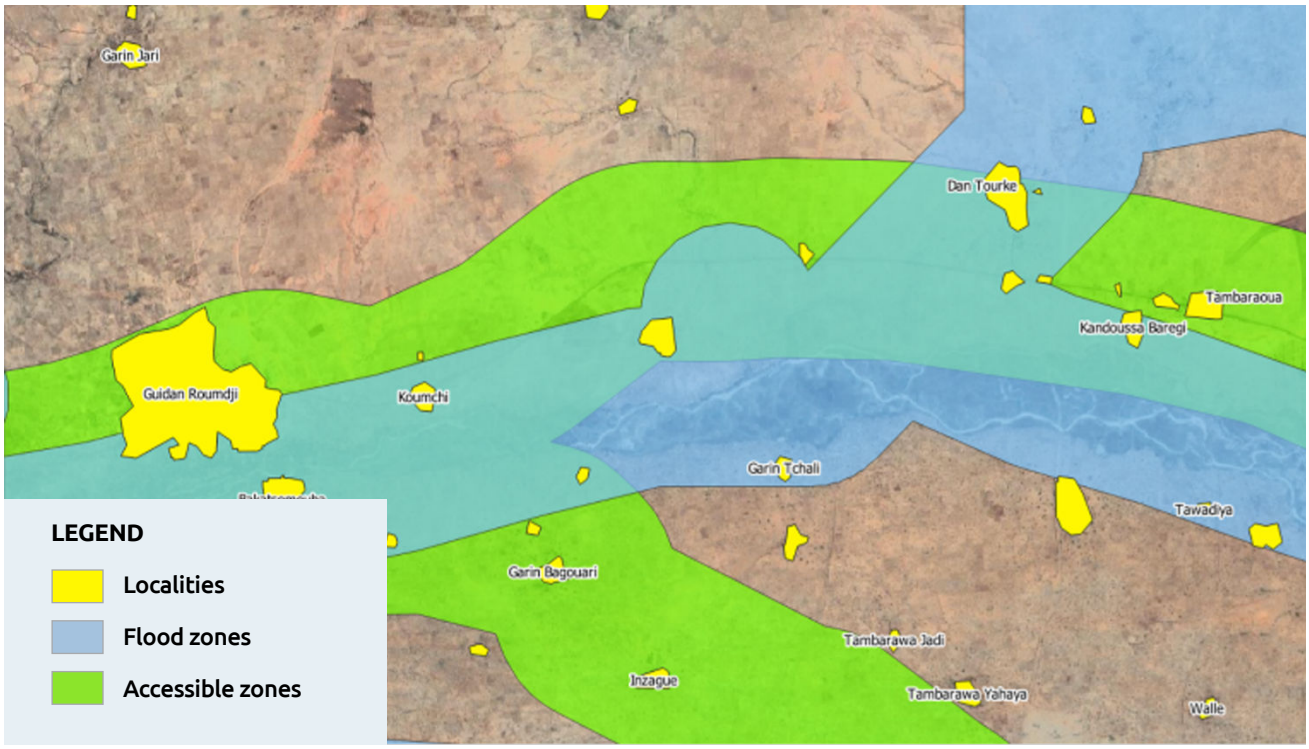
- **Strategically,** it can identify all groups of regions whose households have similar needs and socioeconomic profiles, two factors that have a significant impact on demand. For example, flood zones identify households that have decided to occupy at-risk areas (typically because they had no other choice) and that have specific toilet

needs (accessible during rainfall and sturdy enough to withstand flooding). Likewise, zones with stable soil (where pits can be dug without involving a bricklayer) can be distinguished from areas with loose soil that require more sophisticated inputs and services to dig pits.

- **Tactically,** geographic segmentation can delineate zones where MBS actions would be more effective in view of population density and the accessibility of or proximity to a source of inputs. In Niger, for example, it is easier for a varied, affordable range of products to reach population centers located close to paved main roads than more remote villages that can only be reached by more complicated, costly transportation.

This third stage involves more work that the previous two, because a number of rules and thresholds will need to be defined for the purpose of spatial analysis of the market. Criteria such as accessibility require rules (such as restrictive road types) and thresholds (distances beyond which access is difficult) that must be defined in view of the available sources and in consideration of diverging opinions on the subject. In Niger, a distance of 1 kilometer (0.62 miles) from the main roads (national highways) was identified as the threshold for accessibility or inaccessibility. Likewise, urban villages were differentiated from rural villages based on the area built up in the middle of town, setting 20 hectares (just under 50 acres) as the threshold between the two.

FIGURE 3. An example of superimposed layers: populated areas, flood zones, and accessible areas against a satellite image in the background. This map shows the locations of four household segments: those in non-flood zones that are easy to reach, those in areas that are easily accessible but located in flood zones, those in hard-to-reach non-flood zones, and those in hard-to-reach flood zones.



» **At the end of Stage 3, modeling rules and thresholds will be defined, and the resulting complete GIS file can be used to view the different layers, superimpose them on top of one another, and quantify population segments for each configuration or segment.**

Stage 4: Calculation of Market Segment Sizes

This stage concludes the GIS modeling process by mapping and evaluating the various market segments that have been identified. Based on the final GIS layers, QGIS will quantify the population associated with each segment of interest.

Those numbers can then be exported to spreadsheets for use in various calculations (such as the number of potential sales units based on the rate of access to toilets) and to generate graphs to complement the maps.

For efficiency, all of the produced data can be shared online by using Google Sheets and Google My Maps. Google My Maps portrays GIS layers against a Google Maps background and makes those layers accessible via links or can even make them public. Furthermore, publishing the maps enables the use of those data at a later date. For example, they may be useful during for planning or assessments.

FIGURE 4. Example of market modeling outputs for the Maradi and Zinder regions (Niger). This graph shows the sizes of the different market segments that were assessed (households with unimproved or shared toilets, and households without toilets or those that practice open defecation [OD], in terms of needs and the required number of toilets.

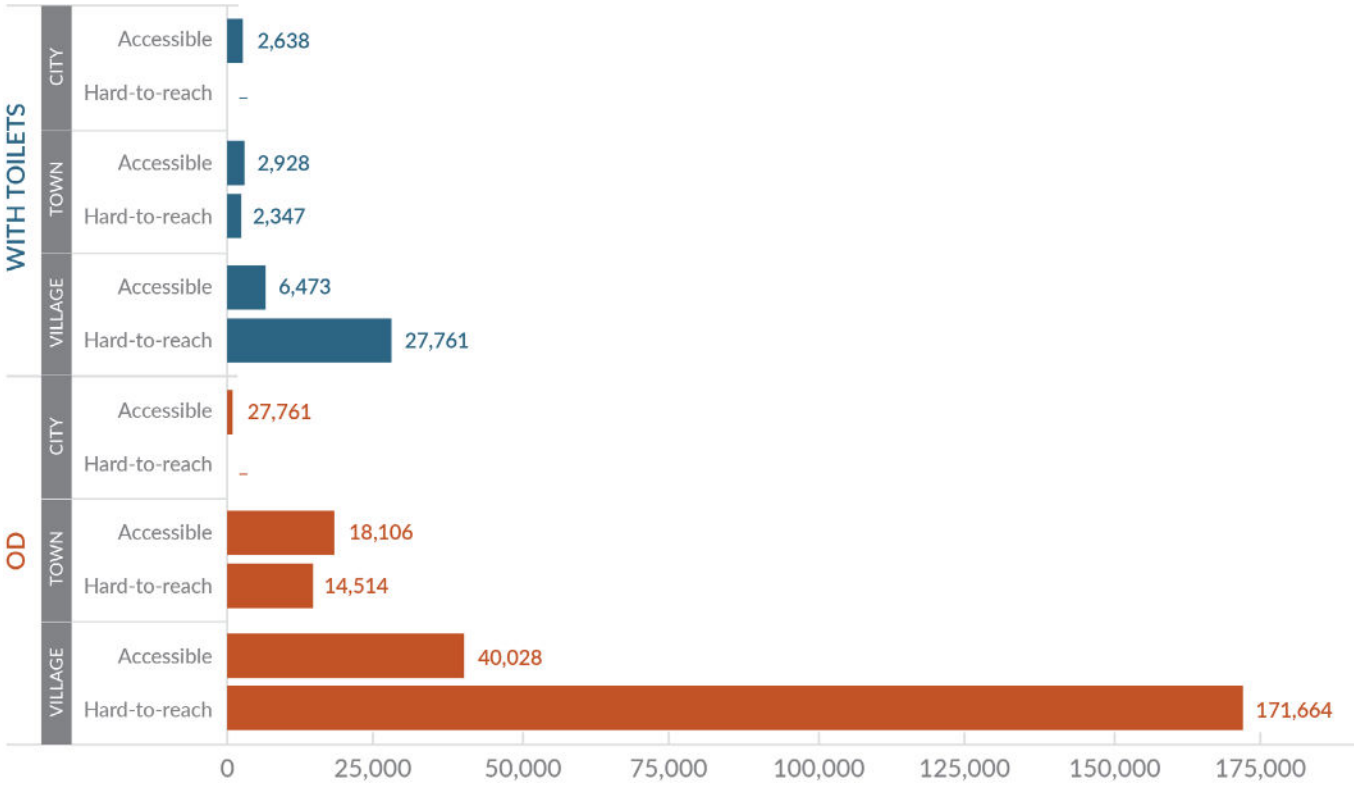


FIGURE 5. Example of market modeling outputs for the Maradi region (Niger). The segments targeted by the partners' chosen strategy are localized on the map (accessible towns), which also shows the cities on which supply chains can rely (link to the online map).

In some instances, iterations may be necessary at this point. This is because certain rules and thresholds can result in excessive estimates due to the model's sensitivity. The different iterations will serve to adjust those figures until images appear realistic to specialists. For example, if the model indicates that 15 percent of the population is "accessible" at a threshold of 1 kilometer from a main road and 30 percent at a threshold of 1.5 kilometers, then that threshold should be adapted in order to strike a balance. In marketing, the goal is to make strategies applicable to as many people as possible in a given market segment. In that case, doubling the population size of the accessible segment by expanding the threshold by a mere 500 meters is an efficient strategy that should be considered.

» **At the end of Stage 4, the finalized GIS file will contain all of the layers needed to model the market, refined by various iterations. The key segments' populations are mapped, quantified, and included in spreadsheets and graphs. These will be useful during the assessments, design, and planning phases of MBS, along with the subsequent implementation phase.**

CONTACT INFORMATION

PRO-WASH
Nicole Weber, Director, PRO-WASH
nweber@savechildren.org
www.fsnnetwork.org/PRO-WASH

PSI
Jennifer Marcy, Senior Manager, WASH
Jmarcy@psi.org

PRACTICA Foundation
Xavier Gras, Sanitation Expert
xavier@practica.org

ABOUT PRO-WASH

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