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Sanitation Service Delivery in West Africa: Report to PSI on Product Scan Findings

Benin

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WSUP Water & Sanitation for the Urban Poor

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Acronyms

ABMS	Association Béninoise pour le Marketing Social et la Communication pour la Santé
CFA	Central African Franc
CISE-SARL	Compagnie d'Ingénierie Sociale et Environnmentale
DCAM Bethesda	Développement Communautaire et Assainissement du Milieu Bethesda
DGA	Direction Générale de l'Assainissement
DGE	Directorate General of Environment (Direction Générale de l'Environement
DHAB	Direction de l'Hygiène et de l'Assainissement de Base
DNSP	Direction Nationale de la Santé Publique (National Directorate of Public Health)
Eawag	Swiss Federal Institute of Aquatic Science and Technology
FS	fecal sludge
FSM	fecal sludge management
IBP	Industrie Béninoise des Plastiques
JMP	Joint Monitoring Programme (WHO and UNICEF)
MDG	Millennium Development Goal
NGO	nongovernmental organization
PLB	public latrine block
PSI	Population Services International
PVC	polyvinyl chloride
SDGs	Sustainable Development Goals
SIBEAU	Société Industrielle d'équipment et Assainissement Urbain
SONEB	Société Nationale des Eaux du Bénin (National Water Company of Benin)
SSD	Sanitation Service Delivery
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VTO	vacuum truck operator
WHO	World Health Organization
WSUP	Water & Sanitation for the Urban Poor

Background

The West Africa Sanitation Service Delivery (SSD) project is a USAID-funded five-year grant for Population Services International (PSI), PATH, and Water & Sanitation for the Urban Poor (WSUP) to improve sanitation outcomes through developing and testing scalable, market-based models in Ghana, Benin, and Côte d'Ivoire that increase access to improved sanitation and fecal sludge management (FSM) and contribute to structural change within West Africa's sanitation sector.

PATH's role in the SSD project is to apply its expertise in product development, as well as financing, to accelerate market-based solutions and build partner capacity in these two technical areas across the project countries. PATH's product development activities are designed to support the development of new business models and the scaling of appropriate and affordable sanitation solutions in Ghana, Benin, and Côte d'Ivoire.

The objectives of the product development work are as follows:

- Develop and validate *new and/or improved latrine designs.*
- Develop and validate *new and/or improved FSM options/products*.
- Contribute to SSD *knowledge management and dissemination activities*.

This report provides an overview of the product scan in Benin and includes a summary of findings, a discussion of potential product development opportunities, and recommendations for next steps.

Study objectives

The first step in the product development process is a product scan, which was conducted in Benin in October 2015. PATH also conducted product scans in Côte d'Ivoire and Ghana in June 2015. In Ghana, we concentrated on identifying sanitation technologies, products, and services that could potentially be adopted in and/or adapted for Côte d'Ivoire and Benin.

The product scan in Benin focused on the following questions:

- *Existing facilities and services*: What products/technologies are currently being used (from end user interface through storage, transport, and treatment to processed fecal sludge [FS] use and/or disposal)?
- *End user needs*: What do end users want/need around sanitation and FSM technologies?
- *Supply chain:* Where and how are these products/technologies being manufactured, serviced, and sold?
- *Opportunities and actions*: What, if any, opportunities are there for product adaptation/adoption, replication, and/or trial? And, what are the best next steps?

Frameworks

The study team framed the findings, opportunities, and recommendations from the product scan activities using existing frameworks used from the sanitation sector. These frameworks provide a structure for understanding national and international indicators for monitoring progress on reaching sanitation goals, the complexity of sanitation systems, and incremental steps that can be taken for improving the quality and safety of sanitation systems and services.

Improved sanitation: the Joint Monitoring Programme sanitation technology ladder

The Joint Monitoring Programme (JMP) sanitation technology ladder was developed by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) in 2008 to establish standard categories to aid in monitoring progress toward the achievement of the Millennium Development Goal (MDG) for improved sanitation.[1] This ladder allows for more nuanced categories of sanitation standards than simply a pass/fail metric. The JMP used a four-rung ladder for measuring progress on the MDGs with the following definitions:

- **Open defecation:** When human feces are disposed of in fields, forest, bushes, open bodies of water, beaches, or other open spaces or disposed of with solid waste.
- **Unimproved sanitation facilities:** Do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines, and bucket latrines.
- **Shared sanitation facilities:** Sanitation facilities of an otherwise acceptable type shared between two or more households. Only facilities that are not shared or not public are considered improved.
- **Improved sanitation facilities**: Are likely to ensure hygienic separation of human excreta from human contact (examples of sanitation facilities that are classified as improved are described below).

One of the outcomes of the SSD project is to increase access to *improved sanitation*, which includes the following six types of sanitation facilities according to the JMP framework:

1. Piped sewer system
2. Septic tank
3. Pit latrine
4. Ventilated improved pit latrine
5. Pit latrine with slab
6. Composting toilet

While it is important to understand the JMP definition of *improved sanitation*, it is also important to recognize that there is an ongoing debate about this definition and the resulting influence on the MDGs and post-2015 targets and indicators for sanitation. The MDGs were recently replaced with the Sustainable Development Goals (SDGs), which were launched in September 2015. The Sustainable Development Solutions Network released a new set of indicators and a monitoring framework in its recent report, *Indicators and a Monitoring Framework for Sustainable Development Goals: Launching a data revolution for the SDGs*, which is available online and will be updated periodically.[2] Presently, indicator 46, "Percentage of population using safely managed sanitation services, by urban/rural," continues to identify adequate services according to the JMP definition, thus excluding sanitation facilities that are shared with other households. However, because of the increasing reliance on shared sanitation facilities and the variance in types of shared sanitation facilities, the debate continues about the suitability of shared sanitation. Global health leaders are calling for further research to evaluate instances in which shared sanitation facilities may be able to effectively separate excreta from human contact, and ensure that excreta do not re-enter the immediate environment.[3,4]

The Swiss Federal Institute of Aquatic Science and Technology sanitation service chain

PATH used the sanitation system template developed by the Swiss Federal Institute of Aquatic Science and Technology (Eawag) to organize and present the results of the product scan and to identify gaps in the system and recommendations to address those gaps. In the second edition of Eawag's *Compendium of Sanitation Systems and Technologies*, the authors describe sanitation as a multistep process of managing waste from its point of origin at the user interface through the sanitation system to disposal and/or reuse.[5]

According to this model, the sanitation system consists of input and output "products" (such as feces and blackwater, urine, flush and washing water) which move through "functional groups" (such as "user interface") within the system via technologies (such as "pour-flush toilet"). Eawag's model provides a holistic framework for considering the logical combination of technologies within the sanitation system as well as the impact of technologies on the movement of "products" through the system (see Figure 1 below). Eawag identifies nine sanitation system templates in their compendium, although they note that other combinations of technologies may be configured.

Throughout this report, PATH uses this framework to map the technologies that were included in the product scan and the opportunities that were identified as a result of this work.

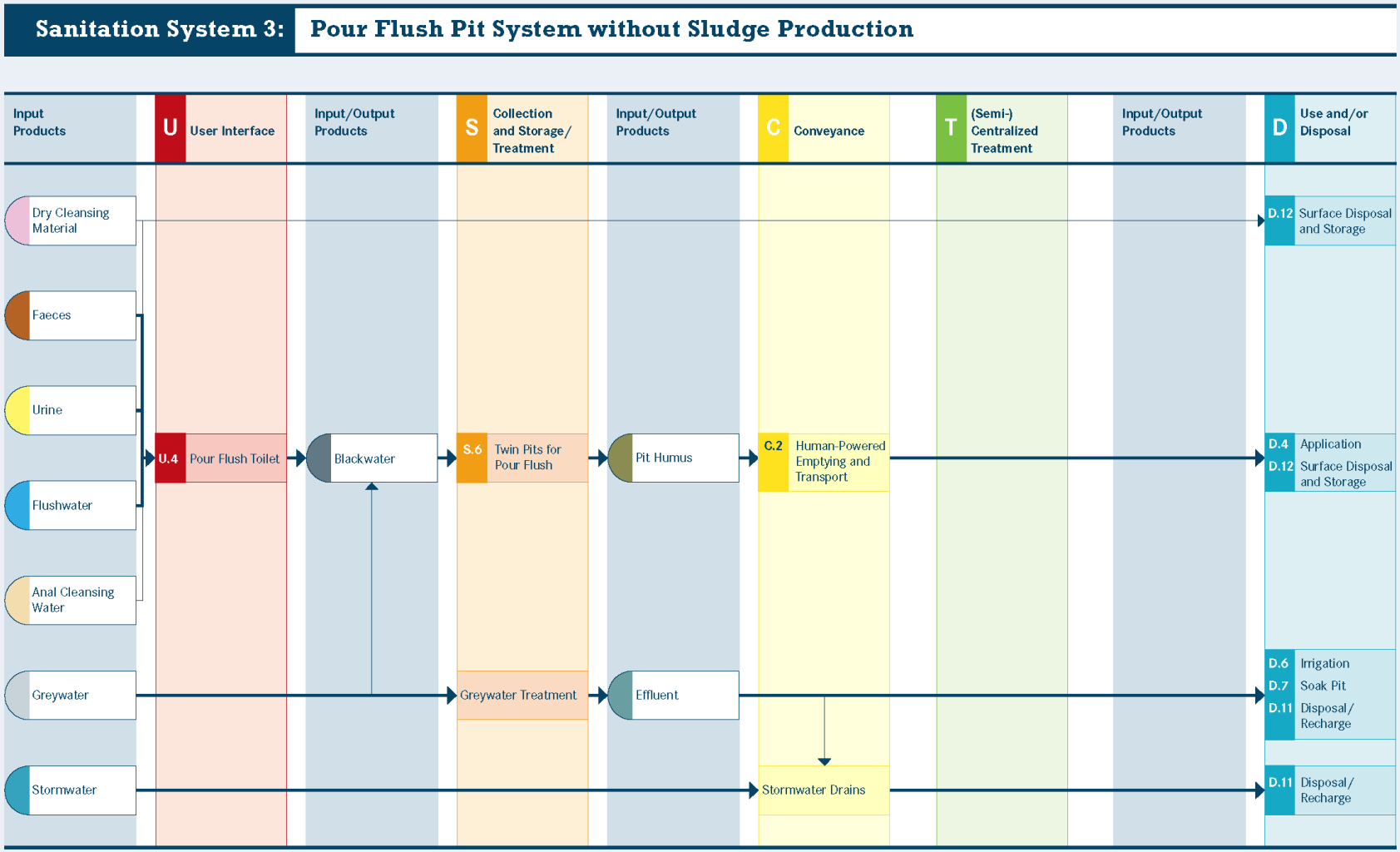


Figure 1. Eawag Sanitation System 3.
Source: Swiss Federal Institute of Aquatic Science and Technology (Eawag). Compendium of Sanitation Systems and Technologies. 2014.

Methods

Research activities

To understand the sanitation and FSM product landscape in Benin, the product scan included five primary activities:

- *Sanitation facility interviews and site visits*—household and compound sanitation facilities as well as public pay-per-use facilities.
- *Landlord interviews and site visits*—individual landlords.
- *FSM interviews and site visits*—conveyance and treatment.
- *Key informant interviews*—other private-sector actors.
- *Market visits*—in and/or nearby the target communities.

Sanitation facilities interviews and site visits: Because both improved latrines (household) and shared (compound and pay-per-use) latrines were identified in the project proposal as possible models to consider, the product scan included interviews with end users of all three types of sanitation facilities.

Landlord interviews and site visits: Since compound housing is an important part of the housing mix in urban areas and landlords play an important role in access as well as the type and quality of sanitation facilities available to tenants, the product scan included interviews with landlords to understand their perspective and challenges around sanitation.

FSM interviews and site visits: Following the Eawag sanitation service chain, the product scan included interviews with service providers from the conveyance, centralized treatment, and use and/or disposal functional groups.

Key informant interviews: The product scan included interviews with additional key informants identified by PSI's local affiliate, Association Béninoise pour le Marketing Social et la Communication pour la Santé (ABMS), and/or the study team.

Market visits: The study team visited five markets to document existing types of products and materials locally available.

Site selection

The product scan was conducted primarily in Cotonou, the largest city and the seat of government of Benin, and in nearby Abomey-Calavi, a suburb of Cotonou. Given the combined size of Cotonou and Abomey-Calavi (1.439 million[6]), PATH worked with ABMS to identify specific communities (i.e. neighborhoods) within these areas. In addition to income levels and sanitation need, the following factors were taken into consideration in selecting the target neighborhoods:

- Primary housing types (single-family households, compounds, etc.).
- Land tenure status (formal housing vs. informal settlements).
- Other community-level variables (such as a supportive local authority and the physical environment).

In collaboration with PATH, the ABMS project team based in Cotonou identified the following four neighborhoods for the product scan: Agbato and Minontchou in Cotonou, and Tokpa-Zoungo and Aganmadin in Abomey-Calavi. Maps of the sites depict the proximity of these neighborhoods to the lagoon, as lower income populations often construct housing in less desirable, for example, flood-prone areas.[7]

Sampling

For the *sanitation facility and landlord interviews*, ABMS used purposive sampling to identify participants in the four target neighborhoods. To participate in the product scan, sanitation facility users needed to have been a resident of the neighborhood for at least a year and have access to a latrine in their house or compound. Landlords had to own a rental property in one of the target communities (and also own all of the units) and have been a landlord for a minimum of two years.

Potential *fecal sludge management* participants and *key informants* were identified based on feedback from ABMS. Through market landscape activities, ABMS identified key actors in the sanitation sector. The product scan research team reviewed this list of actors as well as findings from key market landscape interviews to determine where additional insight was needed to better understand sanitation in Benin.

The study team also conducted five *market visits*: (1) a walking tour of a large hardware market in Cotonou, (2) a driving tour of the auto park on the road to Porto Novo, (3) a visit to a porcelain repair and re-sale shop, and (4 and 5) visits to two cement artisan markets.

Table 1 summarizes the number of site visits and interviews that were conducted under the product scan activities. Maps depicting the locations of the site visits and interviews are provided in Appendix A.

Table 1: Site visit and interview totals.

Type of respondent	No. of site visits and interviews
End users	
Household	5
Compound	9
Landlords	5
Public and/or pay-for-use managers	2
Fecal sludge management	7
Other key informants	3
Market visits	5
TOTAL	**36**

Data collection and tools

The product scan was conducted in Cotonou and Abomey-Calavi in mid-October 2015. The data collection methods included in-depth interviews, audio recordings, photography (where appropriate), and latitude and longitude coordinates (where appropriate). The study team developed semi-structured interview guides for facility end users, landlords, FSM service providers, and other key informants. The study team also used observation sheets to document the site visits for sanitation facilities and FSM sites.

Confidentiality and informed consent

The product scan received a non-research determination from the PATH Research Determination Committee. The PSI Research Ethics Board and local staff also concurred that no additional in-country reviews were needed. All of the participants were over 18 years of age, and informed consent was obtained from all of the participants prior to the interviews. Approval was also sought for audio recording the interviews and for taking photographs during the site visits.

Data synthesis and analysis

Raw notes were taken in English and in French. Observations were recorded in either English or French. Notes recorded in French were then translated into English. The PATH team compiled raw notes from

interviews into a Microsoft Excel data sheet that mirrored the structured interview guides. All audio files were only kept on file for reference and were not sent for translation or transcription. The photos capturing the interior and exterior features of each toilet of the respondents participating in the end user and landlord interviews were reviewed and stored in the project files.

Findings

Existing products and technologies: sanitation and FSM

Among end users and landlords, inherited and/or shared family housing is prevalent. Most landlords and private households inherited their properties, while half of the tenants interviewed lived in a family-owned compound. According to some of the respondents, latrines were a more recent addition to their residences. For example, most of the interviewees from private households said that their latrines had been installed within the past five years. For landlords, the time of installation ranged between seven and ten years. For users of shared facilities, a few respondents did not know when the latrines were installed as they were already present when the tenant moved to the property. Of those who knew, one respondent indicated that the shared latrine was constructed three years ago and the remaining respondents said that their latrines were constructed more than 15 years ago. Respondents reported previous experience with public hanging latrines, the "bush," and facilities similar to their current latrines.

Table 2 outlines some of the key elements of the latrine superstructures (above ground), platforms (floor and user interface, squat or seated), and substructures (below ground, containment, and storage) that we observed during visits of compound and household sanitation facilities.

In general, the density of users per latrine is lower than was found in the product scan research in Côte d'Ivoire. Private, single households (n = 5) reported between 1 and 15 users with one or two toilets available on the household property. Landlords and respondents with compound (or shared) latrines (n = 12) reported between 3 to 15 households sharing the latrines. Two respondents did not report the number of households in their compound. Both tenants and landlords counted the number of doors within a compound to determine the number of households. Reported household size for households using shared latrines ranged from 1 to 12 people with two to four toilets per compound. Researchers at Eawag have found that when compound latrines are used, fewer than four households sharing one improved latrine is acceptable for maintaining the latrine such that it continues to provide improved, shared sanitation.8 Among the compounds we visited, only two had more than four households per latrine, while the average was less than three. See Figure 2 for an example of a well-maintained latrine.

Table 2: Compound and household sanitation facility (n = 18)* materials and features.

SUPERSTRUCTURE	
Superstructure	• Cement used to construct slab and walls in all structures observed • The structural quality of most structures is excellent (n = 9) or good (n = 8)
Roof	• Most have roofs (n = 16)
Ventilation	• Most have some form of ventilation (windows/eaves and/or pipe) (n = 14) • Ventilation for some is natural (e.g., no roof/doors) (n = 2)
Door	• Door materials are wood (n = 9), combination of sheet metal and wood (n = 3) or fabric (n = 2) • Secure latches and locks are often missing (n = 11); only some have effective latches (n = 6) • Some have no doors (n = 4)
Lighting	• Many latrines are somewhat dark or very dark (n = 13) and some have fair or good lighting (n = 5) • All latrines had natural light sources • A few latrines had working electrical light sources (n = 3)
PLATFORM	
Pedestal or squat plate	• Seated (n = 6), squat (n = 5) • Some can be used as either (n = 3) and others have both options on site (n = 4)
Slab or floor structure	• Mostly made of cement (n = 13) • Some tile or combination surfaces (n = 5) • Mixed finish (smooth and rough)
SUBSTRUCTURE	
Excreta containment structure/tank	• Most direct discharge to cement lined/reinforced tanks • Tanks are below ground (n = 8) or partial above/below ground (n = 10) • Most have fair or easy access for emptying services
WATER STORAGE AND FLUSHING	
Flushing	• Most are dry, no-flush (n = 15) • One has tank flush • Two households have pour-flush toilets; one had previously been tank flush (the mechanism stopped working)
Anal cleansing	• Mix of wet and dry • A mix both within compounds and within families

*Although 19 interviews were conducted, one sanitation facility user and one landlord were from the same compound, so only one technology assessment inventory was completed for that facility. Therefore, n = 18 for this table.

Photos: PATH
Figure 2. This compound latrine includes two stalls for users from three households and illustrates a clean, well-maintained latrine. The image on the left shows a clean, dry cement structure with locking doors. Note also the access window for emptying the tank. The image on the right depicts a clean stall with a lid over the squat plate and a ventilation pipe to limit pests and odors.

According to all landlords, the latrines in their compounds are cleaned on a weekly basis. Many end users also said that their latrines are cleaned weekly. Cleaning may be done using water, soap, and bleach. Some respondents mentioned also using deodorizers and/or pesticides when they could afford them. For compounds and households practicing dry cleansing, paper is often collected in a bin in each stall and may be burned as part of the cleaning duties (Figure 3).

Photo: PATH
Figure 3. Burn bin to collect cleansing paper.

A few respondents said that they did not have a schedule for cleaning their latrines and that latrines were cleaned irregularly, or as one respondent put it, "whenever we want." The lack of regular cleaning can be a barrier to use. One end user shared that sometimes small children defecate around the latrine, and because there is no regular cleaning schedule, the latrine may be too dirty to use, so he uses a neighbor's latrine instead. In another compound, the respondent reported that the lack of a regular cleaning schedule results in generally dirty latrines with many larvae, flies, and cockroaches, which then creates another barrier to cleaning, since people do not like to clean the latrines when they get this dirty. Another tenant in the same compound suggested that if the doors were repaired, and locks were installed, which would split access to the latrines across households, the cleaning challenges could be resolved quickly.

Most latrines are cleaned by the tenants (on a rotating basis) or family members. While it is often women who do the cleaning, some respondents reported that both men and women participate in cleaning. Rotation schedules, if they have been established, seem to be satisfactory. One respondent suggested that peer pressure effectively motivates tenants not to skip their turn. While paying for cleaning services was

reportedly rare, a few respondents shared that they use a service that adds disinfectant and pesticide to the pit; costs for this service were reported to range between 500 and 1,000 CFA per month. One landlord shared that he pays 2,000 CFA per week to a nongovernmental organization (NGO) to clean the latrines. Another respondent shared that they had previously used a cleaning service in which each household contributed 500 CFA per month for an annual subscription to cleaning services, for a total cost of 2,500 CFA per month.

End user needs and preferences: sanitation and FSM

When users were asked what they liked about their latrines, their responses illustrated that they do not take their latrines for granted, and that their memories of the inconveniences and dangers of using the "bush," hanging latrines, or defecating in plastic bags—from the challenges of going out when sick, to the dangers of criminals and snakes in the bush, to concerns about contact with fecal matter—are still strong. The major features that the respondents reported they liked about their latrines included the following:

- Access
- Security
- Solid construction
- Protection from the elements
- Limiting exposure to disease
- Improvements over hanging latrines

While some landlords and individual users said that they liked everything about their latrines, some users of shared latrines said that they did not like anything about their latrines. Those with access to individual household latrines expressed appreciation for the following benefits: having an auto-flush, seated toilet; well-maintained latrines that are odor-free and easy to clean; and ownership.

Photo: PATH
Figure 4. The presence of feces, flies, maggots, cockroaches, urine, and a general lack of cleaning and maintenance are a major concern among end users and landlords.

When asked what they do not like about their current sanitation facilities, a major shared dislike of end users and landlords is a lack of cleanliness, including the presence of feces, flies, maggots, cockroaches, urine, and a general lack of cleaning and maintenance (see Figure 4). Another significant and related dislike is odor. This is reflected in our facility assessments in which we recorded medium to high odor in 12 of 18 latrines.

Common dislikes unique to shared/compound users center around the quality of the superstructure. These include poor construction, lack of doors, and exposure to the elements. One tenant shared that because there are no doors, when it rains water gets into the structure and "the walls become green." Other dislikes, primarily expressed by respondents from private households, reflect access to higher quality facilities, such as their toilet is not an auto-flush or a seated model, and the latrine is not tiled. The dislikes of household users emphasize a desire for upgrading their toilets rather than dislikes that are related to safety, maintenance, and repair.

End users and landlords offered multiple suggestions for improving their latrines. Several of these suggestions were related to upgrades, such as installing "modern" toilets—porcelain, seated, auto-flush toilets (though one end user preferred pour-flush); installing tile for aesthetics and ease of cleaning; and improving the finish of the structure (e.g., smoothing the cement finish, plastering, painting). Many suggestions more closely reflected a desire to address maintenance and repair

issues related to their existing facilities (Figure 5). These suggestions included the installation of doors and roofs, adding more toilets as well as handwashing sinks, as well as addressing necessary repairs to both the inside (platform, tank, flushing components) and outside the structure (including the roof, walls, foundation, steps). Other improvements were related to maintenance and included emptying and cleaning the tank and removing odors and pests.

Photo: PATH
Figure 5. Suggested improvements included additions and repairs to existing facilities, such as this latrine that is missing a roof and has a broken door that is sitting in the stall.

When asked to prioritize their suggested improvements, additions and repairs to the facility were of primary concern to many respondents, while others prioritized upgrades to modern toilets. Maintenance concerns were a lower priority for respondents. When asked what their preferred latrine is out of all latrines they have used, every respondent aspired to use of an auto-flush toilet.

Storage/containment and emptying

When we asked end users and landlords about how their waste was contained, most reported that they have cement-lined, reinforced tanks (n = 15). One owner constructed a leach pit and two respondents were uncertain of the type of containment. Of those respondents who said that their pit had ever been emptied (n = 11), one did not know the frequency, four responded that it is emptied every year, and six said every two to three years. Four respondents said their pit had not been emptied since their latrines were built (ranging from two to seven years) ago, and two respondents have not seen their latrines emptied since they moved in (four and five years ago). One tenant was assured by her aunt (the home owner) that the tank would only need to be emptied 25 years after its construction. This range in the frequency of emptying could be a result of several factors: the size of the tank; the quality of the construction of the tank—cracks in the cement could allow the FS to seep out over time, delaying the need for emptying; prevalence of unlined pits; sand slowly filling in the tank, as reported by one respondent, requiring the tank to be emptied more frequently; and partial emptying of tanks, requiring more frequent emptying.

Photo: PATH
Figure 6. A small window with a latching door enables vidange trucks easy access to tanks for emptying.

The only method reportedly used by respondents to empty tanks are vacuum pump trucks known as vidange trucks.[1] Accessibility for vidange trucks does not appear to be a significant issue. One compound latrine was located on a very rough, deeply rutted road, and the respondent reported that the vidange truck had no difficulty traveling on this road. We observed that several latrines have small windows built into the wall of the latrine facing the street to enable hoses from vidange trucks easy access to tanks for emptying (Figure 6).

[1] *Vidange* is French for "empty." In the context of fecal sludge, a *camion de vidange* (vidange truck) is a vacuum truck that empties tanks containing fecal sludge.

Many respondents are satisfied with vidange services. Several participants indicated that the vidange trucks fully empty their tanks. Two landlords shared that they inspect their tanks with torches to ensure they have been fully emptied prior to paying for the service. One landlord described the emptying process for his latrines: he adds water to the pit and mixes before the trucks come and then the vidange operators use a stick to remove trash and sanitary products that are stirred up during mixing and bury the solid waste in a hole near the pit before emptying the tank.

However, both those who are satisfied and those who are unsatisfied have complaints about vidange truck operators. Complaints about vidange services include the following:

- Failure to fully empty tanks. One respondent shared that sometimes the truck arrives half-full. He must pay 45,000 CFA for the services, even if the truck can only partially empty his tank. If the truck needs to come back because it was already half-full, he must pay another 45,000 CFA for the second trip to finish emptying his tank.
- Operators leave a mess for households to clean up afterward.
- Operators are unfair to those who are illiterate, doing a better job if a client speaks French.

One respondent illustrated that tensions between vidangeurs and landlords/home owners run both ways. During this respondent's first eight years of living in her compound, the landlord collected 6,000 or 12,000 CFA from households (depending on size of household) at the time of emptying, which occurred every three years. This landlord supervised the emptying to ensure it was done well, so she was satisfied with the service. Now, the tenants have a new landlord who collects 1,000 or 2,000 CFA per month for emptying based on the size of the household. This landlord, however, does not supervise the emptying of the tank. Once, the vidangeur came and emptied the tank, but the landlord did not pay for the service. As a result, the driver returned and refilled the tank with another client's sewage. The landlord called another service, but they only removed half of the sludge in the tank because the landlord did not pay enough, despite collecting more funds from tenants for emptying than the previous landlord.

Photo: PATH
Figure 7. Several users reported very full tanks in their latrines, suggesting landlords may delay emptying.

The reported cost for vidange services varied. While tenants and private homeowners reported the cost for emptying services to be 45,000 CFA, landlords reported much higher emptying costs, ranging between 95,000 and 120,000 CFA. This discrepancy may be because the vidange association sets the cost for emptying at 45,000 CFA for a $6m^3$ tank. This value is widely known, and tenants, who may not actually have to pay the bill, have been sensitized to this publicized amount while landlords may be quoting the actual cost they pay, and they may be paying to empty larger tanks that exceed the $6m^3$ capacity. Regardless, the costs for emptying services reported are much higher than in Côte d'Ivoire, where respondents reported emptying costs ranging between 12,500 and 26,000 CFA per trip. In fact, one landlord responded that his motivation for renting units was to help pay for the high cost of emptying services. Several tenants also noted that the tanks in their latrines were very full. One complained that liquid would splash up when they used the latrine, suggesting that landlords may delay emptying, possibly due to high costs (see Figure 7).

Multiple respondents noted that tenants contribute to payments for emptying services. Two respondents reported that the landlord collects 6,000 to 7,000 CFA per household at the time of emptying. Two other respondents reported that the landlord collects 1,000 to 2,000 CFA per month for emptying services. One tenant shared that he appreciates that the landlord put in a system to pay for the emptying services by month so that he and other tenants do not need to find all of the money when it needs to be emptied. One co-owner of a compound reported that his tank is emptied by an NGO that has set up a payment plan in which he pays 15,000 CFA at the time of emptying and then two additional installments of 15,000 CFA at month 3 and month 6; the option to pay in installments greatly helps him have access to emptying services.

Other considerations

While the ability of vidange trucks to access tanks for emptying and to satisfactorily empty tanks did not come across as significant challenges, it is important to note that beyond the collection of FS at the household level (the "conveyance" functional group in the sanitation service chain), the satisfactory progress of FS through the sanitation service chain is hindered by inadequate treatment and disposal solutions. The existing capacity limitations of the only treatment plant in the vicinity of Cotonou and Abomey-Calavi perpetuate unhealthy sanitation practices and an unhealthy environment. Potential technical and service models should take this limitation, as well as the high costs of emptying services, into consideration.

Public latrine blocks

We interviewed two managers of pay-per-use public latrine blocks (PLBs). One PLB is located on the property of a Catholic church and the other is a hanging latrine over the lagoon. The PLB at the church is a sturdy, solidly constructed cement structure located behind a gate that is locked at night. There are three stalls with porcelain, pour-flush seated toilets, although only one of the toilets has a seat and a lid (Figure 8).

Photo: PATH
Figure 8. Public, pay-per-use latrine with three pour-flush toilets.

These latrines are open to the paying public (adults and children at least five years of age) and receive a lot of use, particularly during services and events held on the church grounds, when long lines can form for use of the latrines. Even during the time of the interview, which the manager indicated was a slow time of day, there was a steady stream of users. The manager cleans the latrines multiple times per day and, in the short time she has worked at this facility, has already seen the tank emptied by a vidange truck twice (in June and September of this year). When asked about improvements that could be made to the latrine, she suggested installing automatic-flush toilets, as she currently must draw water from the well and fill large, portable tanks outside the latrines so users can fill small buckets to manually flush the toilets. Due to the high volume of use, drawing such a large amount of water from the well becomes a burdensome task. She also suggested that additional toilets should be added to accommodate the high number of users during peak times and that showers could be installed, as she is often asked whether showers are available at the facility.

The PLB hanging over the lagoon was constructed 20 years ago by a local entrepreneur in response to the public need and has separate facilities for men and for women. These latrines are accessed by walking through a garbage dump and then crossing an unstable wooden bridge. Because of the danger of falling into the water, children younger than eight or nine years of age defecate along the path to the latrines. The latrines are poorly constructed and made out of wood and sheet metal, which degrade quickly in the wet environment of the lagoon. At the time of the interview, the women's latrine had fallen into such disrepair that it was collapsing into the lagoon (Figure 9).

Photo: PATH
Figure 9. Public pay-per-use latrine over the lagoon. In the left image, users must walk along a path through a garbage dump, along which children defecate, to reach the latrines. In the image on the right, the women's latrine is collapsing into the lagoon; plans are in place to replace it by December 2015.

According to the manager, the owner plans to replace the current latrines with cement structures by December 2015. However, even though the latrines are being upgraded to a more solid structure, users of the latrine will essentially still be practicing open defecation. Interestingly, the manager said that he prefers using hanging latrines because they are open, and feces are submerged below the water, which limits the unpleasant odors he has experienced in using other facilities, such as improved pit latrines. The manager of the PLB at the church also prefers hanging latrines to either the pour-flush toilets at the church or the pit latrines at home because she is used to them and they are familiar to her. She also likes that when she uses the hanging latrine the fecal waste is taken away and she does not see it again.

Landlords and rental housing

As previously discussed, most of the landlords with whom we spoke had inherited their properties. One landlord purchased land approximately 30 years earlier and over time constructed his own compound so he would be able to rent out households when he retired. All of these landlords live on site with the exception of one who lives near his work, although his family continues to live on site. All of the landlords had constructed their latrines fairly recently, between seven and 10 years ago. One landlord told his father that open defecation was no longer acceptable and behaviors were changing, so they should have a latrine. Another landlord was pressured by his tenants to build a latrine.

All of the landlords have simple pit latrines installed for their tenants and, for the most part, landlords seem to take pride in ownership and their responsibilities as landlords. One landlord shared that no one has complaints, including one of his tenants who is a health care worker. Another landlord admitted that, while he struggles financially to maintain the latrines, he prioritized adding doors to the latrines of the tenants; he

did not have enough money to install doors on all of the latrines at once, and because he did not want to upset tenants, he chose to have his family wait for a new door.

When asked if they had ever tried to access financing, several of the landlords said that access to financing is a challenge and a barrier to improving their latrines. One landlord said that he cannot get a loan since he does not know how to read and write. Most of the landlords said that they would make specific repairs or additions to their properties if they could access financing. One landlord said that if he could access financing he would restore electricity to his property. He said that after his family complained after receiving an unfairly high electric bill, the power company responded by turning off their power and removing the meter from the property.

In response to a question about what would be a fair loan, landlords stated that a loan between 200,000 to 2 million CFA (approximately US$330 to US$3,320) would help them accomplish their goals. Landlords indicated that a repayment rate of around 20,000 CFA per month would be manageable.

Several landlords expressed frustration at the lack of government involvement in their communities; although they pay their taxes, they do not feel that they receive anything from the government in return. One landlord said that his taxes were too high, and that he struggled to afford them. Another landlord suggested that the government should provide assistance in developing the neighborhood.

When asked what associations or organizations the landlords participate in, one landlord said that landlords in his area have organized a neighborhood cleanup on Thursdays. This landlord also owns a bar and participates in a national business association. Another landlord indicated she desires to join a women's association and another sees a need for a landlord association. Beyond our discussions with landlords, we learned that moto taxis, vidangeurs, and a large hardware market all have associations that provide support through functions such as setting prices, resolving issues, and coordinating tax rates with the government.

Findings from FSM interviews and site visits

The MOH's *Direction Nationale de la Santé Publique* (DNSP) is a key actor in overseeing sanitation within Benin and is expected to operate in alignment with the National Strategy of Hygiene and Sanitation Policy (2013). According to DNSP personnel, there is not an urban strategy for Cotonou, although one is desired. According to the World Bank's 2010 Country Status Overview report, *"the subsector appears paralyzed by institutional uncertainty and, consequently, no urban sanitation activities have been undertaken by any of the public authorities.*"[9] Environmental surveillance falls within the scope of DNSP, which operates a laboratory and oversees the sanitary police, who inspect households and communities to ensure they are in compliance with sanitation regulations. The entire city of Cotonou is assigned eight sanitary police.

Other key stakeholders in the urban sanitation sector include the Directorate General of Water, National Water Company of Benin (Société Nationale des Eaux du Bénin [SONEB]); the Directorate General of Sanitation (Direction Générale de l'Assainissement [DGA]); and the Directorate General of Environment (Direction Générale de l'Environement [DGE]). The DGA is responsible for FSM (transport, treatment and re-use), while DNSP is in charge of toilets (collection and storage); and the DGE is in charge of regulations related to environmental protection such as the illegal dumping of fecal sludge; as well as local governments and various ministries, including health, development, housing, and the environment.

The city of Cotonou does not have a functioning sewerage network, nor is there a functioning wastewater or FS treatment center operated by the public sector. However, there are two abandoned communal sludge treatment systems. The *Cité Ville Nouvelle* was a sewage network for about 316 households and was built in 1973 with funding from the African Development Bank of Benin. In 1995, following the economic and social crisis in Benin, the bank went bankrupt and a residents' association has supported operations. However, the association ceased activities in 1996. Houyiho City also has a network that was built in 1987,

but abandoned in 2000. The lack of public-sector investment and the challenges related to a shift from national to commune-level management of sanitation are also noted within the United Nations Development Programme's 2013 report, *MDG Acceleration Framework: Access to Safe Drinking Water and Basic Sanitation*, as challenges in Benin.[10]

To understand the state of sanitation infrastructure and service delivery in Benin, the study team visited seven FS and waste management sites at sites located within Cotonou and the surrounding urban and peri-urban settings, such as Porto Novo and Abomey-Calavi. The sites included (1) a vacuum truck operator (VTO) business; (2) a parking and maintenance station for VTOs; (3) a medium-sized hygiene and FS services business; (4) a nonoperational FS treatment site; (5 and 6) two NGOs focused on technical training with pilot sites relevant to waste management; and (7) one graywater treatment site.

Although not included in the current product scan site visits, the FS treatment facility run by Société Industrielle d'équipment et Assainissement Urbain (SIBEAU) should be noted, as it was referred to by several respondents and, as the only legal FS dumping site that is operational in and around Cotonou, has a significant function in the sanitation service chain. During a previous visit, the PATH team visited the SIBEAU-owned site, a gravity-driven, lagoon system. Following its opening in 1994, the government mandated that the SIBEAU treatment facility would become the official dumping and "treatment" site for all FS trucks servicing Cotonou. Currently, the site receives more than 300% of its designed capacity and is unable to appropriately treat the fecal contents delivered. A recent publication noted that the effluent from SIBEAU is "*poor (up to 2250 mg/L of BOD5) and does not meet any quality standards.*"[11] The dumping fee was noted to be 6,000 CFA for a $6m^3$ volume (1,000 CFA per cubic meter) as of January 2015.

Fecal sludge removal service provision

FS removal service provision within Cotonou is managed through the Sanitation Business Association of Benin. Since the SSD team has already met with members of the association, the study team conducted a courtesy visit with the president of the association. The association was formed in the 1990s to mitigate against illegal dumping of FS. As of early 2015, the association consisted of 72 businesses. Each business pays membership dues.

The Sanitation Business Association assesses the operations and maintenance costs of trucks and then decides the tariff structures for FS removal. There are three truck sizes: $6m^3$, $12m^3$, and $18m^3$. The official tariff (household charge) for a $6m^3$ truck is 44,500 CFA; however, most VTOs and clients rounded up to 45,000 CFA when asked about the cost during the interviews. Illegal dumping is discouraged by two primary methods: (1) a 1 to 5 million CFA fine and imprisonment imposed by the government if caught illegally dumping; and (2) internal pressures within the association ranging from a minor infraction (a warning from the association) to a major infraction (expulsion from the association).

During an interview with a VTO, the study team learned about his experiences and his interactions with the actors along the sanitation service chain. He first noted that clients are not always willing to pay the 45,000 CFA for a 6m^3 volume. Some clients work with "middle men" who negotiate with VTOs to lower the price to 35,000 CFA plus a 5,000 CFA commission for the middle man. The VTO loses a 10,000 CFA profit, while the client receives a 5,000 CFA discount and the middle man receives a 5,000 CFA commission. The VTO also noted that he charges 80,000 CFA for 12m^3 and pays 16,000 CFA to dump his 12m^3 truck, of which 12,000 CFA is for the dumping fee at SIBEAU and the remainder includes fees to the mayor's office and entry fees. The same VTO stated that he makes 15 to 18 trips per month.

Photo: PATH
Figure 10. Vidange truck parking station with on-site mechanic.

The study team visited a parking station within Akpakpa of Cotonou (Figure 10). The site's manager is a member of the Sanitation Business Association, and he interacts with approximately ten FS businesses through this one parking station. The FS businesses typically have their own offices located elsewhere and typically manage more than one VTO. Each of the FS businesses has at least one mechanic, and a specialist diesel mechanic is on site as well. The parking station is actually unused public space, termed *domaine publique*, that the FS businesses converted into a parking station and where they built a small shed from which mechanics maintain the trucks. For use of the public space, the FS businesses pay taxes to the mayor's office. Some parking stations are on private land.

The respondent from CIPA Jessougnon, a hygiene and sanitation services business with approximately 400 million CFA per year in annual sales, provided additional perspective with regard to service provision and barriers to business growth. The business employs over 200 permanent staff and hires temporary staff on an as-needed basis. Most of the personnel and equipment are for hygiene services (e.g., cleaning and disinfecting of hospitals). The company presently only owns one 18m^3 vacuum truck. The FS services provided by this business are detailed in Table 3.

Table 3: Fecal sludge services provided by CIPA Jessougnon.

Volume of fecal sludge (m^3)	Cost of emptying (CFA)	Additional charge for cleaning of tank (CFA)	Total cost of emptying plus cleaning service (CFA)
6	44,500	90,000	134,500
12	89,000	NA	NA
18	133,500	180,000	323,500

In addition to the services noted above, the business also provides a disinfection (latrine facility, pipes, and tank) and pesticide treatment (tank only) service that costs 50,000 to 60,000 CFA and is very popular, with the respondent stating that "*a lot of people request this*." The company guarantees that pests will be eliminated from the latrine for six months.

Fecal sludge supply chains

Respondents provided useful information about FS equipment, spare parts, as well as financing and suppliers.

Renault and Berliet were the most common (~80%) makes of trucks at the VTO parking station. According to the operators, mechanics are easily able to find spare parts for these makes in Cotonou. However, operators also noted that parts can be difficult to find and that mechanics look to Ghana or Nigeria to obtain the parts that they need. Repairs can also be expensive. For example, one VTO said that repairing the water pump on an older truck would cost 800,000 CFA (US$1,344). When asked about expanding his business, the same VTO noted that he would rather use the money to become a spare parts distributor than to repair his truck. He also estimated that a 5 million CFA (~US$8,400) loan would be sufficient to start a spare parts business.

Photo: PATH
Figure 11. Many of the vacuum trucks had a translucent visual level attached to their tanks.

There is a prominent market for used trucks. The VTO operator interviewed purchased his 12m^3 vacuum truck used from a large auto park along the highway to Porto Novo, which is approximately 16 kilometers east of the center of Cotonou. Using a loan from Diamond Bank, the operator paid 9 million CFA (~US$15,126) for the truck plus an additional 2 million CFA (US$3,361) of importation taxes.

During the site visits and interviews, the study team observed that many of the vacuum trucks had a translucent visual level attached to their tanks (Figure 11). This was something unique to Benin and was not seen in Côte d'Ivoire. The site manager noted that these levels are common in Benin and that the majority of secondhand trucks come with these levels already installed.

The respondent from a medium-sized hygiene and FS services business provided input regarding its suppliers. All cleaning equipment and training support come from a company called ALPI[2] in Valence, France; pesticides and disinfectants are purchased from a Ghanaian supplier. Since spare parts for vacuum trucks and equipment are not typically available in Cotonou, he either obtains parts from Nigeria or, for European equipment, purchases parts when he travels to Europe. This company had previously attempted to secure a 50 million CFA (~US$84,000) loan from a Beninese bank. The bank conducted an assessment that was long and arduous and "*went nowhere*." The company eventually approached its European partners who supply the hygiene products and training, and the partners provided the loan quickly.

[2] Meaning of the acronym was not provided by the respondent.

Fecal sludge treatment facilities

The Takon Waste Management site is located in Sakete Commune and is owned by Porto Novo's mayor's office. The site, which is located 70 km from Cotonou and was funded by the World Bank, includes a fecal sludge treatment facility: four parallel systems of three ponds or lagoons (anaerobic, facultative, and maturation) each. The four systems end at a large drying bed for the sludge. While the treatment facility was completed in 2005, it has never been used (Figure 12). The respondent noted that the mayor's office in Porto Novo was originally expected to pay for the ongoing operational costs, which the mayor's office subsequently refused to do. The Ministry of the Environment oversaw the project and has the baseline assessment and technical documents; however, about ten years ago Benin underwent a shift to commune governance (decentralized from national to 77 communes) and documents were not transferred over. Since the Porto Novo commune does not have the technical documents for the Takon lagoon system, the total potential operating capacity of the system is unknown.

Photo: PATH
Figure 12. The Takon Waste Management site was completed in 2005 and has never been used.

The interview during the visit to the VTO parking station provided additional insight into some potential reasons why the Takon site was not successful. According to the respondent, the Sanitation Business Association members were not consulted about the Takon site, which was located approximately 70 km from Cotonou and was considered too far for the VTOs to drive.

SONEB also has plans to construct a new treatment facility in Abomey-Calavi, which is approximately 20 kilometers from the city center. However, SONEB has not yet secured financing for the proposed site. The Sanitation Business Association has been consulted about this site. A respondent said that this site would be *"okay"* since it is only 20 km away from Cotonou.

Overall, the Cotonou area does not have adequate treatment facilities. The SIBEAU site is the only site that is operational and where the VTOs are legally allowed to dump. The Takon site is nonoperational; there is neither a demand for its services nor is financing available to rehabilitate the site after more than ten years of non-use. Finally, while the site proposed by SONEB in Abomey-Calavi has buy-in from the association of VTOs, it lacks financing.

The lack of FS treatment facilities also hinders the ability of FS service providers to expand their businesses. For example, one respondent from a hygiene and FS services business noted the company's desire to purchase additional vacuum trucks and expand their FS emptying services. However, SIBEAU has ceased giving permission (new registrations) to dump at their site, so expansion is presently not feasible since there are not any other sites at which a business can legally dump FS.

Just as the government relies on SIBEAU for FS treatment, the findings from the product scan underscore that the government defers to private sector and NGOs to address waste management in urban centers of Benin. This, along with the absence of an urban sanitation strategy in Benin, result in ad hoc solutions and a fragmented approach to addressing sanitation.

Other waste management

The study team visited two NGOs: DCAM Bethesda (Developpement Communautaire et Assainissement du Milieu Bethesda) and Songhai. Both have focused on providing technical trainings with pilot sites that are relevant to waste management. These site visits and interviews provided insights into how other waste management activities in Benin might be leveraged for improving FSM.

Songhai is an NGO focused on sustainable agricultural practices and operates a technical training school for youth who desire to learn and replicate Songhai's models in their own communities. The personnel at Songhai provided a tour to the study team to demonstrate examples of the organization's different activities in feces (human and non-human) management, waste-to-energy technologies, and waste reuse. Examples of pilot activities at this site included two ecological sanitation facilities for the student dormitories (one male and one female with two stalls each); a biogas system, primarily fed with chicken feces and food or plant scraps; gasifiers (that produce energy for the institution when there is a power outage or when other equipment is running); and plastics recycling (Figure 13).

Photo: PATH
Figure 13. Examples of waste reuse and renewable energy production pilots at Songhai.

The ecological sanitation toilets at Songhai (Figure 14) are intended to be used and self-managed by approximately 300 students. Instructions for use include adding sawdust after each use (a common amendment for ecological sanitation toilets) and applying a chemical disinfectant (using a spray bottle) that accelerates decomposition. When the material is removed from the toilets, it is placed on the ground outside the facility; the material then needs to be turned over after three weeks. After a total of six weeks, the waste is reportedly safe to apply to crops. This process is of much shorter duration than that usually found with ecological sanitation systems, and the project would need to follow up with the technical director to get additional information about this technology. The study team did not have the opportunity to see the spray, which is the primary driver of the enhanced decomposition performance. The

Photo: PATH
Figure 14. Ecological sanitation toilets at Songhai.

SSD project may want to inquire further about this chemical to better understand the claimed performance and costs.

The study team spoke with personnel from DCAM Bethesda, an NGO founded in 1990. DCAM Bethesda focuses on community health, microfinance, agriculture, and waste management, including sanitation. DCAM Bethesda also operates a secondary school that is focused on building technical skills and capacity. The secondary school has a water and sanitation track, and the first students graduated from this program in 2015. The organization helps to provide internships for their graduates and is especially focused on positions with commune-level governments. Additionally, in 2007 a research branch called Compagnie d'Ingénierie Sociale et Environnmentale (CISE-SARL) established itself as a separate company and focuses upon recycling of trash, FSM, and graywater. A representative from CISE-SARL also participated in the interview with the study team.

Three potential key items of interest for the SSD project emerged from the discussions with representatives from DCAM Bethesda. First, they have been operating a Sanitation Credit program for six to seven years through Pebco (the microfinance branch of the NGO) and EcoBank. Second, they have a long-standing history of working with commune-level governance structures for establishing waste removal contracts and advising on site selection for dumpsites. Third, they have a learning mandate (i.e., operating a technical secondary school) and existing collaborations with local government laboratories (e.g., DNSP), as well as local and foreign universities (e.g., the National Institute of Water at the University of Abomey-Calavi and a university in Belgium). Finally, DCAM Bethesda has a catalogue of sanitation technologies developed for the commune of Parakou (scanned copy available upon request). This catalogue provides a useful foundation for estimating costs for construction of various latrine designs within Benin.

In addition to meeting personnel from DCAM Bethesda, the study team visited a graywater treatment site (Figure 15) that is overseen by the NGO and is operated by a graduate and part-time teacher of construction of the technical secondary school. While graywater treatment does not address FS management directly, it provides a potential model for decentralized treatment of FS that could be similarly implemented. Furthermore, because DCAM Bethesda is operating a FS treatment pilot site in Parakou (a location too far away for the study team to visit during the product scan), visiting the graywater treatment site provided the study team with an opportunity to gain insights into DCAM Bethesda's capabilities. The graywater treatment facility began operations in 2012 and treats graywater (laundry water, shower water) through a three-pond system (anaerobic, facultative, and maturation) of elevated cement basins. Presently, there are only 22 households (~120 persons) connected to the system that has a capacity for approximately 700 persons, which means that the facility is only operating at 17% of its capacity. Each household is only required to pay an installation fee of 15,000 CFA (~US$25); households do not contribute to the costs for ongoing operation and maintenance. The technician noted that the facility is *"expensive to*

Photo: PATH
Figure 15. DCAM Bethesda's graywater treatment pilot site.

operate," and he noted the intent of the pilot project is to generate revenue through various means (e.g., tilapia farming in the lower basin). When the study team asked whether any business plans or analyses had been conducted yet, the respondent stated that he had not completed any business or market plans for the graywater treatment facility but he noted interest in business planning support.

Songhai and DCAM Bethesda are implementing demonstrations and pilots of alternative treatment solutions and opportunities for reuse of products, such as biogas production, composting, and fish farming. While these are novel approaches, neither organization expressed plans to translate these demonstrations into scalable solutions, and they had done little to raise awareness among the general public and had an apparent lack of business plans.

Supply chains

In addition to understanding what products and technologies are currently being used, the formative research also focused on where and how these products or technologies are being manufactured, serviced, and sold.

Market visits

To learn more about the supply chain for sanitation products and technologies, the study team visited various suppliers, including two cement artisans located at roadside stalls, one porcelain repairman, and a large hardware market with more than 100 vendors. The team also visited the large auto park. As noted in the section on supply chains for FS, the auto park located on the main road between Cotonou and Porto Novo is a primary location for procuring secondhand trucks.

Cement artisans: The cement artisans typically located themselves road-side on the outskirts of the city. Both artisans fabricated a variety of sanitation-related products, such as squat toilets, ventilation blocks for ventilation of latrines, large washing basins for laundry, and hand-washing sinks (Figure 16).

Photo: PATH
Figure 16. Cement artisans produce squat toilets with lids (left) and a variety of other sanitation products, including ventilation blocks, large washing basins, and hand-washing sinks.

One artisan produces a cement squat toilet with a lid, which typically costs around 10,000 CFA. He delivers his products with a handcart. The other artisan sells his squat toilets for between 10,000 and12,000 CFA for a toilet with tiles, and between 8,000 to 9,000 CFA for a toilet without tiles. He reported that it costs him 7,000 CFA (~US$12) to construct a squat toilet. This artisan rents a vehicle to transport materials to clients. He

reported an annual figure of 700,000 CFA (US$1,176), but he was not able to indicate what is included in this figure or to clearly delineate between sales and profit. His primary clients are schools rather than individual households. The artisan expressed interest in technical skill development and would be willing to pilot new designs.

Porcelain repairman: The porcelain repairman works from a corner shop located on a busy street in the midst of Cotonou (Figure 17). His first experience using a porcelain toilet was after he left the small village where he was born. He was *"amazed by it [the toilet]"* and did not know how to use it. He ended up breaking the lid on the tank and had to pay back the owner of the toilet. Motivated by that experience, he has been repairing porcelain for the past 15 years. He said that the most lucrative part of his business is collecting broken porcelain, repairing, and then reselling it. For example, he sometimes buys toilets from wholesalers whose inventory broke during shipping. He is also interested in obtaining discarded porcelain from more affluent countries and would like to train others on how to do porcelain repair, which he does using the compound called Synthefer from the local paint store. He noted that he is the only one who repairs porcelain and he that he *"cannot go to all the villages."* His business includes making modifications and improvements to toilets based on customer wants and needs (e.g., low flush, replacing the hand lever on the side with a top flush lever). He mentioned that his lower income customers may start with a Western bowl and request modifications to a pour flush (rather than using the tank flush).

Photo: PATH
Figure 17. Porcelain repair shop.

Hardware market: The Marche de Quincaillerie de Gbegamey is a market that was formerly located in a neighborhood near the lagoon called Tokpahoho until 2002, when bridge construction required the vendors to move to the current location. Approximately 90% of the vendors moved to the new location. As captured in Figure 18, the vendors sell a variety of hardware supplies relevant to sanitation, including supplies and tools for construction of facilities, plumbing materials, chemicals (e.g., adhesives, paints), water supply containers, and porcelain features. In 2002 the vendors formed an association. The association has at least 100 members and meets every two months. Five members of the association also comprise an administrative committee. This committee works with the tax agents from the mayor's office to negotiate the tax rates for each stall in the market. A representative from the administrative committee noted that their committee would be best positioned to facilitate any future discussions or proposed activities between the SSD project and the association's members.

Photo: PATH
Figure 18. Vendors at the Marche de Quincaillerie de Gbegamey sell a variety of hardware supplies relevant to sanitation.

Key informant interviews

In July of 2015 ABMS conducted an initial market landscape. In collaboration with ABMS, the product scan team conducted follow-up interviews with three key informants—two distributors and one manufacturer—who participated in the original market landscape to better understand the barriers faced regarding the manufacturing, supply, and distribution of sanitation products, as well as interests in the introduction of innovations.

Ola Oninkpejou is a distributor and retailer of various materials for construction and sanitation that has been in business for six years. Sales from sanitation products make up more than 80% of the annual sales figures of around 200 million CFA (~US$33,163). Clients include landlords and sometimes retailers. Presently, they sell to more than 500 landlords (mix of new and returning clients) in a year. The respondent noted that they are interested in identifying better ways to engage with owners/landlords; in addition, the respondent expressed a desire for more information about the market. The respondent stated that "*people buy according to their means*." The business gets several products from China, which it can offer at a lower price for lower-income clients. The business' high-income clients select high-quality materials; furthermore, the respondent noted that they sell less expensive porcelain pedestals for 25,000 CFA, but they do not sell any squat plates (see Figure 19).

Photo: PATH
Figure 19. This distributor sells less expensive porcelain pedestals.

The respondent highlighted several barriers: *"money is the biggest barrier"* (e.g., heavy taxes, lack of financing), stockouts, and nonpayment. The respondent described how the lack of access to finance is also a challenge to properly stocking the store. *"Clients from up north want to buy in bulk,"* but storing that much inventory requires space and money to purchase and house sufficient stock. The business would also like to sell on credit; however, the respondent also noted some risks: *"landlords and the government can be unreliable, but landlords tend to pay back more quickly."*

The study team also visited a middle- to upper-class distributor called CID Super Décor, which works with suppliers from Spain, Italy, and a few in China. The toilets that sell the best are basic toilets from a supplier in Italy (the Cesar brand). The distributor only sells this toilet as part of a bundled package—porcelain toilet and sink for 68,000 CFA ($US114). According to the respondent, their main barrier is the lack of government support for the private sector. The government is not actively blocking the sector, but the *"taxes are the same regardless of the destination…which makes toilets unaffordable for low-income populations."*

The study team met with a representative of Industrie Béninoise des Plastiques (IBP), which is a local manufacturer of polyvinyl chloride (PVC) pipes, joints, tables, and chairs that has operated in Benin for 11 years. Their annual sales are around 1.5 billion CFA (~US$2.5 million). The suppliers of PVC are Italy, France, and the United States. Their International Standards Organization certified factory uses extrusion

molding for the production of pipes and injection molding for the manufacturing of joints and tables (Figure 20). The company owns three types of injection molding machinery: 750 ton, 1,000 ton, and 1,500 ton. The company works with two levels of distributors: 30 large distributors and more than 50 retailers. Their biggest client is SONEB, which purchases approximately 90% of their joints from IBP.

Photo: PATH
Figure 20. IBP uses injection molding and extrusion molding (left) for the production of pipes, joints, and tables (right).

When the market landscape study team asked IBP about the biggest barrier to their business, the respondent noted, *"The obstacle we face today is the cost of energy in Benin. It is very expensive and I'm not lying. We sometimes have a bill for 35 million CFA per month. This is the primary obstacle."* In addition, production is stalled when the power goes out. While IBP uses generators, they need to reset their processes after a power outage, which results in lost time and wasted materials. The IBP respondent also noted that another challenge for production is the lack of sufficient space for the equipment. The company has a ten-year plan to relocate their operations to a site that they have already purchased on the road to Lagos.

The study team also inquired about IBP's interest in introducing new products into their product line. The respondent noted that they follow the market, and the Beninese market is complicated—*"people buy what they know."* The respondent noted that they would like to remain abreast of any prototypes and innovations emerging from the SSD project and the user research findings. However, they cannot guarantee that they would be available to produce prototypes, since the market has not been developed for those innovative products yet.

Additional insights into the supply chains for sanitation products and technologies in Abidjan are contained in the market landscaping report from ABMS.

Analysis

The team used the gap assessment analysis technique to identify the gaps in the current state of service provision for sanitation within urban centers of Benin (e.g., Cotonou, Abomey-Calavi) versus the desired state. The three categories of gaps are people, processes, and technologies. For the product development activities, the team assessed how technical/product-specific solutions relate to business and other solutions, as noted in Table 4 below.

Table 4: Sanitation gaps with root causes and proposed solutions in Benin.

GAP 1: FACILITIES ARE NOT CLEAN NOR HYGIENIC		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Facilities are not clean nor hygienic. • Latrines do not meet aspirational desires of end-users. • Use of alternative cleansing materials, since hygienic toilet paper is not affordable. • Burning of used dry cleansing materials is common practice. • Minimal disposal options for dry cleansers that meet MOH standards.*	• More toilets for fewer users. • Explore use of biodegradable paper, which may be produced locally. • Develop a hygienic solid waste and burning device that addresses MOH disposal concerns. • Design or modify sanitation technologies that meet MOH's disposal guidelines.	Business models to adapt to new ratio Land rights resolution for construction and ownership.
GAP 2: MINIMAL AWARENESS AND ACCEPTANCE OF SAFE CONTAINMENT, HANDLING, AND TREATMENT		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Common practice of open defecation due to unavailability of latrines. • Limited awareness and availability of viable and safe alternatives. • Existing pit latrines have a strong odor. • Limited WASH behavior change campaigns in urban settings. • Preference for hanging latrines (some lagoons "hide" feces and odors better than pit latrines).	• Identify and integrate aspirational qualities of porcelain and tile toilets. • Develop viable, affordable, and safe alternatives. • Upgrade/adapt pit latrines with pour-flush traps or other odor control mechanisms. • Develop products (e.g., sanitation facilities and handwashing) that support hygiene/BCC messaging.	• Develop tiered product options that allow for both affordability and aspiration. • Increase awareness of improved containment and treatment options (BCC messaging). • Greater focus on WASH behavior change.
GAP 3: MINIMAL SAFE ONSITE CONTAINMENT AND TREATMENT OPTIONS (ESPECIALLY FOR FLOOD-PRONE/HIGH WATER TABLE AREAS)		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Some existing designs do not have safe containment. • Usage of facility with direct discharge to the environment (e.g., hanging latrines). • Prevalence of low-income populations in flood-prone areas. • High water table. • Limited onsite containment and treatment options that are appropriate and affordable.	• Retrofit hanging latrines with floating tanks. • Set up demo units of odor-free water trap toilets near hanging latrines. • Explore above-grade containment and on-site pretreatment options. • Identify service plans, including requirements and service intervals. • Identify low-cost superstructure and storage/containment options. • Pilot test acceptability and feasibility of portable toilets. • Explore condominial sewerage options to reduce toilet costs.	• Experiment with CLTS-like behavior change around hanging toilet use. • Develop service/business plan(s) with frequent service intervals.

GAP 4: PRICING FOR FECAL SLUDGE SERVICES IS PERCEIVED AS UNAFFORDABLE		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Cost of FS services (45,000 CFA per load) is unaffordable. • Lack of competition (e.g., pricing set by association). • No apparent cost share or public-sector funding for dumping and/or treatment (capital or ongoing costs).	• Explore decentralized treatment solutions to increase FS efficiency and reduce cost.	• Analyze the business viability of existing FS services in Benin. • Assess and compare pricing for FS services within Benin to other countries in region. • Collaborate with Vidange Association to optimize VTO routes and identify potential locations for decentralized treatment stations. • Support collaboration and cost share between public and private sectors.
GAP 5: LACK OF SUSTAINABLE INFRASTRUCTURE FOR TREATMENT AND/OR DISPOSAL		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Lack of an urban sanitation strategy. • Insufficient government funding available and/or allocated. • Insufficient public-private stakeholder engagement for planning (e.g., site selection and incentives). • Capacity of SIBEAU site exceeded (mandated by government to open site) without a mutually beneficial incentives plan established. • Existing treatment facility at SIBEAU site not repairable. • Limited attention to revenue/cost recovery. • Grant funding of projects.	• Explore public-private or private-run infrastructure. • Provide technical support and advice on the new sites under consideration (e.g., SONEB's site in Abomey-Calavi). • Introduce new decentralized treatment options (e.g., Slamson, Flexigester).	• Engage stakeholders (business associations, communities) in urban sanitation planning (e.g., site selection). • Explore potential public-private partnerships. • Explore outside funding (bilateral aid, investment, micro loans). • Develop service plan models with cost recovery as a focus (e.g., social enterprise).
GAP 6: MINIMAL EXPERIENCE WITH REUSE TECHNOLOGIES AND BY-PRODUCTS		
Root causes	**Technology/product considerations and/or solution**	**Business and other considerations and/or solutions**
• Very limited experience with reuse options (limited pilot). • Current pilots are very small. • Absence of and/or limited testing of treated waste to ensure safety in existing pilots.	• Investigate local innovations such as accelerators of treatment (e.g., Songhai's spray). • Explore production of bio-solid fuels (e.g., briquettes, pellets). • Focus on using processed waste to produce energy as a by-product (unstable energy sector). • Identify methods to optimize composting for user acceptance (i.e., so it feels, smells, and looks like good earth/compost). • Test by-products for safety and develop technical guidance on safe use.	• Develop service plan models with cost recovery as a focus (e.g., social enterprise). • Assess potential for selling energy. • Explore positive incentives for reuse (e.g., tax credits).

**NOTE: During our visit in October 2015, MOH/DNSP personnel said that the MOH requires that, for new sanitation technologies, used dry cleansing materials (e.g., hygienic toilet paper, notebook paper, cement paper) must be disposed of directly into the pit or other form of containment. For example, the MOH does not approve of toilets that promote disposal into bins, even if they have a lid. The concern is related to the presence of fecal matter on the used materials and potential exposure to humans, either directly or via vectors such as flies.*

Abbreviations: BCC behavior change communication; CLTS community-led total sanitation; FS fecal sludge; MOH Ministry of Health; SIBEAU Société Industrielle d'équipment et Assainissement Urbain; SONEB Société Nationale des Eaux du Bénin; VTO vidange truck operator; WASH water, air, sanitation, and hygiene

In addition to the gaps identified in the table above, the study team identified eight additional challenges that will impact the project's ability to bridge the gaps along the full sanitation service chain (see Figure 21). These challenges should be considered contextually when proposing product development and business solutions.

For example, the lack of an urban sanitation strategy results in an unclear role for and commitment by the public sector to address sanitation in the urban areas of Benin. Additionally, the lack of clarity regarding the public sector role leads to further confusion regarding engagement and collaboration between the public-sector and other sectors (e.g., private sector, civil society).

The unstable energy sector is another important challenge for addressing sanitation in Benin. The lack of a stable energy supply impacts two key aspects of the sanitation-service chain: 1) disruptions and loss of labor and time for manufacturers of sanitation technologies, which may result in higher costs for goods sold and, 2) barriers to the introduction and operation of innovative sanitation treatment technologies, especially those requiring a steady energy supply.

Another important contextual challenge is the business environment in Benin—both for entrepreneurs/service providers as well as consumers. The financing scan illustrated the lack of access to affordable financing options. In addition, according to the World Bank, Benin is ranked 158th (out of 189 countries) for ease of doing business.[12] Based on our interviews, there is a perception by tax payers (for example, landlords, FS businesses, vendors) that the quality of services provided by government is poor and action around improving services is absent. There is also insufficient protection for small business owners. The project may want to explore the use of positive incentives (such as directed taxes and fees) as well as the association model (such as the VTO association) and the values of equity as a bridge toward better business and government planning and accountability.

Our interviews also revealed a lack of consumer advocacy and protection for services. For example, there are minimal options for reporting poor service provision, limited access to information about consumer rights, and a bias towards French speakers. Potential suggestions to address these challenges include developing new reporting mechanisms (e.g., using mobile applications), leveraging existing reporting systems (such as the ABMS call center), incorporating pictograms and local languages into communications materials, using translators who are fluent in local dialects, and including community rights as well as consumer rights.

A final challenge found by the study team is a preference for the known, for what is familiar; that is, minimal acceptance of innovation and change. For example, manufacturers are not interested in developing new products, and suppliers carry a very narrow product range, citing lack of customer interest and/or acceptance in things that are new. This could be addressed by using local patterns, images, and/or textiles (such as tiles) in any new or modified sanitation facilities.

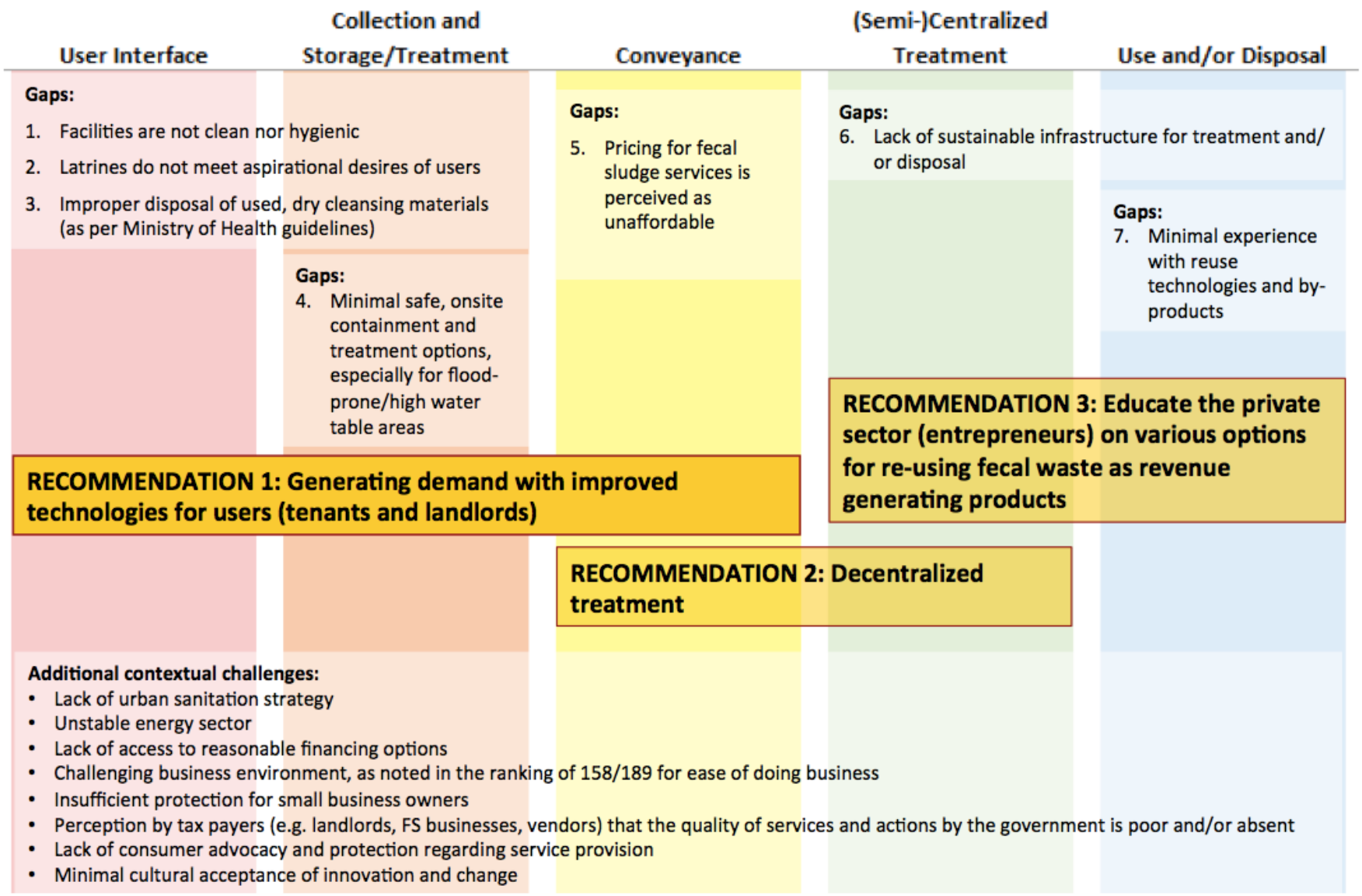


Figure 21. Gaps and recommendations mapped to the sanitation service chain.

Product development recommendations along the sanitation service chain

Based on the findings from the product scan, the goals of the SSD project, and the initial business models proposed for Benin, PATH recommends that the year 2 product development work focus on solutions aimed at building demand for improved latrines through innovative products that address user needs and exploring decentralized treatment options.

Innovative sanitation products and demand generation: As noted in the report, many end users are effectively non-users, as their reliance on hanging latrines and the prevalence of direct discharge both amount to open defecation. Even those who are using shared pit latrines may have minimal exposure to safe containment, handling, and treatment of fecal matter. In addition, some users expressed a preference for hanging latrines because the waste "goes away" and there is no odor. Because there are few product options available and pit latrines are seldom seen as an improvement over open defecation, demand generation activities must accompany the development of new and/or improved technologies that address user needs.

PATH recommends investigating and pilot testing sanitation technologies that address user needs, including concerns related to odor (such as water traps or lids). Noting the cultural resistance to change and new technologies, PATH recommends identifying and exploiting traditional Beninese images, patterns, or materials to ease the transition. In addition, there needs to be a focus on sanitation technologies (user interface along with storage and containment) that are compatible with a high water table, such as the Earth Auger. Product development activities also need to take MOH guidelines around disposal into account; proper disposal options could also be a specific area of inquiry.

Because of the importance of demand generation, we would suggest that the SSD project leverage the ongoing efforts of ABMS under the WASHplus program and call center to provide education and product and service information to end users and landlords to further generate demand. We also recommend that the SSD project strengthen relationships with Bethesda DCAM and explore opportunities for a partnership, for example, leveraging their Sanitation Credit project to bring improved sanitation technologies to end users.

Decentralized treatment of FS: Since the only existing FS treatment facility (the SIBEAU site) for Cotonou and the surrounding communities is operating at more than 300% capacity and is effectively not treating FS, there is a strong need for new solutions. Decentralized treatment solutions (such as Slamson's dewatering technology, Butyl's Flexigester, and BORDA's DEWATS) could provide alternative solutions for treating FS; increase accessibility for vidange trucks, along with profitability for vidange businesses; lower costs for vidange services; increase safety and improve the environment; and, ultimately, treat FS that is otherwise going untreated.

SIBEAU is currently exploring options for upgrading, although they have limited ability to expand at their current site due to the advancing shoreline. SONEB, as noted in the report, is considering sites for a new treatment facility. With both of these entities expressing interest in addressing the gap around treatment, PATH recommends that the SSD team strengthen relationships with both of these entities, including sharing learnings from Côte d'Ivoire, and leveraging their interest and capabilities to explore decentralized treatment options.

We recommend that the SSD team propose to share the results of pilot testing decentralized solutions in Côte d'Ivoire with SIBEAU and SONEB. We also recommend that the SSD project team support ongoing discussions with SONEB and the vidange association to vet and get buy-in on decentralized solutions. We further recommend exploring interest among the vidange association in a financing scheme that could include association-operated decentralized treatment sites that would complement SIBEAU and ease the over-capacity of that site.

By focusing on demand generation for innovative products and decentralized treatment in year 2, we not only address most of the gaps identified between the current state and desired state of sanitation service provision, but we also advance the project toward the objectives of increasing use of improved sanitation and increasing the use of safe disposal and reuse of fecal waste.

As these recommendations are implemented, it will be important to keep in mind the challenges identified by the study team. Without an urban sanitation strategy and with a perception of poor services provided by the government, it will be important for the project to explore partnerships in an effort to both promote unity and cohesion among the various civil-, public-, and private-sector players and to explore parallel service provision where existing services are insufficient. With a lack of protection for small business owners and limited financing opportunities, approaches to product and business development will need to tap into the social and cultural strengths, such as exploring the tradition of association with groups providing goods and services as well as community based-organizations as an avenue for efficiency planning and financing. Minimal cultural acceptance of innovation and change may discourage local manufacturers from producing innovative technologies. Consideration should be given to incorporating culturally appropriate design, such as use of traditional patterns and colors in the design of sanitation technologies to encourage uptake.

Next steps

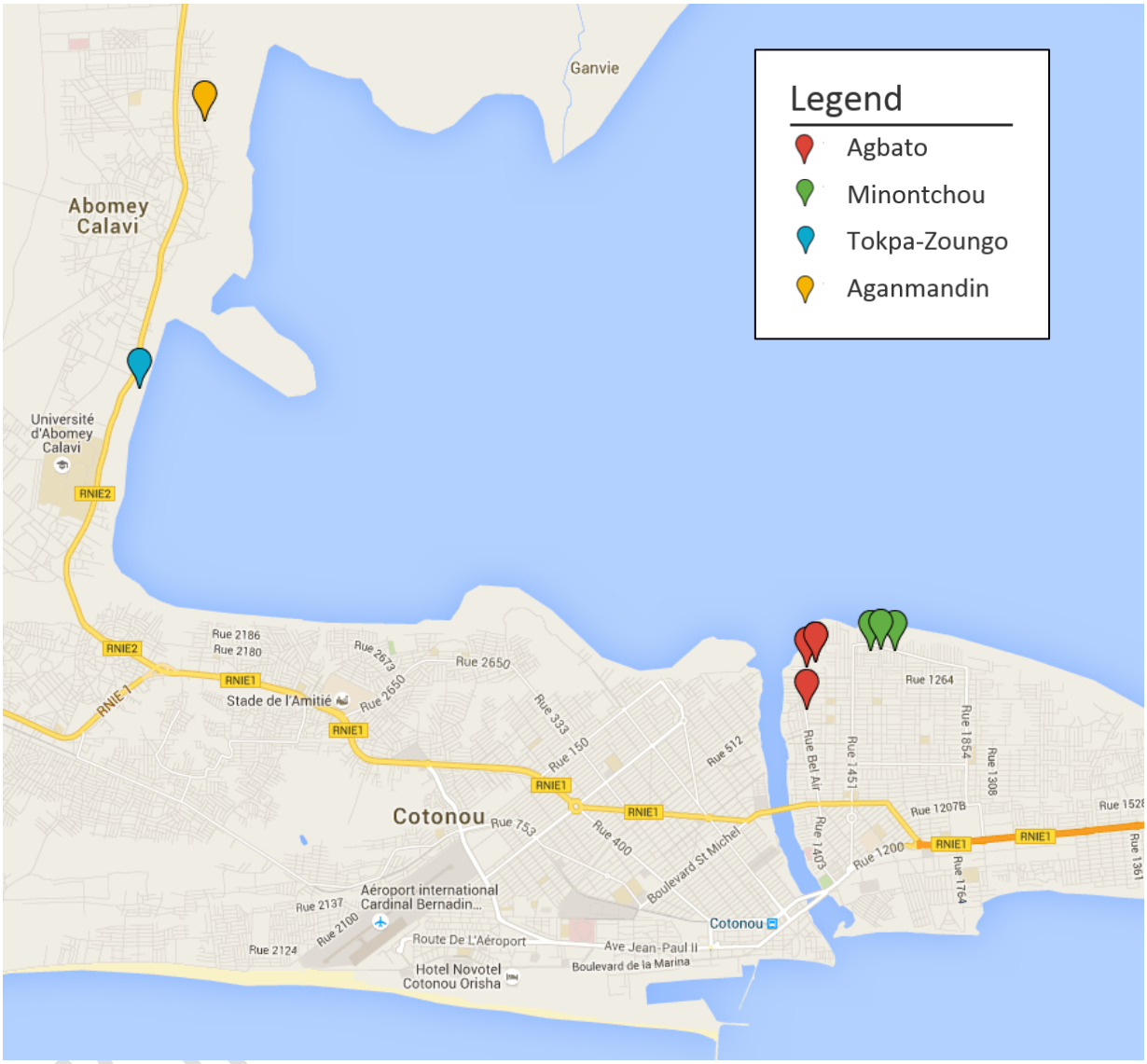
The first phase of the SSD product development work was an initial product landscape covering sanitation and FSM products and services in all three project countries. The product scan in Benin focused on understanding what sanitation technologies, products, and services are currently being used in Cotonou and Abomey-Calavi; user needs and preferences around these technologies; and the supply chain for sanitation and FSM technologies along the sanitation service chain.

Next steps include reviewing the results of the product scan with project partners, finalizing the year 2 product development plan, and prioritizing year 2 technical activities in Benin and the other project countries (including business model support, additional vetting of opportunities, and the implementation of the product development plan).

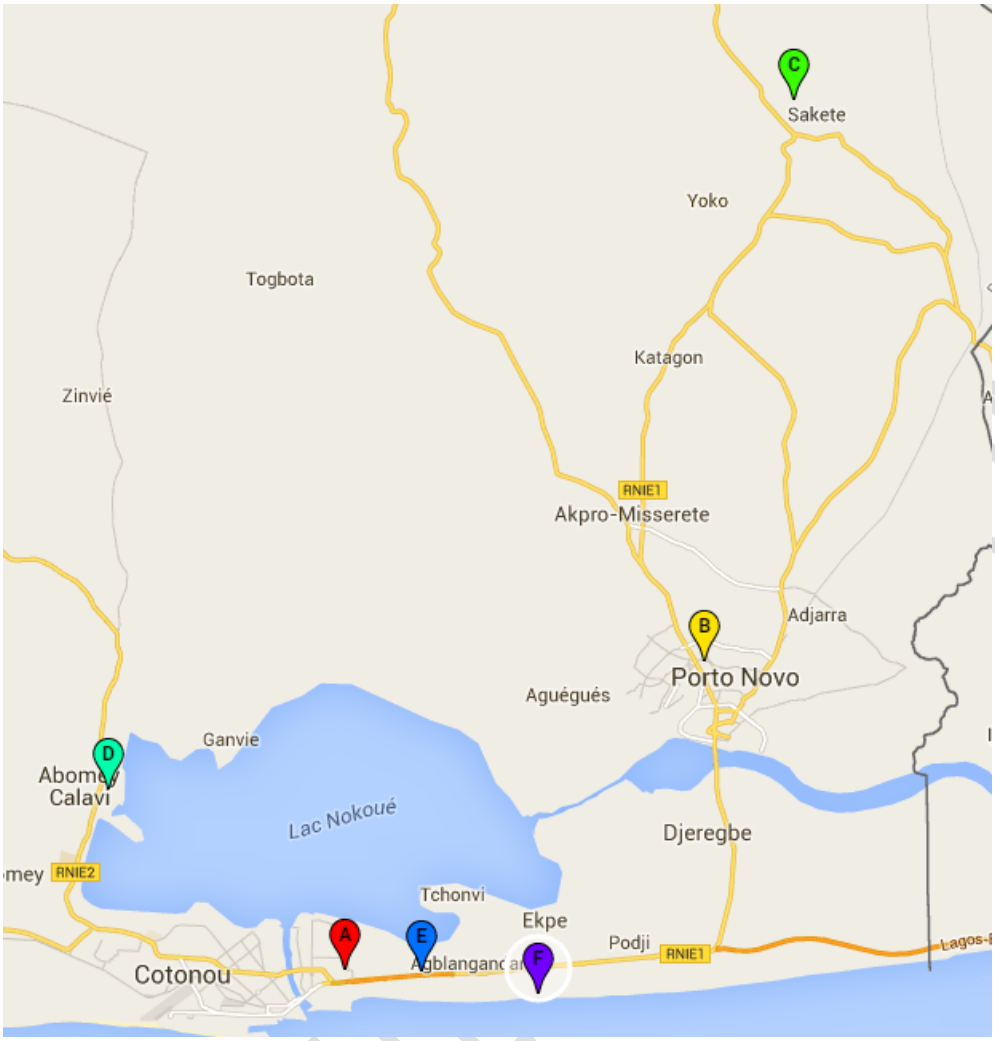
The second phase of the product development work will focus on an iterative product development process and include developing and validating new and/or improved latrine designs (focusing on user interface, superstructure [or shelter], and collection and storage/treatment) as well as FSM options, products, and services (including conveyance through final disposal) and FSM options/products that support sanitation service delivery scale-up in Benin and other project countries.

Appendix: List of maps

1. Map of sanitation facility locations



2. Coordinates and map of fecal sludge management sites



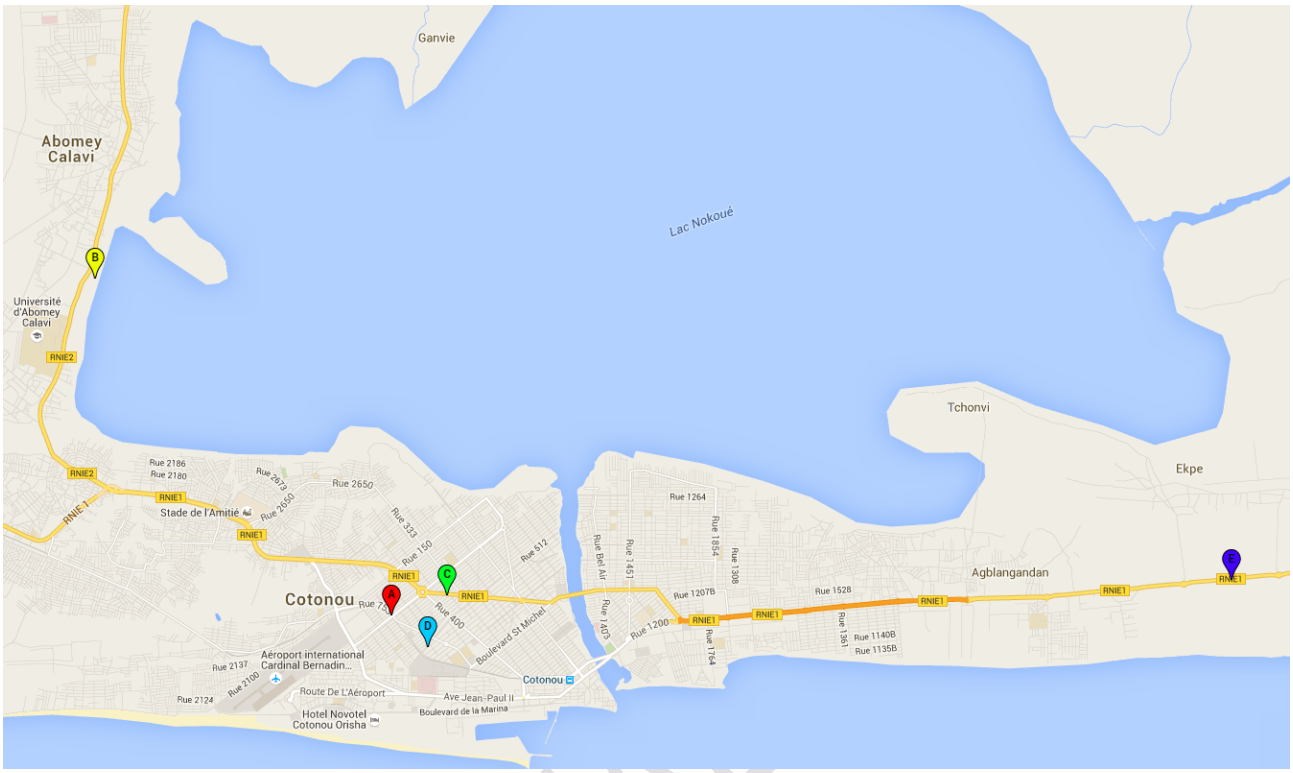
Legend

- A — Vidange truck parking and maintenance site | N06° 22.360' | E002° 27.652'
- B — Songhai | N06° 29.986' | E002° 36.876'
- C — Takon waste management site (no coordinates available; approximate location)
- D — Bethesda graywater treatment pilot site | N06° 26.966' | E002° 21.570'
- E — Vidange truck owner | N06° 22.336' | E002° 29.650'
- F — SIBEAU (no coordinates available; approximate location)

Bethesda DCAM (no location available)

CIPA Jessougnon (no location available)

3. Coordinates and map of market and supply chain locations



Legend

- A: ACBM Cement Artisan | N06° 22.048’ | E002° 24.249’
- B: Cement Artisan | N06° 25.641' | E002° 21.061'
- C: Porcelain repairman | N06° 22.266’ | E002° 24.841’
- D: Marche de Quincaillerie de Gbegamey | N06° 25.641' | E002° 21.061'
- E: Auto park | N06° 22.430’ | E002° 33.274’

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