

Evaluating the Potential of

Container-Based Sanitation

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EVALUATING THE POTENTIAL OF CONTAINER-BASED SANITATION: AN OVERVIEW

The World Bank Water Global Practice (WGP) has developed an approach to urban sanitation based on citywide inclusive sanitation (CWIS) principles, which have been developed in conjunction with sector partners (Bill & Melinda Gates Foundation et al., 2017). This approach aims to shift the paradigm around urban sanitation approaches in World Bank engagements, promoting the following principles:

- **Everybody benefits** from adequate sanitation service delivery outcomes.
- Human waste is **safely managed along the whole sanitation service chain**.
- **Comprehensive approaches** to sanitation improvements are deployed, with long-term planning, technical innovation, institutional reforms, and financial mobilization.
- A **diversity of technical solutions**, which are adaptive, mixed, and incremental, is embraced.
- Effective **resource recovery and reuse** is considered.
- Cities demonstrate **political will** and technical and managerial **leadership**, and they identify **new and creative ways of funding** sanitation.
- **Both on-site sanitation and sewerage solutions**, in either **centralized or decentralized systems**, are considered to better respond to realities faced in cities.
- **Complementary services (including water supply, drainage, greywater, and solid waste)** are considered.

As part of the implementation of these principles, the WGP is developing a suite of tools and other material

to support Bank teams and their clients when engaging in CWIS. One of the aims of this work is to explore innovative approaches to provide safely managed sanitation services along the whole service chain and to support clients in identifying when such options might make sense. The study “Evaluating the Potential for Container-Based Sanitation” aims to answer some of these questions for container-based sanitation (CBS), an emerging sanitation approach.

The objective of this study is to document and assess existing CBS approaches, with a particular focus on evaluating their safety, reliability, affordability, and financial viability. The report also seeks to identify the circumstances in which CBS approaches are most appropriate and whether they could be considered as part of a portfolio of options for CWIS. The study was motivated by growing interest in the emerging CBS experiences and by the fact that many governments, city authorities, and financing entities are often not familiar with the approach.

The study builds on four case studies (Sanergy, Nairobi, Kenya; Sustainable Organic Integrated Livelihoods [SOIL], Cap-Haitien, Haiti; Clean Team, Kumasi, Ghana; and x-runner, Lima, Peru) to provide insights into these questions. The present document is one of these four case studies. The full suite of documents is available at www.worldbank.org/cbs.

Reference

Bill & Melinda Gates Foundation, Emory University, The University of Leeds, WaterAid, Plan International, and World Bank. 2017. *Citywide Inclusive Sanitation: A Call to Action*.

EXECUTIVE SUMMARY

Urban population growth in many developing countries outpaces gains in improved sanitation access and services. In such circumstances, the traditional approach to urban sanitation, premised on extending sewerage networks and building wastewater treatment (WWT) plants, will not be sufficient to deliver citywide sanitation services for all.

Alternative approaches are needed to deliver adequate and inclusive sanitation services across the full sanitation service chain.¹ Informal urban settings pose particular challenges in the rollout of sanitation services, such as difficult access; lack of land tenure or space to build a sanitation solution; often challenging physical and topographical conditions, such as rocky soil, proximity to water bodies, and high-water tables; lack of water supply; and/or regular exposure to flooding. Approaches are needed to meet these challenges so that the population living in informal settings, who is often among the most vulnerable, can benefit from adequate sanitation services. As stated in a *Citywide Inclusive Sanitation: A Call to Action*, released by the World Bank jointly with a number of other sector institutions, delivering safe management along the whole urban sanitation service chain calls for “adaptive, expandable, decentralized and cost-effective approaches, mixing onsite and sewerage solutions, which can be resilient to external economic, demographic and environmental shocks” (2017).

In the past 10 years, container-based sanitation (CBS) approaches have emerged as an alternative service approach for the urban poor to those provided by sewers or by on-site sanitation (OSS) systems. CBS consists of an end-to-end service—that is, one provided along the whole sanitation service chain—that collects excreta hygienically from toilets designed with sealable, removable containers and strives to ensure that the excreta is safely treated, disposed of, and reused.² Rather than

having to build a sanitation facility, households (or public toilet operators) can sign up for a service. The CBS service provider then installs a toilet with sealable excreta containers (also referred to as *cartridges*) and commits to emptying them (that is, removing and replacing them with clean ones) on a regular basis. CBS approaches, therefore, focus on providing a sanitation service rather than on just providing an infrastructure intervention.

CBS approaches provide a sanitation response in situations facing some or all of the challenges mentioned above, as well as in emergency situations and in refugee camps, where they can be deployed rapidly without the need for building permanent infrastructure. Although this kind of approach remains relatively new and has not yet been applied at significant scale, it warrants more investigation regarding its potential place in a portfolio of solutions for a citywide inclusive sanitation (CWIS) approach.

Report Objectives

This report aims to document and assess existing CBS approaches, with a particular focus on evaluating their safety, reliability, affordability, and financial viability. The report also seeks to identify circumstances in which CBS approaches are most appropriate and whether they could be considered as part of CWIS.

The report is based on a rapid landscaping study that mapped where CBS approaches have been introduced and reviewed their performance based on available information. Four CBS service providers were selected for more in-depth case studies: Sanergy (Kenya), Sustainable Organic Integrated Livelihoods (SOIL) (Haiti), Clean Team (Ghana), and x-runner (Peru). These case

studies are available as stand-alone reports (available at www.worldbank.org/cbs). The present report builds on the main findings and presents lessons learned from these experiences aimed at governments, funders, and other stakeholders who may be interested in incorporating CBS into a portfolio of CWIS solutions.

Independent consultants conducted the case studies, with initial field work done in early 2017. Methods include reviews of existing literature, site observations, and extensive interviews (through focus groups) with CBS service providers and local stakeholders, including national and local authorities, service users, and service funders. No comprehensive surveys could be undertaken, however, due to time limitations. Data and documents were collected and analyzed until May 2017, though major developments and updates through May 2018 are reflected.

A Brief History of CBS Services

A group of CBS entrepreneurs initiated implementation of their businesses in the early 2010s as they strived to identify safe sanitation solutions for the urban poor with the potential to meet four critical obstacles:³

- The high cost and technical challenges associated with installing conventional sewerage networks in dense and informal urban areas;
- Severe physical space constraints for installing and emptying OSS installations;
- Low political priority of sanitation for the urban poor, leading to low investment; and
- Poor and unreliable availability of water supply, which has a direct impact on the amount of black-water and wastewater generated by a household as well as whether there is sufficient wastewater volume to effectively flush household waste to sewers.

A number of CBS service providers launched their operations less than a decade ago: Sanergy started operating

in Kenya in 2010, SOIL in Haiti in 2011 (after having experimented with the model in a humanitarian context in the country in 2009), Clean Team in Ghana in 2011, x-runner in Peru and Sanivation in Kenya in 2012, and Loowatt in Madagascar in 2014. Other service providers have since followed or are in the process of developing their own models, including a large private utility, Manila Water, which has piloted a CBS service for hard-to-reach areas where on-site or sewerage-based solutions have proved difficult to implement. Other CBS service providers are at an early piloting stage and/or do not yet have well-developed business models.⁴

The different CBS service providers work in a variety of country contexts, and all are seeking to develop self-sustaining business models while relying on a mix of public, philanthropic, and private funding sources. The early pioneers, who are also the largest service providers, came together in late 2016 to form the CBS Alliance to advocate for CBS approaches and to better structure CBS service provision by promoting, for example, common standards and guidelines.⁵

Overview of CBS Service Characteristics

The main target market for CBS services are the urban poor, who typically live in densely packed settlements, in rented accommodations, or with no formal land title. The portable nature of CBS as a sanitation approach makes it appealing in these contexts as it requires little space and limited or no in-house construction. In some cases, potential customers who live in single-room dwellings may have insufficient space to install a CBS household toilet, thereby rendering single-household CBS responses unfeasible. In such conditions, shared CBS approaches have emerged, such as the Fresh Life Toilets from operators who have entered in franchising agreements with Sanergy in Nairobi.

CBS service providers have made different choices regarding which segment of the sanitation service chain to tackle. Those reviewed for this study were shown to

maintain tight control over the containment, emptying, and transport steps of the sanitation chain. A number of CBS service providers operate across the whole sanitation service chain, treating the feces for reuse, whereas others have chosen to focus on collection and emptying. Still, some sanitation issues remain beyond the scope of CBS approaches to date—for example, none of the CBS service providers assessed provide services for the management of household greywater. This means that in areas with high water consumption, additional greywater management solutions need to be established to reduce the risks of disease and nuisance spreading.

CBS approaches can be deployed with different types of toilets (seated or squat, shared or private) to respond to customer preferences. Most CBS toilets are seated portable units that are placed inside the household. Sanergy's service involves shared squat toilets, and Loowatt has solutions for use in homes and in external superstructures. All but one of the service providers use urine-diverting systems, though they do not usually collect the urine separately nor do they try to reuse it, given the weight of urine and the consequent cost of transporting it for treatment or reuse.⁶ In those cases, households usually collect the urine separately and throw it in nearby drains or existing pit latrines, where available. Sanergy and Sanivation collect the urine separately. Sanergy currently disposes of it in nearby sewers and does not reuse it while Sanivation infiltrates it at their treatment site. The CBS service providers collect the feces (or, in the case of Loowatt, Sanergy, and Sanivation, excreta) either from within the customer's home (or the public toilet), at the doorstep, or at a drop-off point, depending on the physical constraints of the settlement in question and on customer preference.

Various modes of transportation are used to take the collected feces/excreta to the treatment site, depending upon the terrain and the road access, but it usually involves a combination of hand carriages, handcarts, three-wheeled transporters (auto rickshaws or tuk tuks), tractor-trailers, flatbed trucks, and box trucks. To optimize the transportation system, the collected feces is

usually temporarily stored and consolidated at one or more points (transfer stations) before being taken to the treatment site.

CBS service providers have had to adapt their businesses to the limited and fragile cash flows of the urban poor, so they have developed a variety of payment plans to smooth out sanitation payments over time.

The policy and regulatory framework for CBS services is unequally developed. CBS is a functionally distinct category of sanitation, but it has yet to be recognized as such by most policymakers and regulators as it is still a relatively new approach. Its association with bucket latrines among some policymakers in Ghana and elsewhere has left CBS in a legal gray area.⁷

The recognition of CBS as a distinct category of improved sanitation in Kenya has made it more acceptable to communities and local authorities and provides a strong basis for its development. As the Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016–30 emphasizes the importance of appropriate and affordable technologies and contains a list of technology options that includes the cartridge-based toilet, county governments in Kenya are increasingly considering CBS as part of their portfolio of sanitation options. In other places, such as Haiti, policymakers consider CBS to be a transitional solution, providing them with more time to identify alternatives for the long term.

Existing regulation of CBS services does not currently focus on the activities of households or toilet operators (in the latter case, for Sanergy), leaving the service providers to self-regulate this component. Adequate regulation of CBS services would require norms and oversight of the quality of the containers and the timeliness and quality/effectiveness of their emptying, the quality and timing of hygiene promotion by the CBS service provider, the frequency and effectiveness of monitoring of households' behavior by the CBS provider, and the behavior of households or private toilet operators.

In addition, an explicit regulatory framework for the reuse of treated feces in agriculture would enable some of the CBS service providers who treat excreta to high standards for reuse, such as x-runner, to be able to effectively market their products.

The CBS Alliance is looking to provide an anchor for the development of shared CBS metrics and performance indicators. In collaboration with the World Health Organization (WHO), the CBS Alliance and its members worked on the development of Sanitation Safety Plans (SSPs) for their operations in order to provide stronger assurance to relevant authorities and the public that CBS services can be managed in a safe way. In the future, it is looking to develop overall service standards to support the development of public sector contracts and results-based financing models and, ultimately, enable broader replication of CBS service models. These service standards would also enable the benchmarking of service quality across different service providers—and countries—and would help ensure that consistent high-quality services are promoted. Potential performance indicators could include the percentage of missed collections, the volume of feces or excreta that is safely collected and treated, the volume of feces or excreta that is reused (independently of whether it is sold), or the volume of reuse products sold.

Services provided by existing CBS providers are considered safe but have some areas for improvement.

The observations undertaken for this study found that CBS sanitation services can be considered safe as the feces is double-sealed throughout most of the emptying and transport processes to reduce exposure risks.⁸ These observations were supported by external assessments undertaken by academics in the case of SOIL (Remington et al. 2016; Sklar and Faustin 2017).

The process is safer when the feces or excreta is handled by only trained and professional personnel. As with other fecal sludge management (FSM) solutions, there are health risks associated with the handling process

that are mitigated through clear internal procedures for CBS service providers' personnel regarding protection, as well as through the careful design and use of double-sealed containers. In some cases, the local context and/or customer preferences may dictate the participation of customers in the removal from the household, transportation, and subsequent emptying of the containers. However, this participation comes with potential health risks due to possible exposure to feces, so monitoring, follow-up hygiene promotion, and enforcement of sanctions by CBS service providers for any improper operation need to be strictly applied in these cases. Out of the four case studies conducted for this study, only x-runner involves customers in the emptying and transporting, with customers manually taking their containers to a locker for pickup or to a collection truck as it passes through the community.

The study found that treatment and resource recovery processes operated by CBS service providers are providing a high level of treatment when compared to what is currently practiced in the areas where they operate. For example, in the case of SOIL, all of the excreta collected is transformed into compost through a carefully monitored thermophilic composting process that meets the WHO's standards for safe treatment of feces. The final compost is then sold to recover some of the costs of the treatment process (Remington et al. 2016).

Three of the four CBS service providers reviewed (SOIL, Sanergy, and x-runner) use composting to ensure that fecal pathogens are eliminated from the feces before end use/disposal. Clean Team in Ghana disposes of it in a landfill managed by the municipality. The level of treatment provided by the CBS service providers was found to be higher than the treatment applied to feces and septage in the areas where they provide services, due to the lack of dedicated fecal sludge treatment facilities in these areas.

Reliability is high, but clear contingency plans are needed. CBS collection services were assessed to be

reliable with few missed collections.² The study found that in situations when collections were missed, they were remedied as soon as they were reported, even though not all service providers maintain detailed records on performance indicators. In the case of Sanergy, the number of complaints and the time taken to respond to such complaints are systematically tracked, and each type of complaint has a target timeframe for resolution. The customers interviewed for the study did not raise complaints about the reliability of collections.

The study also found that CBS service providers should have contingency plans in place for countering any possible severe disruptions in order to allow them to continue providing services as much as possible. It was not clear from the assessment whether CBS service providers have clear strategies for coping with potential disruptions to their operations, which could occur due to staffing issues, natural disasters (such as hurricanes or floods) or manmade disasters (such as riots or civil conflict), epidemics, or interruptions to external funding that is critical for continued service provision. Although these might be low-probability events, their potential to disrupt collections makes them a threat to the long-term acceptance of CBS, whereas contingency plans involving local public health departments, and other entities as appropriate, could help make CBS services an asset in high-density, poor urban areas that are prone to such unexpected events. During epidemics of infectious diseases, CBS collection staff face high exposure, but they also provide a potential source of early warning/surveillance information. Through their direct and regular contact with households, they could quickly inform the appropriate institutional/regulatory bodies if infectious diseases symptoms arise or become prevalent.

CBS services are resilient to floods and drought. CBS services can be more resilient to climate variations than other solutions, particularly to floods and droughts. In Haiti, CBS service users highlighted that they could continue to use their toilets during floods, whereas traditional latrines would become unusable. In Nairobi,

some service users saw the fact that Fresh Life Toilets are waterless as a distinct advantage in a water-scarce environment where there is no piped water and, consequently, water for household use is costly and needs to be hauled over considerable distances.

Customer satisfaction with existing services is high.

This finding, which held in all four cases, was based on focus group discussions, as well as results of surveys undertaken by CBS service providers themselves.² The CBS services that were assessed had well-functioning and responsive customer feedback mechanisms. In situations where customers had been waiting a long time for sewerage network expansion or for the provision of other adequate sanitation services (such as in Haiti or in Nairobi), customers did not see CBS services as a transitory solution but rather as a long-term, reliable solution.

The four CBS providers analyzed under the study adopt market-based strategies to gain new customers, increase the density of their services, and reduce costs. These approaches include a strong focus on understanding and responding to demand for their services by closely studying the needs of potential users, adapting their services to meet those needs, and ensuring that customer outreach approaches engage with potential new customers. The process of signing up new customers for the services, referred to by the four CBS providers as “sales,” can be conducted by staff in charge of collection or by dedicated sales agents motivated through individual incentives or collective incentives at the level of a sales team. All four of the CBS providers were found to offer financial incentives to existing customers for successful referrals, which is a growing focus of their modus operandi to increase subscription levels. The goal is to increase coverage density in the areas where they are already operational, specifically by targeting slow adopters within this market.

CBS services are considered to be priced similarly to the main sanitation alternatives in their service areas, such as public toilets connected to sewers or lined pit

latrines with associated FSM services. However, it is difficult to make a direct comparison due to differences in the cost structures and the services provided. All CBS providers charge different amounts, collect them in different ways, and use different approaches to service delivery (for example, emptying frequency, emptying process, and cover material). Irrespective of these differences, one common advantage of the CBS model is that monthly charges can be a convenient way for households to smooth out the cost of paying for a reliable sanitation solution over time. This eliminates the need for households to mobilize substantial funding or to get credit for initial installation costs for OSS solutions and for the subsequent emptying costs, which is often a significant barrier, limiting access to pit latrines and septic tanks, for example. Sewerage services are usually similarly charged on a monthly basis, though initial sewerage connection costs can be unaffordable, particularly when network extensions are necessary and in-house plumbing adaptations are needed. Complementary approaches can also be deployed to smooth out cash flows over time, such as facilitated access to credit.

All of the CBS service providers reviewed in the case studies are funded through a mix of user charges for the toilet services, revenues from reuse activities (where these are undertaken), and external funding. Of the four CBS service providers reviewed, all of them are receiving significant external support (covering between 80 to 90 percent of their total costs) in the form of funds and technical assistance from private foundations, individual donors, and, in the case of Clean Team, in-kind from a government agency. Reliance on such sources of funding creates an operational risk should these funds cease.

The proportion of total CBS service costs covered by revenues is still small (currently between 10 and 19 percent).¹⁰ None of the CBS service providers reviewed were able to recover their full costs from the revenues linked to their activities, a situation that is likely to persist in the foreseeable future despite substantial efforts to reduce costs and boost revenues. Other sanitation

services in similar geographic areas, such as sewerage services or OSS and FSM, face similar challenges in recovering their costs and tend to receive subsidies, either in the form of cross-subsidies from water supply services or from government sources. Mobilizing revenues from the sale of reuse products can be an option for covering some or all of the shortfall, but in the cases where the financial situation of the CBS service providers was reviewed, they had not proven sufficient to cover a substantial portion of the operating costs up to this point.

The assessment found that service fees could potentially be increased to cover a greater portion of total costs. The CBS service providers reviewed have variable experiences with such increases in charges but, overall, have had limited negative impact on demand for their services. For example, Clean Team increased its prices in April 2017 (by 8.5 percent for mobile money subscribers and by 23 percent for direct payment subscribers) without a noticeable reduction in the number of their customers. SOIL began providing its service for free and then increased the price to G 100 per month (US\$1.50) within six months but nevertheless maintained 71 percent of their customers; further rate increases followed (from G 250 to G 350, or US\$4 to US\$5.65 in Port-au-Prince) with an 80 percent retention rate.

All four have strived to reduce their costs and to improve the efficiency of their operations by focusing on the geographical areas where they are already operational for new sales, rather than opening in new areas. This allows them to densify services and generate economies of scale in existing service areas. They all have deployed strategies to improve the efficiency of their services to reduce their dependency on external subsidies—for example, by improving the usage of transport trucks (x-runner) and reducing the number of weekly collections (SOIL).

Current experience suggests that profitable CBS sanitation services along the whole sanitation service chain are likely to be the exception at present. Given this, predictable subsidies will likely be needed for CBS service

providers over the medium to long term. To keep subsidies at the lowest level possible, CBS service providers need to further reduce their costs, as they are already striving to do.

To reduce costs per household, a certain scale and density of customers are needed, and the experience of the CBS providers reviewed suggests that reaching such a scale may take at least five years from the end of the initial “start-up” phase.¹¹ CBS works best when a high proportion (density) of the population subscribes to the service in a given area. This has implications for CBS’s interaction with other viable sanitation alternatives where they exist as it would likely replace existing solutions only where the level of service provided is currently very poor. Similarly, densification may be difficult where other sanitation alternatives are already in place but do not reach all households. Where applicable, planners could identify “designated service areas” for CBS service providers to foster densification and to scale up services, which is consistent with plans to roll out other non-CBS sanitation services.

Growth has been steady but slow. Since launching, the four CBS service providers assessed for this report have achieved steady, though relatively slow, growth over time. Average customer growth rates range between 15 to 25 new toilet facilities installed per month, with the largest general number of new customer installations observed in all four cases around 40 units per month. Exceptions include months when as many as 75 new customers signed up for SOIL and 65 for Sanergy (where each toilet serves an average of 35 to 40 people). Overall, the CBS service providers assessed have experienced surges in growth, but they have also had brief periods of toilet closures/withdrawals by customers who had accumulating debts or who had failed to operate their toilets hygienically.

CBS service providers have experimented with various strategies to drive growth in their customer base, including changing sales approaches, reducing prices,

densifying services in existing areas of operation, opening up new areas of operation, and targeting new customer segments (for example, Sanergy targeted non-resident landlords). Some CBS providers (particularly Clean Team and SOIL) have deliberately put customer growth temporarily on hold in the past in order to focus on improving the efficiency of their business models. Customer growth can be subject to capacity constraints, such as toilet-manufacturing capacity (in the case of Sanergy); the capacity to attract, onboard, and provide support to new customers (for SOIL); or regulatory constraints preventing the commercialization of reuse products (for x-runner).

CBS approaches can play a key role as part of the CWIS portfolio of solutions.¹² CBS is a potential solution for densely populated areas, particularly those where the environment for constructing OSS containment (that is, latrines and septic tanks) and sewerage networks is challenging (due to lack of space, soil conditions, high-water tables, and/or topography), where access for emptying on-site solutions (for example, using vacuum trucks) is limited, and/or where there is insufficient water supply consumed by households to flush their toilet to a sewer. CBS approaches are also particularly suitable in flood-prone areas or in informal settlements where building a long-lasting, generally capital cost-intensive infrastructure—such as a latrine—may be difficult due to land tenure issues or physical conditions (for example, where there are settlements on stilts above water bodies).

For the CBS service providers reviewed, the study found that they provide a sanitation solution that is viewed by existing customers as superior—in terms of hygiene, comfort, and convenience—to existing alternatives, mainly due to the service providers’ strong focus on customer service and the poor quality of existing sanitation services. In existing CBS service areas, the alternative sanitation solutions are generally unhygienic pit latrines and/or limited numbers of public toilets, which may not be adequately constructed or run.

Pit latrines in Port-au-Prince, Cap-Haitien, and Nairobi are considered expensive to desludge, so the process is often delayed and when the rainy season arrives, they frequently overflow. When desludging is conducted, it is done manually and the sludge is often disposed of unsafely into the nearby environment.

Pour-flush public toilets in informal settlements in and around Mukuru, Nairobi, are few in number and concentrated at the periphery of the settlements, which also makes them unsafe to use at night, especially for women and girls. In the low-income peri-urban settlements on the hill slopes around Lima, households generally have their own pit latrines, but once these fill up, the limited plot sizes, steep slopes, and, in some areas, hard rock subsoils make it difficult and costly to build a new latrine. In Kumasi, Ghana, public toilets have long been a widely used sanitation option and remain the main alternative to CBS, despite local authorities' strategy to promote a toilet in every household, one that appears to be hampered by design standards that result in expensive toilets. Furthermore, the public toilets are not always well-maintained and are not conveniently located for many households. CBS may also be preferred to sewer-based sanitation in situations where there is insufficient water supplied to the households to allow the sewers to function.

CBS service provision is labor-intensive and, therefore, may be more cost-effective in areas where low-skilled labor is cheap and the corresponding running costs are lower than the amortized cost of the construction of on-site structures and the mechanical equipment needed to service them (for example, exhauster trucks for collection/transportation of feces).

The advantages and potential drawbacks of CBS approaches are summarized in table ES.1. There are several advantages, particularly in terms of inclusiveness and resilience, that make these services a good consideration as a service delivery approach within a menu of CWIS options. In some cases, CBS approaches can also provide a “stopgap” measure in areas that are unlikely

to be reached by other solutions in the short term as they are less infrastructure-intensive and can provide improved sanitation services while the government decides whether to explore or roll out other sanitation approaches. However, it appears that in the majority of cases, these services are not yet ready to be significantly scaled up, as many of the existing providers have been focusing on increasing service density in their existing service areas before looking to expand.¹³

In most areas where CBS is currently being implemented, municipal authorities and/or utilities have plans for rolling out alternative solutions at scale, such as sewer-based sanitation. Physical and financial barriers, however, imply that investment-heavy solutions may not be forthcoming at scale in the foreseeable future. In such situations, CBS can be seen as a practical and robust solution to be considered as part of the sanitation options portfolio to deliver universal sanitation. In reality, in many cases, it would take years, if not decades, before sewers are rolled out to all households in some of the most rapidly expanding cities of developing countries. CBS services could, therefore, be adopted in the interim period while more durable solutions that can tackle all excreta streams are designed and gradually rolled out. They are also suitable for situations where the duration of stay or permanence of a community is unclear, such as in refugee camps—Sanivation has successfully deployed this kind of service in Kenya.¹⁴

Emerging Lessons

The review of the four CBS case studies has generated emerging lessons for governments and external funders that may be considering supporting CBS technologies and services development.

CBS approaches should be considered as part of a menu of CWIS options. The specific planning and roll-out of CBS services would vary based on location, but, as with other CWIS solutions, it should be articulated closely with urban planning and development priorities.

Table ES.1 • Summary of Potential Advantages and Limitations of CBS Services

Potential advantages	Potential limitations
<ul style="list-style-type: none"> · Inclusive: CBS is a practical approach in hard-to-reach areas, where space is constrained, it is difficult to dig, or the water table is high. Where CBS toilets are in-house, it can improve safety for women and girls. · Resilient: CBS is a good solution both in water-scarce areas (such as Nairobi or Lima), as it is associated with lower water consumption, and in areas with risk of flooding (such as Haiti). · Sustainable: Emphasis is on the whole service chain, either via services provided directly by the CBS service provider or in partnership with others. · Acceptable to customers: Most customers express overall satisfaction with existing CBS services. · Hygienically safe: CBS is safe as long as proper handling, treatment, and reuse of the feces along the service chain is maintained. · Affordable: CBS does not require upfront investments for the households, who have to pay only a periodic (daily, weekly, or monthly) fee. · Efficient: Most CBS service providers have a business approach, with heavy focus on improving the efficiency of their operations and with good awareness of their costs: They are generally working to generate further efficiency gains and reduce costs, which should reduce the need for external subsidies over time. 	<ul style="list-style-type: none"> · Current dependence on external funding: CBS service providers rely on external funding to cover 80 to 90 percent of their costs. Such reliance would likely reduce as service density increases and economies of scale are realized. · Dependence on external expertise: CBS service models were set up by entrepreneurs who are non-native to the countries of operation. The staff working for these providers all appear highly committed to the operations, even if quite dependent on the ongoing involvement of their founders. · Relatively slow growth rate: Despite having been in operation for more than five years, most CBS service providers are still at a relatively early stage of development and are still working out their business models. In some cases, they have temporarily curtailed expansion while they work on improving their operating margins. Existing CBS service providers that have been reviewed indicated they are not ready to scale up beyond their current areas of operation. · Lack of explicit regulation and service standards: In some cases, a legal vacuum can limit the types of services that CBS service providers can offer. · Partial solution: Complementary approaches are needed for greywater management. As urine is heavy to transport, none of the CBS service providers currently process and reuse it (with the exception of Loowatt), which has potential impact on the environment in areas where the water table is high. · Limited interaction with local authorities: Some CBS services were developed independently to fill sanitation service gaps, with limited interaction with mandated service providers and/or local authorities. They have increasingly worked on developing relationships with local authorities, however, so this issue has been reduced over time.

One option could be to identify geographical areas where CBS approaches would be the most appropriate or the best fit, given local conditions, and support their development accordingly.

The introduction of CBS services could be considered especially for poor urban populations for whom alternative on-site or sewer-based sanitation services might not be appropriate. These include dense slums and areas that are flood-prone or hard to reach (such as hilly terrains or settlements above or very near to water courses). CBS services can also be considered for areas where:

- The housing density and/or the size of the living quarters prevent the construction of pits or septic tanks or the laying of sewers and where most of the population lives far (that is, more than 50 meters) from existing shared toilets, which means that some people, notably women and girls, do not have safe access at night and disabled people might not have access at all;¹⁵
- The ground conditions are not suitable for the installation of latrine pits, septic tanks, or sewers (for example, flood plains);
- Landlords are not willing to invest in toilets;
- Water shortages make sewer-based solutions more challenging;
- The majority of households do not lie on roads or paths that are large enough or otherwise suitable for the installation of sewers (including simplified/narrow diameter sewers, though these can be installed in very dense slums with minimal access ways) or are not accessible for proper FSM access and collection; or
- Existing sanitation planning does not foresee the rollout of more conventional sanitation services in the short to medium term.

Some CBS service providers (such as Sanivation in Kenya) have also started expanding in refugee camps, where such approaches can be particularly

well-suited as the CBS units are rapidly movable and can be deployed—and redeployed—quickly to meet unplanned influxes of people.

Adopting a conducive policy and regulatory environment could be an important first step for governments looking to foster CBS services in suitable areas. Regulation of CBS and FSM services would ideally be done in conjunction in order to regulate public health and environmental aspects up to the point where the pathogen and nutrient parameters meet the national/local standards for discharge to a water body, disposal to a landfill, or transformation into a reuse product. This would include clear procedures for operators in the emptying and transportation processes to ensure that all CBS and FSM service providers are held to the same standards in mitigating potential health and pollution risks. Regulatory oversight should also ensure that CBS service providers adequately monitor the operation and management of CBS toilets by customers and react swiftly and appropriately where hygiene is substandard.

Where it does not exist, a regulatory framework should be developed for the reuse of treated feces/excreta, including for agricultural and other uses, which have sometimes been limited by health concerns—such regulation would serve for both CBS and other FSM services. The development of overall service standards could enable broader replication of CBS service models and benchmarking of service quality, thus promoting consistency and further confidence in the CBS approach. It would also provide a level playing field to allow for the development of CBS approaches alongside other sanitation services, especially OSS and FSM. A better definition of the institutional framework required for developing and monitoring standards could help improve the safety of services and overall service quality.

Recognizing that CBS service providers will likely not be covering their full costs in the short term—and that most urban sanitation services are subsidized—public

authorities and/or water supply and sanitation (WSS) service providers could explore ways to ensure that CBS services are sustainably financed. Examples include cross-subsidies from services provided in more affluent service areas, including other types of sanitation provision and other related services (for example, water supply or solid waste management) or direct subsidies from public sources. In situations where governments contract CBS service providers for delivery in specific areas, such arrangements could be structured as performance-based contracts so as to introduce incentives for greater efficiency, cost reductions, and greater accountability.

The customer-oriented nature of CBS services means that the providers offer a way for new customers to begin accepting to pay for sanitation services and to practice better household hygiene which, in turn, is more widely beneficial. As and when other sanitation solutions are rolled out in the future, forerunner CBS services can fill more than a temporary access gap as they also build the mindsets of customers who subsequently value sanitation services and who are used to interacting in a responsible way with service providers.

Areas for Further Analysis

Although this report indicates that CBS can effectively provide safely managed sanitation in urban areas, there are currently a small number of operators providing CBS services in different parts of the world, each at a relatively limited scale. As these existing CBS operators scale up their services, it will be important to continue carrying out operational research to explore the following questions, among others:

- What constitutes a safe CBS service, and what are its essential features? Can a broadly accepted definition of “safe CBS services” be developed to provide the basis for their inclusion as part of the improved sanitation options for achieving sustainable development goal (SDG) 6?¹⁶

- How can CBS services be integrated within a broader menu of options for WSS and CWIS service provision so as to facilitate service integration, promote services to the poor, and encourage cost recovery?
- What management models can be considered to ensure the safe provision of CBS services, ranging from dedicated CBS service providers to the incorporation of CBS as part of a menu of options provided by larger utilities?
- How do CBS approaches compare financially and economically to other available sanitation alternatives in the cities where CBS service providers currently operate or could potentially enter?
- How can existing CBS service providers be supported to scale up service provision in existing service areas or to expand into new areas, where applicable?
- How could performance-based contracts be designed for CBS services? What could be suitable service standards and “payment triggers” as a part of results-based financing arrangements?

Notes

- 1 For the purpose of this report and in alignment with the CWIS approach, the sanitation service chain consists in containment, emptying/collection, transport, and treatment and reuse/disposal. In addition, activities related to demand creation and marketing have been considered in their own right as part of the sanitation value chain, given their importance for CBS services.
- 2 In this report, the term *excreta* is used instead of *waste* to avoid any potential confusion with solid waste. Tilley et al. (2014) define excreta as “urine and feces that is not mixed with any flushwater.” Note that for the four CBS case studies prepared for this report, the feces and urine are separated using urine-diverting toilet technologies. Cases where the CBS service provider collects only feces are referred to accordingly as *feces*. Also note that cover material (for example, sawdust or carbon cover) is added to the feces or excreta in all cases.
- 3 It is worth noting that other sanitation solutions may respond to some of these challenges. For example, condominal sewers and other forms of simplified sewerage have proved to overcome a number of these challenges, whereas dry sanitation can be applicable for situations with low water supply. However, CBS has been identified as one of the options that responds to all these challenges simultaneously.
- 4 For example, Sanitation First in India, Banza in Nairobi, and the nongovernmental organization (NGO) Maji Safi kwa Afya

- Bora Ifakara (Safe Water for Better Health Ifakara; MSABI) in Tanzania.
- 5 Current members of the CBS Alliance include SOIL, Sanergy, Clean Team, x-runner, Sanivation, and Loowatt.
 - 6 Loowatt is currently the only CBS service provider that does not separate urine from feces. A waterless flush helps to seal urine and feces in biodegradable polymer film in a plastic container, which, once full, is collected and hand-delivered to Loowatt's treatment plant. There, the waste is anaerobically digested and pasteurized to produce liquid fertilizer and vermicompost.
 - 7 Bucket latrines in emerging markets consist of open containers used as toilets and serviced through regular emptying by bucket collectors. Although these were previously formal in urban areas of Ghana, they were declared illegal due to the unhygienic way in which they were used (there was no cover material or separation of feces from urine) and in which excreta were collected, transported, and disposed. The buckets were often not well-sealed, and the excreta was often disposed of into nearby gutters. Similarly, these methods of excreta disposal were banned in Kampala, Uganda, and Kisumu, Kenya. For more detail, see S. Tilmans, K. Russel, R. Sklar, L. Page, S. Kramer, and J. Davis, 2015, "Container-Based Sanitation: Assessing Costs and Effectiveness of Excreta Management in Cap Haitien, Haiti," *Environment and Urbanization* 27, no. 1: 89–104.
 - 8 *Double-sealed* means that the feces is contained in a plastic bag-lined bucket or a container with a lid. The only time when the feces is not double-sealed is when the plastic bag containing feces is removed from the bucket, either when transporting it manually (in the case of x-runner) or when emptying the cartridges at the treatment location. In the case of x-runner, the plastic bag is removed but is immediately put into a new bucket for manual transportation, where it is again double-sealed.
 - 9 CBS service providers have their own regular satisfaction surveys, which were consulted as part of the secondary sources reviewed. Details of the focus group discussions undertaken in each study location are included in the specific case studies.
 - 10 This situation is representative of all CBS service providers, which are dependent on external financing to ensure their financial viability. This aligns with the situation of other sanitation service providers in developing countries, who are generally unable to cover the full-service costs from service fees and tend to rely on external subsidies.
 - 11 Although all the CBS service providers analyzed have been operating for several years (in some cases, for more than five years), this initial operational phase has provided time for the businesses to start up so as to establish their service offerings and gain the trust of policymakers and customers. As such, they haven't been focusing on densifying their service areas since day one, and they believe a period of five years from the moment they do start to focus on this is required to achieve the necessary densification.
 - 12 The "traditional approach" to urban sanitation, premised on extending sewerage networks and building WWT plants, will

not be sufficient to deliver CWIS services for all. CWIS occurs where everybody benefits from adequate sanitation service delivery outcomes; fecal waste is safely managed along the whole sanitation service chain; effective resource recovery and reuse are considered; a diversity of technical solutions is embraced for adaptive, mixed, and incremental approaches; and on-site and sewerage solutions are combined, in either centralized or decentralized systems, to better respond to the realities found in developing country cities.

- 13 Some of these advantages and limitations are shared with other sanitation service solutions. However, the focus of the report is not to compare CBS services with other sanitation services but rather to assess CBS services in their own right.
- 14 This experience was not the subject of a dedicated case study for the purpose of this report.
- 15 C.f. SDG 6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- 16 In the SDG 6.2 definition and according to the Joint Monitoring Programme (JMP), "Improved sanitation facilities are those designed to hygienically separate excreta from human contact." (JMP 2018) Defining a safe CBS service could ensure that the solution is counted among those improved sanitation facilities in SDG monitoring.

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ABBREVIATIONS

avg.	average (mean)
BSFL	black soldier fly larvae
CBS	container-based sanitation
CDC	Centers for Disease Control and Prevention
CWIS	citywide inclusive sanitation
DESA	Dirección Ejecutiva de Salud Ambiental (Executive Directorate of Environmental Health), Peru
DINEPA	Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation), Haiti
EHSD	Environmental Health and Sanitation Directorate, Ghana
EIA	environmental impact assessment
EPS	entidad prestadora de servicios de saneamiento (sanitation service provider), Peru
FLO	Fresh Life Operator
FSM	fecal sludge management
GAMA	Greater Accra Metropolitan Area
HH	household
KeBS	Kenya Bureau of Standards
KESHP	Kenya Environmental Sanitation and Hygiene Policy
KMA	Kumasi Metropolitan Assembly
MOU	memorandum of understanding
MSABI	Maji Safi kwa Afya Bora Ifakara (Safe Water for Better Health Ifakara), Tanzania
NEMA	National Environment Management Authority, Kenya
NGO	nongovernmental organization
OREPA	Office Régional d'Eau et d'Assainissement (Regional Water and Sanitation Office), Haiti
OSS	on-site sanitation
OTASS	Technical Organism for the Management of Sanitation Services
SDG	Sustainable Development Goal
SEDAPAL	Servicio de Alcantarillado y Agua Potable de Lima (Lima Sewerage and Water Supply Service), Peru
SOIL	Sustainable Organic Integrated Livelihoods
SSP	Sanitation Safety Plan
SUNASS	Superintendencia Nacional de Servicios de Saneamiento (National Superintendent of Sanitation Services), Peru
t	ton
TP	treatment plant
UDDT	urine-diverting dry toilet
US\$	United States dollar
WASH	water supply, sanitation, and hygiene

WGP	Water Global Practice (of the World Bank)
WHO	World Health Organization
WSS	water supply and sanitation
WSUP	Water & Sanitation for the Urban Poor
WWT	wastewater treatment

INTRODUCTION

The Urban Sanitation Challenge

Urban population growth continuously outpaces gains in improved sanitation access and services. More than half of the world's population is now urban, representing approximately 3.9 billion people, nearly 1 billion of whom live in urban slums with poor or no sanitation. The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) estimates that 4.5 billion people in the world do not currently have access to safely managed sanitation. An estimated 57 percent of people living in urban areas do not have toilets with a full sanitation service, and 16 percent do not have a basic sanitation service (WHO and UNICEF 2017). Approximately 100 million people living in urban areas still practice open defecation. This results in environmental degradation; epidemic and endemic disease; low productivity; and constraints on the delivery of essential urban services such as housing, transport, potable water, and drainage. Ultimately, this limits economic growth, urban development, and city competitiveness. With limited financial and human resources, a changing climate, and rapid, unplanned urbanization, many cities are struggling to cope.

Improved sanitation results will generate multiple benefits, including lower disease burden, improved nutrition, reduced stunting, improved quality of life, increased attendance of girls at school, healthier living environments, better environmental stewardship, increased job opportunities and wages, improved competitiveness of cities, and economic and social gains to society more broadly. The sustainable development goals (SDGs) provide a new impetus to ensure access to sustainable water and sanitation services, keep cities safe

and resilient, and ensure citizens' health and well-being. In this context, the World Bank Water Global Practice (WGP) has identified urban sanitation as a significant challenge, as many cities in developing countries struggle to deal with the most basic task of managing fecal waste for all citizens.

“Business as usual” in urban sanitation is not working.

The “traditional approach” to urban sanitation—premised on extending conventional sewerage networks and building large, centralized wastewater treatment (WWT) plants—will not be sufficient to deliver citywide inclusive sanitation (CWIS) services for all. CWIS occurs in situations where everybody benefits from adequate sanitation service delivery outcomes; fecal waste is safely managed along the whole sanitation service chain; effective resource recovery and reuse are considered; a diversity of technical solutions is embraced for adaptive, mixed, and incremental approaches; and on-site and sewerage solutions are combined, in either centralized or decentralized systems, to better respond to the realities found in developing country cities.

Alternative approaches are needed to deliver adequate and inclusive sanitation services across the full sanitation service chain.¹

Informal urban settings pose particular challenges in the rollout of sanitation services, such as difficult access; lack of land tenure or space to build a sanitation solution; often challenging physical and topographical conditions, such as rocky soil, closeness to water bodies, and high-water tables; a lack of water supply; and/or regular exposure to flooding. Approaches are needed to meet these challenges so that the population living in informal settings, who are often among the most vulnerable, can benefit from adequate sanitation services.

Cities need to develop comprehensive approaches to sanitation improvements that encompass long-term planning, technical innovation, institutional reforms, and financial mobilization. They will need to demonstrate political will and technical and managerial leadership to focus on drivers for innovation and to manage funding for sanitation in new and creative ways.

The present study was initiated to develop a better understanding of existing container-based sanitation (CBS) approaches and identify whether they could be included as part of a portfolio of solutions for CWIS.

What Are CBS Approaches?

Since the early 2010s, CBS models have emerged as an alternative service approach in circumstances where existing sanitation solutions were deemed inadequate or unfeasible. CBS consists of an end-to-end service that collects excreta hygienically from toilets built with sealable, removable containers and strives to ensure that the excreta is safely treated, disposed of, and reused.² Most CBS toilet systems separate urine from the feces through urine diversion mechanisms, though none of the CBS providers reviewed currently process the urine for reuse, as it is heavier to transport. Households benefit from having a toilet in their own homes or nearby (with associated benefits of convenience and privacy) without having to provide upfront financing for investing in infrastructure (such as a latrine), which in many cases they cannot afford.

Rather than building a sanitation facility, households (or public toilet operators) can sign up for a service. They are usually provided with a light, portable toilet that is independent from any superstructure, though in some cases, such as for Sanergy, that can also be included. The CBS service provider conducts regular visits to empty the facilities. The toilets contain sealable excreta containers (also referred to as

cartridges) that are safely sealed and removed, without exposing residents or workers to the excreta, and taken to a treatment or resource recovery center for processing and cleaning. The service provider provides the customer with an empty, clean container when the full one is removed. Transport methods can vary (and may involve *tuk tuks*, motorcycles, hand carts, and donkey carts) so as to adapt to a variety of space and logistical constraints.

CBS service providers may manage the entire sanitation service chain themselves or partner with other groups or local authorities to implement other parts of the chain. Some of the CBS service providers build and operate resource recovery facilities, taking advantage of the high nutrient content of the relatively “fresh” and undiluted excreta to produce biogas, solid fuel, fertilizers, or other products.

Report Objectives

The objective of this report is to document and assess existing CBS approaches, with a particular focus on evaluating their safety, reliability, affordability, and financial viability. The report also seeks to identify the circumstances in which CBS approaches are most appropriate and whether they could be considered as part of a portfolio of options for CWIS.

The study was motivated by the growing interest in the emerging CBS experiences and by the fact that many governments, city authorities, and financing entities are often not familiar with the approach. The study’s findings should be relevant to public sector agencies (including governments, both at national and local levels, water and sanitation service providers and other urban service providers, regulatory agencies, and others) and sector donors (including multilateral development banks, bilateral aid agencies, international nongovernmental organizations (NGOs), and foundations) that may wish to better understand these models

and consider them in the design of urban sanitation programs. The study could also be relevant for CBS service providers looking to improve performance and scale up operations.

Study Methodology

The study was conducted in three stages:

- Stage 1 – A global landscaping study
- Stage 2 – In-depth case studies of selected CBS models
- Stage 3 – A summary assessment (this report)

Stage 1 involved a global mapping of where CBS approaches have been introduced and a rapid review of their performance based on readily available information. This phase included gathering information from CBS entrepreneurs and from organizations that have financially supported such approaches or are considering doing so in the future. Information was collected regarding their perceptions on the quality of CBS services, their relevance for developing country contexts, and their assessment of the viability of current CBS models and prospects for expansion.

Based on this global mapping, representative case studies were selected for further analysis. The criteria for selection were to include CBS service providers that were already operating at a comparatively larger scale while ensuring a diversity of operating models.

Stage 2 consisted of four in-depth case studies of CBS service providers identified under Stage 1, namely Sanergy (Kenya), Sustainable Organic Integrated Livelihoods (SOIL) (Haiti), Clean Team (Ghana), and x-runner (Peru). Each study investigated how CBS services fit within the overall city context and assessed how each provider compared with alternative sanitation solutions, from the point of view of customers and of the authorities responsible for sanitation services. Each case

study was prepared as a stand-alone report using a common format.

The case studies include interviews with key personnel of each CBS service provider; the collection of documents, data, and reports; and observations of equipment, facilities, and key activities. Interviews were held with customers and users, investigating their motivations for adopting the service, their level of satisfaction, complaints, and the sanitation alternatives available to them as well as their reasons for not using them. Local residents not currently using CBS services were also interviewed. Officials from the relevant policymaking and regulatory bodies and utilities were interviewed to ascertain their knowledge and views of CBS, if and how it is regulated, and what future plans exist that might impact the prospects of CBS in the city in question. A summary is given in table I.1.

Views from a limited number of service users were gathered through individual interviews and focus group discussions. No representative surveys were undertaken for the purpose of the study due to time and budgetary constraints; however, where the CBS service providers had themselves conducted surveys, this information was consulted. Details and a full list of references are provided as appendixes to the case studies and Appendix A of this report.

Stage 3 drew a summary assessment on the affordability, safety, reliability, and financial viability of existing CBS approaches. On the basis of this analysis, preliminary conclusions were formulated as to whether CBS approaches could be adopted as part of a mix of sanitation solutions to promote CWIS.

This report builds on the main findings from the case studies. It formulates lessons from these experiences aimed at governments, funders, and other stakeholders who may be interested in incorporating CBS into a portfolio of sanitation solutions to deliver universal services.

Table 1.1 • Information Collected from Stakeholders for the Case Studies

Overall city context	
<ul style="list-style-type: none"> · Economic and political environment, poverty characteristics · Water and sanitation service coverage, including hardware and service coverage across the whole sanitation service chain, FSM, and septage management · Areas served by alternative sanitation options—common characteristics/subdivisions (socioeconomic profile of population) · Current and planned target areas for CBS service provider being studied · Topography, water availability/scarcity indicators, housing density, physical and communication infrastructure, labor market (skills, cost of labor) 	
Key stakeholders and topics for study	
Authorities/utilities	Community leaders
<ul style="list-style-type: none"> · Policies (national/municipal) · Regulations (national/municipal) · Enforcement · Strategies and plans, including for meeting sanitation SDGs (if any) · Key metrics when evaluating CBS · Current support for CBS (funds, land, etc.) · Potential and future support for CBS 	<ul style="list-style-type: none"> · Public perceptions (CBS, alternatives) · Health impact · Environmental impact · Sanitation improvement plans, projects · Potential for expansion of CBS · Local political considerations and their impact
CBS service provider and commercial partners	Customers and other local residents
<ul style="list-style-type: none"> · Operations mapping · Sales and marketing approach · Cost recovery · Challenges · Partnerships/tensions · Health/environmental impact evaluation · Plans for expansion and support required 	<ul style="list-style-type: none"> · Motivation/concerns for adoption · Affordability · Perception of CBS versus alternatives · Satisfaction/complaints · Consistency of use of service · Turnover/dropout reasons
Donors/financiers	
Financing to date (amount, type) Anticipated returns and timeline (social, financial, and environmental) Future support plans	

Note: CBS = container-based sanitation; FSM = fecal sludge management; SDG = Sustainable Development Goal.

Notes

- 1 For the purpose of this report and in alignment with the CWIS approach, the sanitation service chain consists of containment, emptying/collection, transport, and treatment and reuse/disposal. In addition, activities related to demand creation and marketing have been considered in their own right as part of the sanitation value chain, given their importance for CBS services.
- 2 In this report, the term *excreta* is used instead of *waste* to avoid any potential confusion with solid waste. Tilley et al. (2014) define excreta as “urine and feces that is not mixed with any flushwater.” Note that for the four CBS case studies prepared for this report, the feces and urine are separated using urine-diverting toilet technologies. Cases where the CBS service provider collects only feces are referred to accordingly as *feces*. Also note that cover material (for example, sawdust or carbon cover) is added to the feces or excreta in all cases.

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CHAPTER 1 • OVERVIEW OF CBS SERVICE MODELS

A Short History of CBS

Container-based sanitation (CBS) approaches first emerged when different actors sought to design safe sanitation solutions for the urban poor with the potential to overcome four critical obstacles:

- Severe physical space constraints for installing and emptying on-site sanitation (OSS) solutions, combined with the high risk of flooding of these solutions in some areas;
- The high cost and technical challenges associated with installing conventional sewerage networks in dense and informal urban areas;
- Low political priority of sanitation for the urban poor, leading to low investment; and
- Poor and unreliable availability of water.

Implementation of CBS approaches on the ground started in the early 2010s. In 2009, Sustainable Organic Integrated Livelihoods (SOIL) and Oxfam launched a household CBS project in northern Haiti before shifting focus to CBS as an emergency response to the earthquake in Haiti's capital in 2010. Sanergy launched operations in Kenya in 2010; promptly followed in 2011 by SOIL in Haiti (when it relaunched its CBS household service), Clean Team in Ghana, and x-runner in Peru; then Sanivation in Kenya in 2012; and finally Loowatt in Madagascar in 2014.

Some pioneer CBS service providers began with a full sanitation service chain approach. Sanergy began as a for-profit start-up whose business model was to link the safe sanitation service chain with agricultural markets. SOIL's operation evolved from a EcoSan public toilet model, which had been implemented in rural and urban areas of Haiti since 2006. SOIL started with public double-vault composting toilets before moving to container-based household toilets as the challenges of voluntary management of toilets became apparent. Sanivation, another

for-profit start-up, first established a full sanitation chain approach in Naivasha to serve households. Since then, it has implemented CBS services in a refugee camp and signed a memorandum of understanding (MOU) with the water and sanitation utility in Naivasha and the local government to process all the fecal sludge in the county.

Others focused, at least initially, on one or the other end of the sanitation service chain. x-runner in Peru began with industrial designers seeking a mobile toilet solution that would deal with space constraints and poor access to emptying services. Loowatt focused on developing a waterless toilet that facilitates excreta reuse. Clean Team was set up to test the idea that a containment, emptying, and transport service could be set up as a business—in a context where people were already paying for public toilets.

These CBS pioneers, which are also the largest service providers at this point in time, came together in late 2016 to form the CBS Alliance, as described in box 1.1.

Manila Water, a private company, is testing the applicability of CBS as an alternative front-end component for areas where other sanitation alternatives, such as sewer-based solutions or septic tanks, cannot be installed due to space or other topographical constraints. Manila Water provides water and sewerage services in the Manila Metro East area under a 25-year concession contract and is looking for solutions for the customers at the bottom of the pyramid. Following a presentation of Clean Team's early experience in 2014, Manila Water decided to carry out a CBS pilot in the service area of Laguna Water, one of its subsidiaries that provides water services to approximately 80 percent of households in the municipalities of Biñan, Santa Rosa, and Cabuyao in the Laguna Province. An initial phase of the pilot took place in 2017, during which two alternative toilet models were tested from Lixil and Loowatt in 30 households. The pilot's objective was to identify whether this approach could be scaled up in areas

Box 1.1 • The CBS Alliance

The CBS Alliance is a coalition of container-based sanitation (CBS) practitioners from around the world. The founding members of the CBS Alliance include Sustainable Organic Integrated Livelihoods (SOIL), Sanergy, Clean Team, x-runner, Sanivation, and Loowatt. Members came together in November 2016 to promote knowledge sharing and learning, to create a set of common CBS guidelines and standards, thus formalizing CBS as a service model, and to provide the basis for a scale-up of these services beyond its initial members.

See www.cbsa.global for more information.

that are difficult to reach with more conventional sanitation solutions or where space is limited so as to comply with Laguna Water's universal service obligations. The pilot also aimed to compare the two portable toilet models according to specific criteria (financial, environmental, customer satisfaction, health and safety, and ability to scale up) and rank them accordingly. The pilot is embedded in Laguna Water's "Utility Business Model," wherein water revenues cross-subsidize the operations and maintenance of its "used water services" after the collection of environmental fees (2018). The Laguna Water team has presented pilot results to Manila Water's management and is exploring the potential for further rollout.

The aforementioned CBS service providers have different legal arrangements, but all are seeking a self-sustaining business model. Manila Water, Loowatt, and Sanivation are private companies, though they have received funding from philanthropic foundations. SOIL is a U.S.-based nonprofit organization, and Clean Team is a Ghana-based social enterprise set up by a partnership between a U.K.-based nongovernmental organization (NGO), a large private corporation, and an academic research organization. Sanergy is composed of two entities: a for-profit entity, which provides services at a fair market value to its nonprofit entity (which owns a toilet franchise) while selling reuse products with an eye to generating profits. x-runner is a private Swiss company, whose operations in Peru are conducted by a Peruvian nonprofit.

Four other examples of sanitation solutions that fit the CBS Alliance's definition of CBS were also identified. These approaches are not yet fully developed

and were not investigated in detail as part of this study, in some cases because they function more like conventional NGOs rather than companies seeking to adopt an entrepreneurial approach. Sanitation First has a multiple container system with four containers on a roller base underneath toilet floors, which works so that the feces are older and drier by the time they are removed. Its system serves 10 to 12 neighboring households in Puducherry and Cuddalore in India. Fundación Sumaj Huasi (La Paz, Bolivia) has constructed more than 900 high-standard household EcoSan toilets that use a 100-liter movable container to store the feces, which is collected monthly, and 20-liter jerrycans to collect the urine, which is collected weekly. Initially, households were encouraged to use the excreta in their own gardens, but later, two local companies initiated a collection service. The feces are treated via vermicomposting, and the urine is stored for three months and then used as fertilizer (Suntura and Sandoval 2012). Banza portable toilets were piloted in Mathare, an informal settlement in Nairobi, in which compostable bags held the feces, which was collected daily. A business model was to be developed but, as of 2017, the operation appeared to have stopped. The NGO Maji Safi kwa Afya Bora Ifakara (Safe Water for Better Health Ifakara; MSABI), in Tanzania, developed a sealable polyethylene tank designed to be emptied monthly. This is a pilot nonprofit operation with no associated business model.

Key characteristics of the CBS service providers identified through the study are summarized in table 1.1, for those service providers where information was available. The remainder of this report presents information

Table 1.1 • Key Features of CBS Service Providers (as of May 2017)

	Sanergy	Clean Team	SOIL	x-runner	Sanivation		Loowatt	Manila Water	Sumaj Huasi	Sanitation First
Corporate status	Dual: nonprofit and for-profit	Nonprofit	Nonprofit	Dual: nonprofit and for-profit	For-profit		For-profit	Concession utility	Nonprofit	Nonprofit
Location	Nairobi, Kenya	Kumasi, Ghana	Cap-Haitien and Port-au-Prince, Haiti	Lima, Peru	Naivasha, Kenya	Kakuma, Kenya	Antananarivo, Madagascar	Laguna province	El Alto, Bolivia	Puducherry and Cuddalore, India
Type of area	Dense urban	Dense urban	Dense urban	Peri-urban	Peri-urban	Refugee camp	Dense urban	Dense urban	Peri-urban	Dense urban
CBS start date	2010	2011	2009	2011	2012	2016	2014	2017	1998	2014
Toilets in operation	1,026	1,100	1,049	739	120	250	100	30 (pilot)	900	92
Population served or uses per day	47,746 uses per day	5,500 served	6,295 served	3,695 served	600 served	1,250 served	500 served	100 served	No data	No data
Access	Shared/compound/school	HH compound	HH	HH	HH	HH	HH	HH	HH	Group of 10 HH
Cost of toilet unit to service provider	US\$345	US\$92	US\$27 (ferrocement) or US\$50 (wood)	US\$115	US\$46	US\$187	US\$200	TBD	US\$770	No data
Containment	Fixed squat	Portable seated	Portable seated	Portable seated	Portable seated	Fixed seated	Portable seated	TBD	Fixed seated	Fixed squat
Cover material	Sawdust	Sawdust	Agricultural waste	Sawdust	Ash	Charcoal dust	Biodegradable bag	TBD	Sawdust; small amount of water after urinating	Ash
Urine-diverting?	Yes	Yes	Yes	Yes	Yes	Yes	No	TBD	Yes	Yes
Collections/week	76% daily 23% every two or three days	One (mostly)	One or two	One	Two	Two	One	Two	Monthly	One
User payment	Pay per use	Monthly	Monthly	Monthly	Monthly	Free	Monthly	Water bill	Monthly	Free
Feces/month collected (t)	165	137	46	20	8	7.5	4 (feces + urine)	Negligible (pilot)	Not known	Not known
Main reuse products	Compost, animal feed	None	Compost	Compost	Solid fuel briquettes		Electricity, fertilizer	None	Compost	Compost

Note: HH = household; t = ton.

related to the four case studies that were analyzed in more detail.

Where Have CBS Approaches Been Developed?

The main target markets for CBS are the urban poor living in densely packed settlements. CBS approaches offer several advantages for this market:

- **CBS requires less space than other solutions** such as traditional OSS or sewers, which normally require stand-alone superstructures (large pits or vaults/tanks as well as ways to access and empty them) in compounds/yards or space within households for their installation.
- **Household CBS toilets can be moved or reinstalled if the subscriber moves.** There are, therefore, no sunk costs for the customer and limited sunk costs for the service provider.
- **CBS toilets can be more climate-resilient than alternatives and safer than badly run on-site solutions, as the feces is sealed in the container and does not leak into the environment.** In areas that are prone to flooding, for example, due to the lack of urban drainage, CBS toilets can provide a more hygienic solution than on-site solutions as the latter tend to overflow and/or infiltrate into the groundwater. CBS toilets are also more climate-resilient in areas with scarce water resources as they do not necessitate water and alternative products, such as sawdust, are used as cover. Sewers require a minimal use of water for proper flushing.
- **CBS requires no upfront investments by users** (or landlords) because they require limited or no in-house construction; thus, there is no need to invest in building infrastructure. This makes CBS particularly attractive to renters, who may face difficulties obtaining a toilet from their landlords. Payments for the service are spread over time (typically a monthly fee) and can, therefore, be more affordable for cash-strapped households.

- **CBS approaches can also be extended in emergency situations or in refugee camps,** where they can be deployed rapidly without the need for building permanent infrastructure.

Some potential customers living in single-room dwellings, however, have insufficient space and privacy to install a CBS unit.¹ As most potential customers in its service area face such circumstances, Sanergy provides shared toilets, with different arrangements for public/commercial areas, compounds of multiple dwellings/households, and schools.

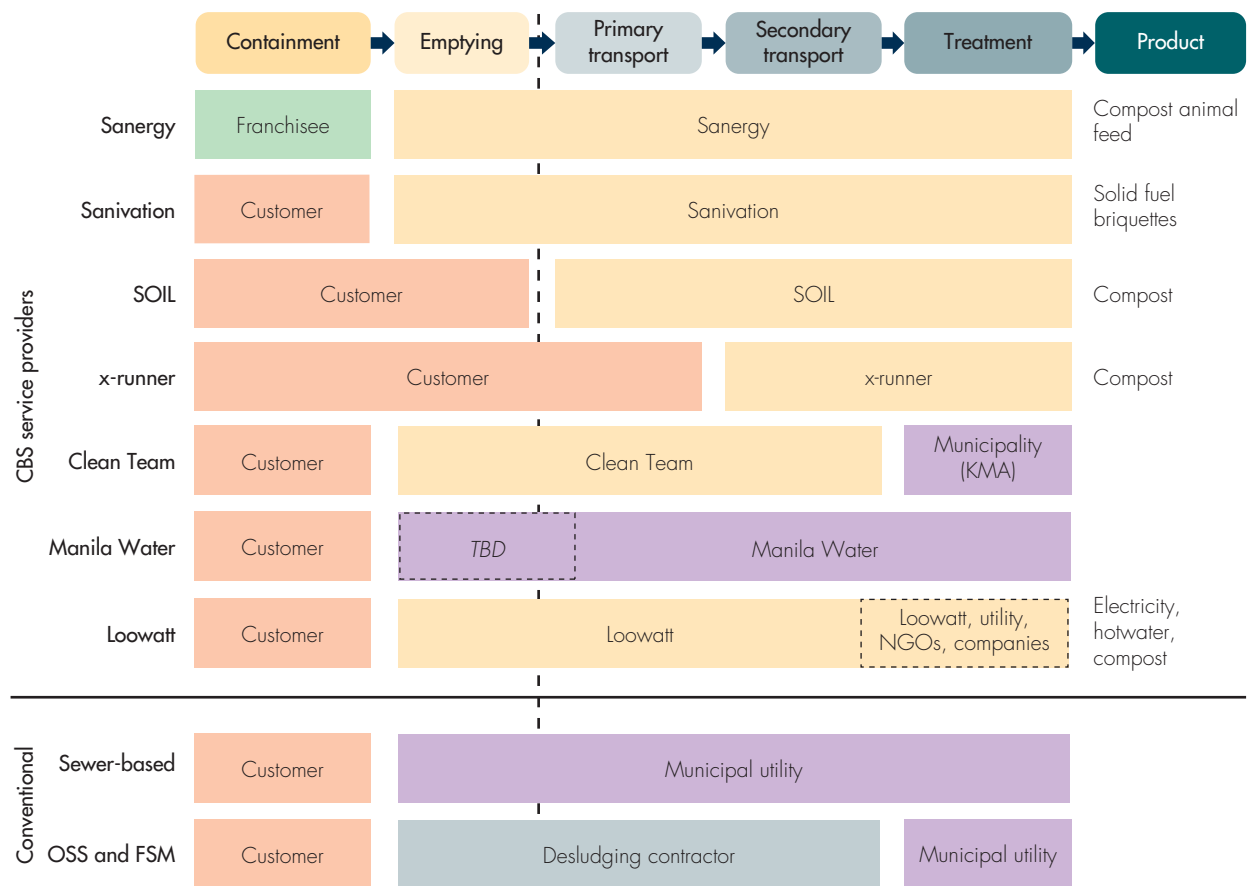
CBS Service Models across the Sanitation Service Chain

The majority of CBS approaches seeks to provide services across the entire service chain, though each provider delivers different levels of service. For the purpose of this report, the sanitation service chain is broken down into six steps:

- **Demand creation:** Promoting safe sanitation practices and the uptake of related suitable hardware and products
- **Containment:** The toilet unit where excreta is initially contained
- **Emptying:** Removing the excreta from the toilet's storage system
- **Transport:** Moving the excreta from the emptying point to the treatment site
- **Treatment:** Bringing the levels of pathogens and nutrients in the excreta to safe/permitted levels for disposal/reuse
- **Disposal/reuse:** Discharging the treated excreta to the environment or incorporating it into, and selling, a reuse product

Figure 1.1 shows which segments of the sanitation service chain selected CBS service providers cover and illustrates that the customer (or franchisee in the case of

Figure 1.1 • CBS Service Providers along the Sanitation Service Chain vs. Conventional Sanitation
Service Providers



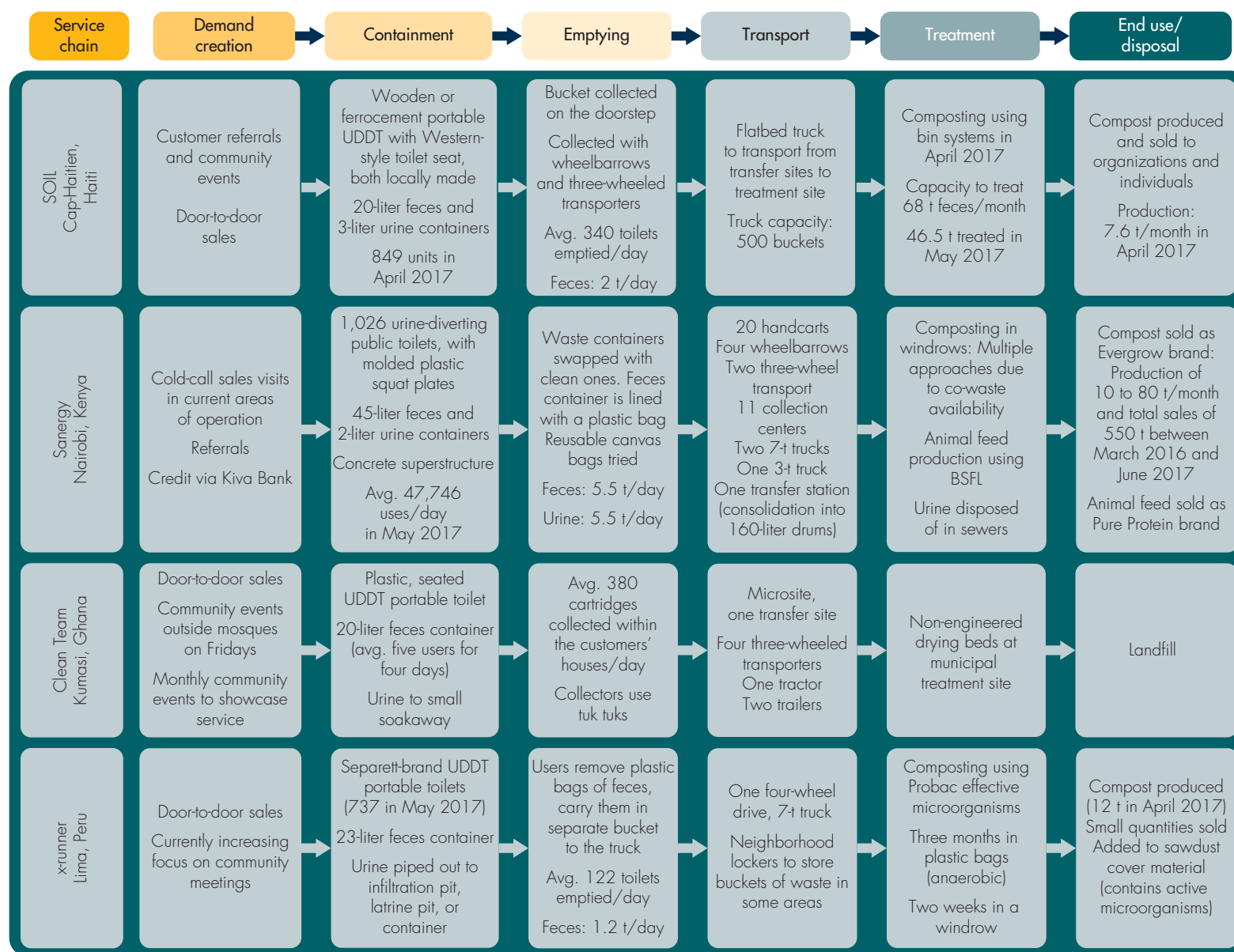
Note: KMA = Kumasi Metropolitan Assembly; NGO = nongovernmental organization. Dotted line indicates the position of the boundary between the house (or of the public toilet in the case of Sanergy) and the external areas where other sanitation services are provided. Green bars show the scope of the CBS service. Red bars show customer responsibilities (except in the case of Sanergy, where a franchised operator (green bar) manages containment). Purple bars show utilities' areas of responsibility. The gray bar shows services contracted to a third party. Reuse products are shown on the right-hand side for additional information.

Sanergy), the CBS service provider, and the municipality/local authority play different roles. This is compared with typical setups for more conventional alternatives, including sewer-based solutions and OSS with fecal sludge management (FSM).²

CBS service providers have made different choices on which segment of the sanitation service chain to tackle, maintaining tight control over containment, emptying, and transport. Although the customer operates the toilet, the toilet remains the property of the CBS service provider, who could repossess it if the customer does

not pay or does not operate it in a hygienic manner. For example, x-runner uninstalls toilets if its staff does not observe adequate standards of hygiene at the household level and if users do not respond to hygiene promotion visits and adjust their behavior accordingly. In the case of Sanergy, if adequate standards are not met (namely the toilet is not kept clean and adequate consumables are not provided), the contract with the franchised operator can be cancelled. Sanergy would then repossess the squatting plate and the containers (the toilet superstructures themselves are not portable) and debrand the toilet superstructure.

Figure 1.2 • Summary Description of Four CBS Service Providers along the Sanitation Service Chain (as of April–May 2017)



Note: Avg. = average; BSFL = black soldier fly larvae; t = ton; UDDT = urine-diverting dry toilet.

A number of CBS service providers operate across the whole sanitation service chain, treating the feces for reuse. The four service providers reviewed under the case studies do so to a large extent, which is described in more detail in figure 1.2. Clean Team is the exception, given that it only dries the sludge before disposing it to the municipal landfill.

Traditional approaches to sanitation service provision, including sewer-based solutions and OSS combined with FSM, should successfully cover the full sanitation service chain when properly operated. In practice, however, the more conventional services often fail to reach customers in the service areas where CBS service providers are currently operating; WWT plants may not safely treat all the sewage due to insufficient capacity, poor design, or improper operation; and sewage may enter the environment in significant quantities from poorly operated or poorly maintained pumping stations or pipelines. Furthermore, OSS with FSM may carry significant safety risks, notably at the points in the service chain where feces is handled. The emptying of pits, vaults, septic tanks, and other OSS containment facilities is often carried out by manual emptiers operating in unsafe conditions and/or the emptying is frequently delayed too long by the households, resulting in the overflowing of fecal sludge into the environment, particularly during heavy rains.

Additionally, the cost of desludging OSS facilities is one of the reasons that the urban poor, who have fragile cash flows, may be tempted to delay emptying. Desludging is often poorly regulated, and the business has generally not been professionalized with standards, codes of conduct, and branded solutions. Therefore, there are many situations with OSS and FSM in which the collected excreta may be discharged—untreated—into the environment and in which the emptying process itself is unsafe for both workers and households. The associated lack of regulation/oversight could also potentially affect CBS service providers, even though the customer-oriented nature of the services and the design of the containers, which are not vulnerable to flooding, aim

to minimize the potential for exposure and the risk to emptiers. However, the fact that the CBS service providers currently operate at a relatively small scale with a strong focus on safety and reuse has meant that they have been able to avoid illegal discharges.

CBS services do not address all sanitation issues. For example, none of the existing CBS service providers tackle the issue of greywater management, which means that alternative solutions need to be found for such waste streams, such as connection to functioning drainage pipes or to soakaways.

The rest of this section presents how the CBS service providers reviewed have organized service delivery along the sanitation service chain.

Demand Creation and Marketing Strategies

CBS services currently involve substantial investment of time and resources in customer onboarding and support, primarily to deal with late payments and to maintain minimum standards of customer behavior.

The sales strategies the four CBS service providers employ are similar, but the organization of their sales teams is quite different. CBS providers typically adopt market-based strategies to gain new customers, increase the density of their services, and reduce costs. These approaches include a focus on demand by closely studying the needs of potential users, adapting products to these needs, and ensuring that customer outreach and service personnel clearly communicate with potential new customers. The sales strategies generally revolve around door-to-door sales, promotions at community meetings and events, and incentivized referrals by existing customers. The sales pitch is usually focused on the benefits of the toilet and of the service provided in terms of hygiene, convenience, and comfort and on the unpleasant, unhygienic, and inconvenient nature of existing sanitation alternatives. Referrals by existing customers are an important component of marketing strategies and support the approach of increasing

coverage density within the areas of operation in order to further achieve economies of scale, and the CBS service providers reviewed are specifically targeting slow adopters.

CBS service providers offer employees – and sometimes customers – financial incentives or rewards for successful referrals. SOIL currently does not have dedicated sales staff and relies upon its collection service personnel, who produce a little more than half of all new customer sign-ups. Clean Team's and Sanergy's sales team members, on the other hand, receive substantial individual bonuses/commissions based on their number of sales. x-runner's sales team has a team target, and team members follow up on each other's sales visits, reflecting a strong team ethos within the organization. Another interesting aspect of x-runner's strategy is that it discounts the price of the service to all customers by 25 percent in communities that reach 50 percent or more coverage with its service.

Sanergy has a franchise system in which toilets are operated as commercial public toilet ventures, by landlords for their (multiple) residents, or by schools. This makes the sales and customer onboarding process more complex. For the commercial toilets, as well as some school toilets, negotiating access to land requires Sanergy's sales and government liaison team to coordinate with community leaders and local authorities. A credit scheme for the installation payments has been set up with Kiva Bank, a microlending institution. Although Kiva shoulders the financial risk, Sanergy helps administer the system and is responsible for following up on late payments. Sanergy is also experimenting with a leasing model for landlords, with a monthly payment of a little more than US\$8, replacing the US\$350 installation payment and US\$70 annual fee. This system targets landlords, whom Sanergy sees as its principal future target market, and reduces the sales cost because it takes less time, on average, to persuade them to sign up for a service that does not require a down payment. From Sanergy's point of view, this approach helps generate better economies of scale,

thanks to the consequent increase in user density in a given area.

CBS service providers have generally adopted a very responsive and customer-centric approach when it comes to nonpayment. The urban poor will often get into debt, including with their CBS service providers, when financial difficulty strikes. CBS service providers conduct follow-up visits with their debtors to understand what the problems are and to see if and when the customers can get back on track with their payments. Although most CBS service providers allow a grace period before imposing penalties or sanctions, in three of the four case studies (that is, Clean Team, Sanergy, and SOIL), the service providers have uninstalled a substantial number of toilets at some stage in their history to cut back on debtors, resulting in a corresponding significant and sharp dip in their customer numbers.

CBS requires users to operate their facilities correctly, keeping them clean and using cover material in sufficient quantities. Poor utilization by households will generally be identified and reported by collection agents, and follow-up visits will be made by customer support staff to reinforce the expected standards. Failure to respond to such follow-up orientation puts the safe sanitation chain at risk, particularly at the emptying/collection stage. It also typically results in the uninstallation of the toilet, which in all cases remains the property of the CBS service provider.

Hygiene is also an important component of customer interaction and service provision. All CBS service providers interviewed provide hygiene training as part of the onboarding process, as well as follow-up visits through their emptying and/or sales teams. Such training reinforces the importance of proper and hygienic use of the toilets through regular communication with customers, and the necessary resourcing and human capital deployment was provided in all cases. Menstrual hygiene waste is sometimes collected in separate bins provided by the service provider and burned (as in the case of Sanivation and Sanergy), or it is left for the customer to throw away with the household trash.

Photo 1.1 • Examples of CBS Toilets

a. SOIL's ferrocement EkoLakay model



b. SOIL's wooden EkoLakay model



c. Clean Team's imported plastic model



d. Sanergy's Fresh Life Toilet



e. Separett toilet, used by x-runner



Sources: a–c, Adrien Mazeau; d, Sanergy; e, Julian Parker.

Containment

The majority of CBS toilets are seated portable units that are placed inside the household (see photo 1.1). All but one of these toilet types has a urine diversion system.³ Loowatt's toilet is the exception and has a proprietary mechanism to encapsulate the combined urine and feces in biodegradable plastic film. Three of the four models reviewed are pedestal toilets, designed for sitting on; however, Sanergy's Fresh Life Toilet, which is either public or shared between multiple households, has a squat plate. Clean Team uses a seated toilet that is sometimes shared between families, but seeing as these families tend to live under the same roof for a prolonged period in a compound house, they know each other well and such intimacy is generally acceptable.

The toilets vary considerably in price with a general increase in convenience and comfort at higher prices. SOIL has a ferrocement model that costs US\$27, but, as it is handmade, it is not necessarily suitable for large-scale production. A cost of US\$40 to US\$50, including import costs, was recommended to Clean Team as a target (Ernst & Young [EY] 2017); the toilets it has been importing currently cost US\$92 each. The Separett toilet is sold to x-runner by its foreign producer at a heavily discounted price. In this case, customers would likely not accept the possible downgrading to a cheaper unit because they see the current plastic toilets as easier to clean and maintain a hygienic state.

A key component of most CBS systems is a good supply of cover material to add to the feces after each use to prevent odors and flies. The most common cover material is sawdust, which has good odor-elimination and desiccation properties, though its effectiveness varies with the wood species, dryness, and coarseness. Agricultural waste (for example, sugarcane bagasse and peanut shells) and ash or charcoal dust are also used. The cover material used depends on what materials are available locally and are typically provided to users as part of the service.

The reliable sourcing of good-quality cover material has presented some challenges. The availability and sourcing strategy should be reviewed prior to a new CBS operation or a major expansion. In 2017, x-runner started to face challenges obtaining sufficient quantities of sawdust because for each purchase (from various small carpentry businesses), it has to physically check the quality and quantity available and negotiate a price.⁴ In Kumasi, sawdust is readily available from large sawmills, and its supply has been outsourced by Clean Team to a contractor. However, some customers reported maggots and ants developing in the sawdust when the collection schedule changed from three times a week to two. SOIL, on the other hand, has been exploring the potential use of compost as cover material. Sanergy's franchisee operators deal with sourcing cover material themselves, but have a strong incentive to ensure its supply and quality to maintain good hygiene standards and limit odor. This is a good example of how the franchise model can help outsource tasks that otherwise can be a significant logistical burden without compromising on quality.

There is currently no CBS toilet model or system that is specifically designed for users that practice washing for anal cleansing. One of Sanergy's franchisees in an area with a significant Muslim population raised this as an issue and provides customers with a small container of water so that they can wash over the urine hole. Sanivation rolled out a model to six households in the Kakuma Refugee Camp: Early findings found that five households adopted this solution, but one did not accept it. Loowatt toilets can be used by anal washers as it collects all excreta—feces and urine—together, so the issue that other CBS service providers have of not mixing the two is not a problem for them. It piloted service provision with anal washing to families together with Laguna Water (as mentioned previously).

Emptying/Collection

The CBS service providers collect the feces either from within the customer's home (or the public toilet), at the doorstep, or at a drop-off point, depending on physical

constraints and customer preference. Containers that are full of feces are swapped with empty ones at the collection point in most, but not all, cases. For example, x-runner's customers remove bags of feces from the toilet cartridge, which has a lower and wider profile than a standard bucket, and place them in standard off-the-shelf buckets, which they seal and carry to the pickup point. x-runner washes and disinfects the collected buckets before putting them back into circulation for the next round. The bags used to line the feces containers are used throughout the journey and are either removed before or during the treatment process (for example, by being sieved out) or they are biodegradable in nature (in the case of x-runner and Loowatt). Sanergy piloted the use of reusable canvas bags for 80 toilets, given that plastic bags are a significant cost and the Kenyan government legislated to ban their use in September 2017. As of May 2018, Sanergy had generalized the adoption of these reusable bags, which are washed in an industrial process.

Transport

The form of transportation CBS service providers use depends upon the terrain and road access and is usually a combination of handcarts, three-wheeled transporters (auto-rickshaws or tuk tuks), tractor-trailers, flatbed trucks, and box trucks. In some cities, there are households/toilets accessible only by narrow alleyways or steep staircases, which preclude vehicles. Handcarts and three-wheeled transportation modes are used to transport feces or excreta (in the case of Sanergy) from the toilets and drop the feces at some form of transfer station, where it is consolidated on trucks for haulage to the treatment site. The steep topography in the settlements in Lima where x-runner operates means that the only cost-effective way to get the feces from households not directly on the roads is for the customers to carry it themselves to a drop-off point, from which a truck will pick it up.

To optimize the use of transport, feces is usually temporarily stored and consolidated at one or more points. x-runner provides dedicated storage spaces referred to as

lockers for some groups of customers (typically six to 10) to leave their bags of feces when they leave home before the truck's early morning collection round. Most CBS service providers operate one or more transfer stations—sites where feces-filled containers can be temporarily stored and consolidated for onward transfer. In Sanergy's case, these are differentiated into collection centers, where the 45-liter containers collected from toilets are temporarily stored before onward transport, and transfer stations, where the feces is repacked into 160-liter drums for trucking to the treatment site. As operations scale up and coverage density increases in existing areas of operation, the use of collection, temporary storage, and feces consolidation facilities will increase, and more than one stage may be required for storage. Access to land and buildings where the CBS services are provided will impact the collection, storage, transfer, and transportation options that are available.

Treatment and Reuse/Disposal

Some CBS service providers have opted to reuse the feces to produce a marketable product, with feces-based compost (organic fertilizer) being the most common. Blended with organic co-waste streams, including an organic-rich cover material such as sawdust or agricultural waste materials, feces-based composts improve the structure and organic content of soil. Across the globe, monocropping and the application of large quantities of chemical fertilizer are exhausting soil—that is, destroying their structure and reducing their organic content to critical levels. Byproducts from sanitation services could provide a critical input to enrich soil quality in contexts where soils are being rapidly depleted, and CBS service providers have been working to market their products accordingly. In the case of CBS, collected feces is fresh (not partly or fully digested as it is in other sanitation service options), so it has greater methane production potential and does not need to be dried for composting. Because it is not diluted with urine or water, it carries less risk of household system misuse (such as having solid waste disposed of in the toilet).

Other options for reuse of CBS products include

- Animal feed, when the feces is fed to black soldier fly larvae (BSFL) and such larvae is converted into animal feed; and
- Fuel, either through the production of biogas (from anaerobic digestion) and its accompanying residue that can be used for agriculture after appropriate pathogen reduction or from solid fuel briquettes.

Excreta reuse products have the potential to generate significant revenues. However, this requires meticulous experimentation and optimization and the securing of reliable markets to achieve scale, in terms of both supply of the organic waste products and demand for the reuse products. Even though most CBS systems separate urine from feces through urine diversion mechanisms at the containment stage, only Sanergy currently collects the urine separately (and even it ultimately discharges it in nearby sewers without attempting to reuse it). Some of the main reasons for this lack of emphasis on reusing urine—and why the urine is separated in the first place—are the high costs associated with transporting liquids, drier feces is easier to transport, and any malodor produced in the toilet is significantly reduced, if not eliminated. The potential for urine reuse should be further explored, given its high nutrient content and its relatively easy processing for soil application.

None of the CBS service providers has run a profit yet from its reuse operations. Sourcing sufficient quantities of suitable co-wastes at low cost is critical for the profitability of the composting process. Co-wastes are predominantly agricultural wastes (for example, sugarcane bagasse, peanut shells, stalks, and vegetable peels) whose availability varies by season. Hence, different blends may be needed throughout the year, for which the ratio of feces to co-waste needs to be adapted accordingly. Transport will often be the major cost parameter for co-waste as it is likely to be sourced from farms and factories over a wide area. Solid fuel briquettes have a large proportion (between 75 and 95 percent) of high-carbon co-waste (for example, charcoal dust or residues from agricultural production)

and, therefore, are also sensitive to the availability of the co-waste inputs. Regulatory constraints have also been a significant barrier to scaling up reuse: In Peru, x-runner is not allowed to sell its compost due to such constraints.

Sanergy believes it will be able to turn a profit on its reuse product sales, which it runs as a separate for-profit business, based on expanded production, optimization of the production process, and the expansion of the distribution networks for the final products. However, this does not take into consideration the front end of the service chain (capture, containment, and emptying), which is run by the nonprofit and will likely continue to require subsidies until a sustainable scale/density is achieved.

CBS service providers that generate reuse products sell them on the open market, often as branded products. Sanergy, SOIL, and Sanivation all sell their end-use products to a purely retail market—branded farming inputs in the case of Sanergy and SOIL and solid fuel briquettes in the case of Sanivation. SOIL is seeking output-based aid subsidies to supplement the US\$280 per ton that it receives for its compost. Sanergy is able to get a higher price (approximately US\$400 per ton) for its compost in Kenya and has introduced high-protein animal feed as a second major end-use product. Sanergy and SOIL sell to a combination of commercial farmers and smaller customers such as smallholder farmers. Sanivation sells briquettes to roadside food outlets, restaurants, and hotels, as well as private individuals—it started with direct sales and is gradually building up a retail distribution network to reduce sales costs. The briquettes are marketed based on their longer burn time, greater heat production, and reduced smoke—as compared to charcoal and firewood—and the fact that they contribute to stemming deforestation. Loowatt produces electricity for use on its treatment site, as well as a pasteurized fertilizer and compost.

The treatment processes used and the products generated by some of the CBS service providers reviewed are summarized in table 1.2.

Table 1.2 • Reuse Activities: Processes and Products

Service provider	Treatment processes	Reuse products
SOIL	Aerobic composting: static pile then windrow turning, with sugarcane bagasse co-waste at start of process.	Compost branded as Konpos Lakay, sold at US\$280/t.
x-runner	Bokashi anaerobic composting followed by two weeks of aerobic windrow composting, with effective microorganisms added at the beginning of each stage.	Compost product. Not marketed due to a lack of regulatory framework for treated feces reuse.
Sanergy	Aerobic composting with a variety of agricultural/organic co-waste materials.	Evergrow compost sold at US\$400/t.
	BSFL digestion of feces.	Pure Protein animal feed, under development.
Sanivation	Mixing feces with high-carbon material (for example, ash or carbonized rose waste) and pressing and drying of briquettes.	Fuel briquettes sold for between US\$150 and US\$180/t.
Loowatt	Anaerobic digestion to produce electricity. Pasteurized digestate residue sold as is or converted to compost via aerobic composting followed by vermicomposting.	Products yet to establish a market—willingness to pay study conducted.

Note: BSFL = black soldier fly larvae; t = ton.

Notes

- 1 The concept of privacy depends on the context: In Haiti, there has not been a problem with people finding space, even in very small dwellings, whereas in Kenya, there seems to be resistance to having an in-home toilet in a small dwelling.
- 2 *Fecal sludge management* is defined here as the emptying of pits, vaults, septic tanks, and so on, and the treatment of the resultant fecal sludge (or feces in CBS cases) at plants specifically designed to treat concentrated fecal sludge and/or septage.
- 3 In the case of SOIL, though household toilets are urine-diverting, the rental service EkoMobil is not. The toilets used for events are larger and come with more cover material to keep them dry during the time of use, and then the whole structure is transported to the treatment facility and the urine is treated with the feces.
- 4 As of May 2018, x-runner has entered working agreements with three larger sawdust suppliers, which has alleviated this pressure.

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CHAPTER 2 • LEGAL AND POLICY ENVIRONMENT FOR CBS SERVICES

This chapter reviews the legal and policy environment for container-based sanitation (CBS) services.

The legality of CBS services in the different contexts where they are currently implemented varies. In Ghana, Haiti, and India, the legality of the CBS approach is seen as tenuous, whereas in Kenya, there is a defined legal category of “cartridge-based toilets,” which provides a conducive environment for CBS businesses. As sanitation policy evolves, CBS actors become better organized globally and the regulation of sanitation services is strengthened in countries where it is currently weak. The explicit recognition of CBS services is also anticipated to increase. Robust regulation of CBS services will be of growing importance if more entrepreneurs are attracted to providing such services so as to mitigate the risk of poor-quality copycats.

Overall Legal Environment for Sanitation

In the four countries reviewed in the case studies, the current landscape for the sanitation sector is characterized by fragmented and overlapping institutional responsibilities and major changes with regard to policies and/or institutional roles. In January 2017, Ghana established a new Ministry of Sanitation and Water Resources, to which responsibilities have been gradually transferred from other ministries. Kenya has a new Environmental Sanitation and Hygiene Policy (KESHP), but a regulatory framework needs to be developed and the policy emanates from the Ministry of Health, whose sanitation engagement hitherto has been mostly limited to rural sanitation promotion. Currently, the national environment regulator, the National Environment Management Authority (NEMA), provides the closest regulation of Sanergy’s operation through the licensing of the vehicles it uses to transport excreta.

Peru released a new sanitation policy in January 2017, and regulations are under preparation. Institutional roles overlap, however, and the Ministry of Housing, Construction and Sanitation is preparing to implement a program that will take over water supply and sanitation and asset development in Lima from the city’s utility, Servicio de Alcantarillado y Agua Potable de Lima (Lima Sewerage and Water Supply Service; SEDAPAL). In Haiti, there is clarity on institutional roles, with the Direction Nationale de l’Eau Potable et de l’Assainissement (National Directorate of Water and Sanitation; DINEPA) as the national coordinating agency; urban sanitation policies and regulations are slowly being developed from a low base. In the Philippines, the sanitation policy is well-developed, and the government’s strategy focuses on promoting non-sewer-based solutions in the urban environment as part of a mix of solutions, but regulation of urban sanitation services suffers from fragmentation.

Legal Regimes for CBS Services

The legal regimes under which CBS services are currently provided are summarized below. These range from countries in which the legality of CBS is tenuous (such as in India, Haiti, and Ghana)¹ to those where CBS is legally possible but not specifically encouraged (such as in Peru) to others where the legal regime has recently been modified to explicitly allow for CBS (such as in the Philippines and Kenya). The specific legal and regulatory regimes are discussed in the following paragraphs, beginning with those countries where the legality of CBS is more tenuous.

In India, a 2013 law banning “manual scavenging” and the handling of fresh feces presented a particular

challenge to CBS service providers. Sanitation First has overcome this by developing a toilet with four containers that can be rotated in the vault to ensure that feces is the required 28 days old before the containers are manually removed and the feces transported to a composting site.

In Haiti, CBS is allowed but not officially referenced in any government document. It most closely corresponds to ecological sanitation, which is allowed in urban areas only if there is adequate domestic demand for the compost produced. A reference document for sanitation is being developed, and Sustainable Organic Integrated Livelihoods (SOIL) is advocating with DINEPA for the inclusion of CBS in this document to provide more solid legal ground for its services. As of May 2018, these conversations were still ongoing.

In Ghana, the legal situation is ambiguous, and CBS is neither prohibited nor supported by national level institutions. At the municipal level, it is cautiously supported.

In Peru, CBS is allowed but not specifically encouraged. The policy framework is agnostic on technology and requires service providers to be incorporated and licensed as an entidad prestadora de servicios de saneamiento (sanitation service provider; EPS), with environmental impact assessments (EIAs) as a prerequisite for acquiring such a status. x-runner did not have EPS status at the time of writing but was outsourcing the transport process to a private company with EPS status. A gap in Peruvian policy means that reuse of treated feces is illegal, but reuse of wastewater and the biosolids from wastewater treatment (WWT) is legal, thereby presenting a barrier to a full CBS sanitation chain approach by not allowing the sale of reuse products.

In the Philippines, CBS matches the legal “box and can privy” category. Although the regulatory environment is somewhat fragmented, the Philippines has a comprehensive policy framework, and the government is currently shifting its focus away from sewer-based solutions, which are considered unaffordable for universal

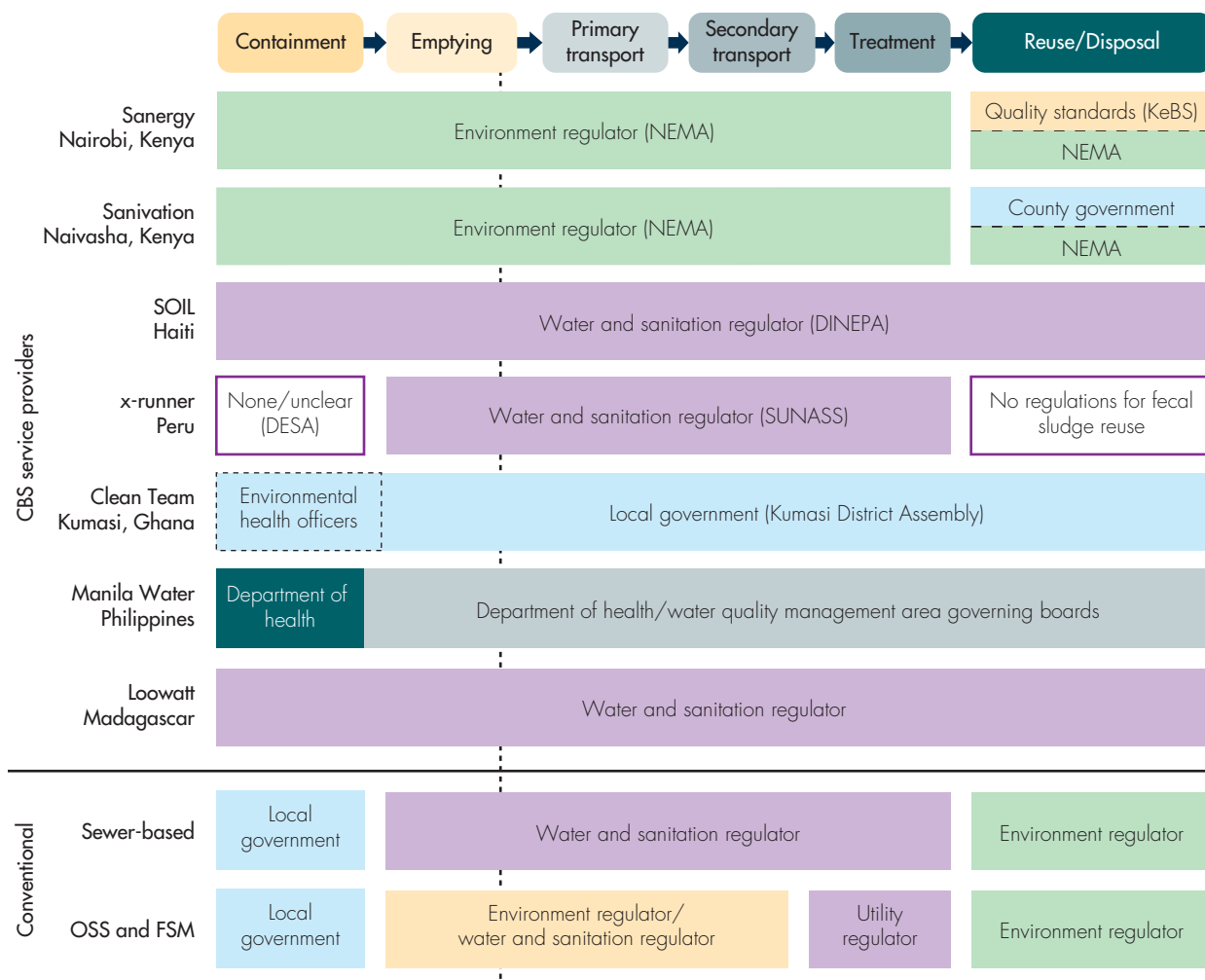
service provision. Septic tanks and septage treatment have been formalized under the private concession contracts in Manila with the capital’s two water and sanitation utilities and are very much part of the plans and practice for universal service provision. Manila Water’s piloting of CBS is a clear sign that additional non-sewer-based approaches are needed to reach the unserved (Asian Development Bank 2013).

In Kenya, CBS has been recognized as a legal class of improved sanitation in the KESHP (2016–30). The policy is new and signaled a shift in focus of the Ministry of Health from promoting rural sanitation to looking more broadly at hardware and service systems. A detailed regulatory framework has yet to be developed, and enforcement capacity is weak. The recent renaming of the Ministry of Water and Irrigation to the Ministry of Water and Sanitation is an important development for the evolution of urban sanitation in the country. However, in the absence of the president’s executive order, any expansion of the mandate of the new ministry remains unclear. Explicit recognition of CBS as improved sanitation in Kenya provides a platform upon which support for CBS approaches can be built, thus providing a strong basis for its development. Appropriate regulations and strengthened enforcement mechanisms will be required to provide a level playing field on which CBS can compete with alternative approaches.

Regulation of CBS Services

The agencies in charge of regulating CBS services in each of these countries are shown in figure 2.1, according to the steps of the sanitation service chain they oversee. The main regulatory body for CBS services varies from country to country but is usually the public health/water and sanitation sector regulator. The current significant exceptions are Kenya, where the environment sector regulator, NEMA, is principally responsible, and Kumasi, Ghana, where the local authorities provide this function. Moving along the service chain

Figure 2.1 • CBS Regulatory Bodies, by Country and Typical Regulation of Alternatives



Note: DESA = Dirección Ejecutiva de Salud Ambiental (Executive Directorate of Environmental Health); DINEPA = Direction Nationale de l’Eau Potable et de l’Assainissement (National Directorate of Water and Sanitation); KeBS = Kenya Bureau of Standards; NEMA = National Environment Management Authority; SUNASS = Superintendencia Nacional de Servicios de Saneamiento (National Superintendence of Sanitation Services). The color of the bars show the sector responsible for the regulation of that segment: purple: water and sanitation regulator; green: environmental regulator; orange: water and sanitation and environmental regulators; teal: health regulator; blue: local government; white: none. Dotted line indicates shared responsibilities.

from the toilet to the treatment plant, the health hazard generally becomes more diffuse as the feces moves from densely populated areas to less populated areas and from more open forms of transport (handcarts and tuk tuks) to closed forms (trucks). As is the case with fecal sludge management (FSM), an environmental agency would appear an appropriate regulator for the transport of feces, which is sometimes illegally tipped into the

environment (rivers, streams, waste ground), but as this is typically done close to population centers to reduce transport costs, it is a bigger risk to human health than to the environment—and for the reuse of the treated feces.

Existing regulation of CBS services currently pays little attention to the activities undertaken by households or toilet operators (in the latter case, for

Sanergy), leaving the service providers to self-regulate these components. Although regulators often specify certain types of sanitation infrastructure and/or design parameters (such as for the construction of septic tanks), these regulations are seldom enforced in practice. Yet the household part of the service chain—be it for more traditional FSM or for CBS—involves a large number of different actors whose public health awareness, attitudes, and behaviors usually vary widely. This contrasts with the downstream part of the service operated by CBS providers, where a largely trained and professional team conducts its activities (collection² and transport) on a daily basis and according to an established system.

For CBS services, therefore, the regulation of the household component of service should be similar to that of on-site sanitation (OSS) with FSM, which would require control of the quality of the containers and the timeliness and quality/effectiveness of the emptying; the quality and timing of hygiene promotion by the CBS service provider; the frequency and effectiveness of monitoring by the CBS provider; and the behavior of the households or private toilet operators. The current CBS service providers are supervising these areas themselves, but as they scale up their services and as new actors join the market, self-regulation will not be appropriate, especially in situations where CBS is in direct competition with another sanitation service (including with a rival CBS service).

In addition, an explicit regulatory framework for the reuse of treated feces in agriculture, and for other end uses, would enable some of the CBS service providers who treat their feces to high standards for reuse to effectively market their products. This is the case for x-runner, who currently faces a legal barrier that precludes any use of associated products.

One of the barriers to clearer regulatory arrangements is the lack of definition of what constitutes a “quality” CBS service. The development of overall service

standards could support the development of public sector contracts and results-based financing models and, ultimately, enable broader replication of CBS service models. This would also enable quality benchmarking across the board and help ensure that consistent high-quality services are promoted. Potential performance indicators could include the percentage of missed collections, the percentage of feces or excreta that is safely treated, and the percentage of feces or excreta that is reused (independently of whether it is sold).

Finally, most countries where CBS is currently being implemented have policies that allow and encourage private sector participation, but the legal and regulatory frameworks for such participation are often not well-developed. Private companies need to obtain registration and accreditation as service providers (that is, EPS) in Peru. The Technical Organism for the Management of Sanitation Services (OTASS) was set up in 2013 to provide support for and build capacity of sanitation EPS, but some of its responsibilities overlap with that of the sanitation regulator, the Superintendencia Nacional de Servicios de Saneamiento (National Superintendence of Sanitation Services; SUNASS). Private sector participation is required in Ghana by the National Environmental Sanitation Policy, with the provisos that private monopolies are banned in large towns and that a minimum of 20 percent of the volume of environmental sanitation services are provided by the public sector. In Kenya, the sanitation policy states that the government will support private sector participation in sanitation provision by creating clear standards and guidelines and creating legal instruments, such as exemptions, but other than a law on private sector participation, these instruments were still pending as of May 2017. The institutional framework for sanitation in Haiti states, “Private sector participation is encouraged. ...The private sector is called upon to participate in sanitation sector development through partnerships.” (DINEPA 2014)

Notes

- 1 In Kumasi, Ghana, the Kumasi Metropolitan Authority (KMA) officially recognized in January 2018 that Clean Team was compliant with sanitation bylaws.
- 2 The use of the term *collection* here recognizes that in some cases (x-runner and SOIL), the households conduct the emptying of the toilet and the CBS service provider then collects the sealed waste containers at doorsteps or a pickup point.

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CHAPTER 3 • CBS SERVICE PERFORMANCE

This section assesses the performance of selected container-based sanitation (CBS) models in terms of service delivery. A clear indicator of service performance is customer growth: All CBS service providers have achieved steady but relatively slow growth in customer numbers since their creation, though some have faced temporary lulls as they uninstalled services due to nonpayment or focused on improving the efficiency of their service models. In terms of customer service, performance has generally proved satisfactory for customers and superior to available alternatives in their areas of operation, based on customer interviews, focus group discussions, and customer surveys conducted by the service providers themselves (where available).

CBS Service Customer Growth

Since they launched, each of the four CBS service providers assessed for this report have achieved steady, if relatively slow, customer growth over time, as shown in figure 3.1. The graphs for Sustainable Organic Integrated Livelihoods (SOIL) and Sanergy also illustrate the relative contribution of different cities and different business models, respectively. Even though all the CBS service providers reviewed had been in operation for five to seven years, the number of CBS systems they operated was around the 1,000 mark as of May 2017.

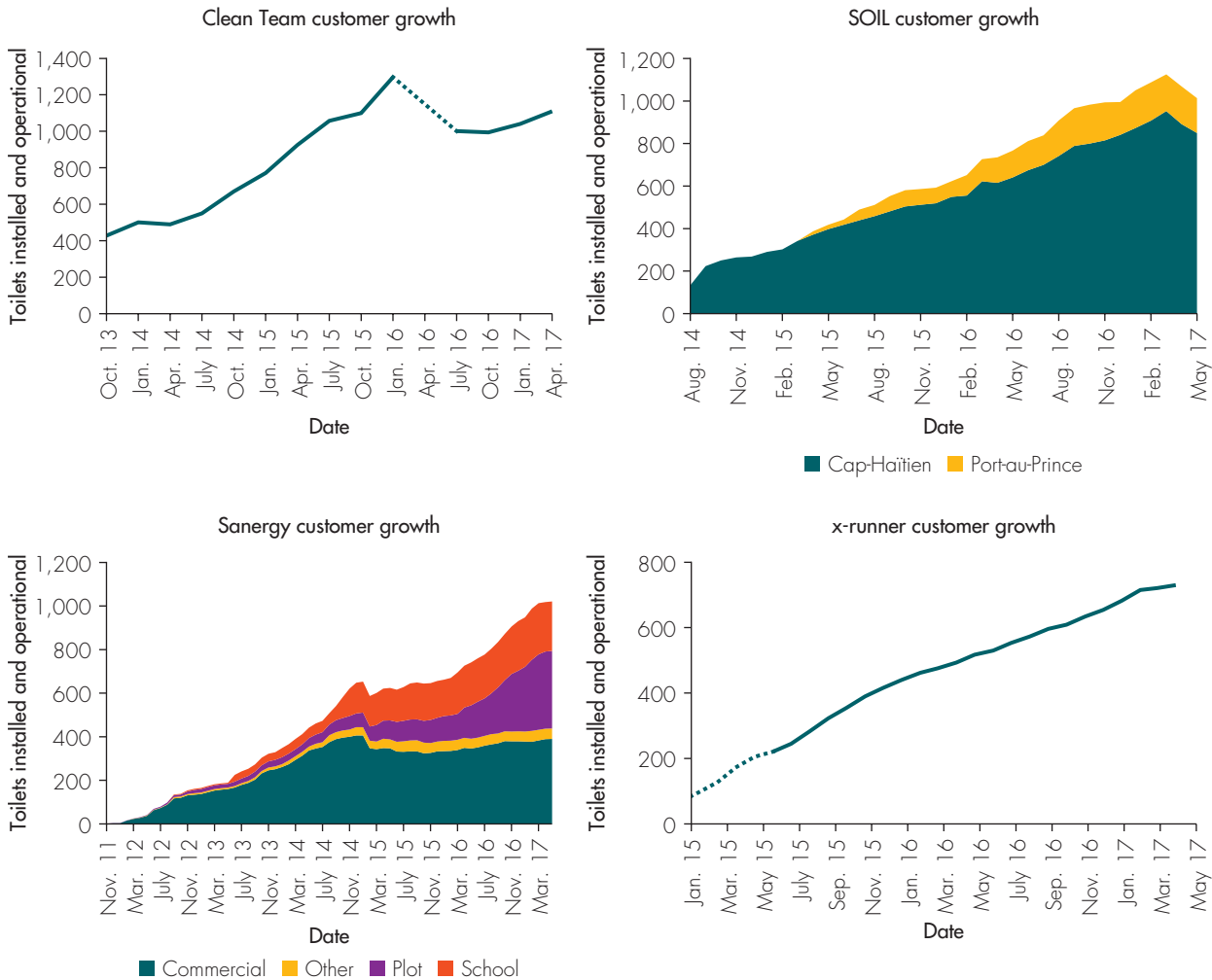
Average customer growth rates range between 15 to 25 new toilet facilities installed per month, with the largest general number of new customer installations observed in all four cases around 40 units per month. Exceptions include months when as many as 75 new customers signed up for SOIL and 65 for Sanergy. Overall, the CBS service providers have experienced surges in growth, but they have also had brief periods of toilet closures/withdrawals by customers who had accumulating debts or who had consistently failed to operate their toilets hygienically.

Although this reflects the clear and assertive application of the service providers' debt and management policies, these periods of closures have slowed overall take-up rates and set service providers back, which can explain, in part, the relatively slow growth rates. In some cases, moving into new customer segments (Sanergy), new cities (SOIL), or new areas of cities where they currently operate has helped drive growth. Over the long run, however, growth has been subject to capacity constraints, such as toilet manufacturing capacity (in the case of Sanergy) and the capacity to attract, onboard, and retain customers (in the case of SOIL, who had been struggling with payment collections until the introduction of mobile payments). At different stages in their companies' evolution, Clean Team and SOIL deliberately put customer growth temporarily on hold to focus on improving the efficiency of their business models.

CBS service providers have experimented with various strategies to drive growth, including changing sales approaches, incentivizing referrals, reducing prices, densifying services in existing areas of operation, opening up new areas of operation, and targeting new customer segments. For example, though Sanergy's residential model continued to lead growth into 2017, it identified nonresident landlords (that is, landlords not living in the plots where they rent out dwellings) as a new market segment to target, building on the surge in popularity of its toilets aimed at households.

Looking to the future, it is important to note that CBS works best when a high proportion (density) of the population subscribes to the service in a given service area. This has implications for CBS's interaction with other viable sanitation alternatives where they exist, as it would likely only be seen as a viable service approach where the level of service provided is currently poor. Similarly, densification may be difficult where other sanitation alternatives are already in place but do not reach

Figure 3.1 • Customer Growth for CBS Service Providers Examined in Case Studies (as of May 2017)



Sources: Clean Team, SOIL, Sanergy, x-runner.
 Note: Dotted lines indicate unavailable data.

all households. Where applicable, planners could identify “designated service areas” for CBS service providers to foster the densification and scale-up of their services.

Value of CBS Services to Customers and the Community

The value of CBS services to customers was reviewed based on key dimensions of customer experience, including safety, reliability, and affordability. Current levels of customer

satisfaction and CBS providers’ responsiveness to customer complaints were also assessed in the four case studies.

Safety: CBS Services are Considered Safe, with Some Areas for Improvement

CBS services provide comparable safety to flush toilets and sewerage for the containment, emptying, and collection stages of the sanitation service chain.¹ When feces is collected by CBS service providers, it is sealed in

plastic or biodegradable bags, which, in the case of most CBS models, are inside sealed plastic containers. Plastic bags of feces are removed from the containers only at the customers' toilets or in areas under the control of the CBS service provider—a transfer station or a collection truck (in the case of x-runner). For their protection, operators wear gear and follow clear excreta-handling guidelines, as is the safety standard for other comparable processes such as fecal sludge management (FSM). As the CBS service providers remain relatively small, well-managed companies, they tend to apply these safety guidelines more tightly. Accidents (dropped containers and split bags) are possible, but due to the limited size of the containers, these kinds of incident would have a low impact and could be remedied immediately. In such instances, the main risk would be to the collection staff, who are provided with personal protective equipment and regular vaccinations. Only one such incident was reported in the four case studies during interviews with staff (that is, spillage of the container contents in the street, reported by the CBS service provider itself).

By contrast, on-site sanitation (OSS) solutions can be deemed safe where pits are adequately lined and do not let in rainwater, though this is rarely the case in many vulnerable communities where CBS service providers operate. In addition, OSS services often involve unsafe manual emptying and transportation processes in harder-to-reach areas.

In some cases, the local context and/or preferences may dictate the participation of customers in the removal of containers from households, as well as their transportation and subsequent emptying. This household participation comes with potential health risks due to the possible exposure to feces, so monitoring, follow-up hygiene promotion, and enforcement of sanctions by CBS service providers for improper operation all need to be strict. Out of the four case studies reported here, only x-runner involves customers in the emptying process.

CBS treatment and resource recovery processes are superior to the municipal treatment related to

the existing sanitation services in the cities where they operate. Cap-Haitien has no existing wastewater treatment (WWT) facilities,² and facilities in Nairobi, Kumasi, and Lima leave a large proportion of wastewater either untreated or inadequately treated. Only Kumasi has a fecal sludge treatment facility, but it was nonfunctional at the time of the case study (May 2017). Treatment and resource recovery processes operated by CBS service providers are, in general, providing a high level of treatment (composting or anaerobic digestion, or transformation into briquettes).

Reuse products generated by CBS service providers who are active in this market conform to high safety standards. Sanergy's compost and animal feed products have proved to be safe for their intended use by international standards and Kenyan regulators. Independent verification or certification of SOIL and x-runner's composting processes and products are not available as Haiti does not have a licensing system for compost and Peruvian law currently does not allow for reuse of treated feces. Safety is therefore assessed by the two CBS service providers themselves, and they both hold themselves to high standards. For example, SOIL had its composting process verified and endorsed by the U.S. Centers for Disease Control and Prevention (CDC), and it tests every batch of compost for indicator pathogens (Berendes et al. 2015).

It is worth noting that none of the CBS service approaches that were assessed provide for the management of greywater at the household level. This means that in areas with high water consumption, additional greywater management solutions need to be established to reduce the risks of disease and nuisance spreading due to stagnant greywater. At present, populations living in the CBS service areas would typically dispose of greywater in nearby drainage canals or in old pit latrines where they exist (such as in the case of x-runner).

Table 3.1 compares the levels of safety provided by CBS services to that of the other sanitation services currently

Table 3.1 • Safety and Potential Reach of Sanitation Services: Comparison between CBS Services and Safest Viable Alternatives in CBS Service Providers' Areas of Service

	Safety of sanitation service chain					Potential reach
	Containment	Emptying	Transport	Treatment	Disposal/reuse	
Nairobi, Kenya						
Sanergy CBS	CBS	In sealed containers		Composting/BSFL		Extensive
Sewer-based	Public pour-flush toilet	Sewer		WWT ponds	River	Limited mostly to periphery
Lined pits + FSM	Lined pit	Manual	Drum on wheels	None	To river/waste ground	Extensive—where space allows
Kumasi, Ghana						
Clean Team CBS	CBS	In sealed containers		Septage TP (partially functional)	Landfill	Extensive
Household latrines	Lined pit	Vacuum tanker		Septage TP (partially functional)	Landfill	Medium/ extensive—reaches most areas
Cap-Haitien, Haiti						
SOIL CBS	CBS	In sealed containers		Composting		Extensive
Lined pits + FSM	Lined pit	Manual	Hand carts	None	To hand-dug pits and waterways	Extensive
Flush toilet + FSM	Septic tank	Mechanical	Trucks	Variable	Not regulated	Medium
Lima, Peru						
x-runner CBS	CBS	In sealed containers		Composting—if regulation can be established		Extensive
Sewer-based	Household flush toilet	Sewer		WWT plant	River	Difficult to reach all areas
Municipal UDDT	UDDT with three months' storage	Manual	Municipal trucks	Composting—if regulation can be established		Medium—requires space and access

Note: Green = safe; yellow = partially safe; red = unsafe. Where sewer-based alternatives are not mentioned (as in Cap-Haitien, Haiti and Kumasi, Ghana), these solutions would not be implementable in the near to medium term. BSFL = black soldier fly larvae; CBS = container-based sanitation; FSM = fecal sludge management; TP = treatment plant; UDDT = urine-diverting dry toilet; WWT = wastewater treatment.

Note on potential reach: Potential to provide corresponding sanitation service to all households in specific targeted geographical area.

provided in the same geographical areas. It also assesses the potential reach of these services given common conditions in such areas.

In September 2017, the World Health Organization (WHO) started supporting CBS Alliance members with the adoption of its Sanitation Safety Plan (SSP) to review implications for CBS services. The WHO initially developed this approach to identify, prioritize, and manage the health risks from sanitation systems in a systematic manner (“Sanitation Safety Planning” 2015). The SSP includes three essential actions: First, mapping the different components of the sanitation system and identifying the health risks of highest priority. Second, establishing control measures at critical points in the sanitation system and mechanisms to ensure that a failure to control is being detected in a timely manner. Third, preparing a management plan that details procedures and corrective actions to be taken to minimize health risks. The undertaking and dissemination of SSP assessments could play an important role in providing assurance to authorities and the public that CBS services can be managed in a safe way, as well as providing a potential benchmark with other sanitation service provisions in a given area or city.

Reliability: CBS Collection Services are Reliable

The collection services of the CBS service providers in the four case studies were reported as reliable, with very low rates of missed collections. Missed collections were reported to be less than 1.5 percent after totaling the average recent monthly missed collections reported by SOIL, Clean Team, and Sanergy. Missed collection data for the months reviewed during the study were available only for SOIL, Clean Team and Sanergy. Clean Team recorded 0.8 percent missed collections in March 2017, which reduced to 0.2 percent in April after introducing a system of pairing temporary collectors with full-time, experienced collectors who knew the routes better. Sanergy’s 2 percent missed collection rate in the first four months of 2017 was mostly due to compounds

or schools being locked when excreta collectors arrived. Between March and May 2017, there were only two complaints (out of approximately 870 customers) for missed collection services. The customers interviewed in the four case studies indicated that missed collections were rare and that they were satisfied with the collection systems.

Missed collections were remedied as soon as they were reported. x-runner’s transportation system involves just one truck that covers different routes each day, meaning that a missed household would need to wait a whole week. To overcome this problem, x-runner provides two bags and two carrying buckets to each household, which effectively affords spare capacity in case toilets fill more rapidly than expected. In addition, it has custom-made storage points (referred to as “lockers”) in the community, which allows customers to drop off their bags of feces at a time that best suits them.³ Sanergy is the only company of the four reviewed that provided information on the number of complaints and their response time to them, which is information that it routinely tracks. Each type of complaint has a target timeframe for resolution. Sanergy reported a steady improvement in the timeliness of case resolution from about 20 percent from July to October 2016 to 80 percent in April 2017. SOIL reported receiving two complaints (out of approximately 870 customers) for missed collection services between March and May 2017.

Although the customers interviewed consider the services reliable, CBS service providers should have contingency plans in place to preempt serious disruptions in order to continue providing services as much as possible. Currently, it is not clear whether CBS service providers have clear strategies for coping with potential disruptions to their operations, which could occur due to staffing issues, natural disasters (such as hurricanes or floods) or manmade disasters (such as riots or civil conflict), epidemics, or interruptions to external funding that is critical for continued service provision. Although these might be low-probability events, their

potential to disrupt collections makes them a threat to the long-term acceptance of CBS, whereas contingency plans involving local public health departments, and other entities as appropriate, could help make CBS services an asset in high-density, poor urban areas that are prone to such unexpected events. During epidemics of infectious diseases, CBS collection staff face high exposure, but they also provide a potential source of early warning/surveillance information. Through their direct and regular contact with households, they could quickly inform the appropriate institutional/regulatory bodies if infectious disease symptoms occur or become prevalent.

CBS services can be more resilient to climate variations, particularly to floods and droughts, than are other solutions. In Haiti, CBS service users highlighted that they could continue to use their toilets during floods, whereas traditional latrines become unusable. In Nairobi, the fact that Fresh Life Toilets are waterless is a distinct advantage in a water-scarce environment where there is no piped water and where household water needs to be purchased in small volumes and hauled from considerable distances.

CBS Services are Usually Priced in Line with Locally Available Alternatives

The price for users reflects CBS service providers' pricing strategies rather than actual costs, given that the majority of their costs are currently subsidized (see Chapter 4 for more detail).

The CBS services reviewed were found to be priced at similar overall levels to the sanitation alternatives in, or close to, their service areas, as illustrated in table 3.2. Alternative sanitation services include public toilets connected to sewers or lined pit latrines with FSM approaches.

CBS service providers' pricing strategies take account of the prices paid for other sanitation services, in addition to the following:

- The low and precarious incomes of the target populations limit how much they are able to pay. As CBS services are currently subsidized, emphasis is usually placed on setting tariffs they deem users are willing and able to pay.

Table 3.2 • Tariff Charged to Users for Sanitation Services: Comparison between Providers and Alternatives

Service cost to users/year	Sanergy	Clean Team	SOIL	x-runner
CBS services	US\$63 ^a	US\$106	US\$36	US\$108–US\$144
Fee-charging public toilets	US\$63 ^a	US\$125–US\$167 ^a		
OSS solutions		Pit latrine, pour-flush, or septic tank	Pit latrine	Household pit latrine
• Upfront installation costs		US\$350–US\$1,160	US\$320–US\$480	US\$263
• Avg. desludging cost/HH/year		US\$7.5–US\$40.5	US\$7.3–US\$36.5	US\$49

Note: Empty cells indicate that these services are not commonly present in the areas served by container-based sanitation (CBS). Avg. = average; HH = household; OSS = on-site sanitation.

a. Estimated based on a family of two adults and three children, each making one paid visit per day.

- CBS is novel, and even if the service is often superior to other options, people can be reluctant to pay for something they are not yet convinced will work.
- CBS becomes more cost-efficient when more customers are clustered together in a service area. Hence, it is preferable to charge a price that will encourage a significant proportion of the population to adopt the service to reduce the overall cost per person served.

CBS service providers have adapted their businesses to the limited and fragile cash flows of their target markets. x-runner initially charged a signup fee but later removed this as the novelty of the service was already a significant barrier to potential customers and the installation fee was seen as discouraging many from “making the leap” and signing up. Sanergy operates a credit service in partnership with a microlender, Kiva Bank, but is also experimenting with a model that involves no signup fee for franchisees. At the other end of the spectrum, SOIL is considering implementing an installation fee as a way to demonstrate the willingness of new clients to pay.

It is difficult to compare the prices of CBS services for users to those of other sanitation options because of differences in the timing of payments. From a customer cash flow point of view, poor customers find that having a regular monthly charge—and not facing an upfront cost—makes it easier for them to pay for and access CBS services. By contrast, household toilets for OSS or sewer interventions are expensive to construct, and many households are put off by the initial installation costs. In Kumasi, for example, the cost of building a household-level OSS solution, such as a septic tank, can be as high as US\$1,160, which is unaffordable for many low-income families. The cost of using public toilets, which is the only option for many Kumasi residents, is also substantial (though it is more regularly spread over time). Clean Team used both of these as benchmarks for defining the price of its own services.

Once installed, toilets are affordable so long as they provide minimally acceptable service to the owners and users. However, when a pit latrine or septic tank needs emptying or when it floods due to heavy rains, the cost of desludging might be unaffordable to the household. Some SOIL customers interviewed for this study, for example, said that they abandoned latrines (and adopted CBS) because they could not afford the desludging of the former. Desludging can be a fraction of the annual cost of CBS services (as shown in table 3.2), but its “lumpy” and unpredictable nature makes it difficult for people with unreliable incomes to plan for and afford. Sewerage services are usually charged on a monthly basis, though initial sewerage connection costs can be unaffordable, particularly when network extensions are necessary to install a new sewerage connection and in-house plumbing adaptations are needed.

Comparing the annual costs of alternative sanitation services does not take into account affordability constraints or the difficulties that households face in setting aside the necessary substantial sums for desludging or in getting credit for the initial installation costs and subsequent operation and maintenance. One advantage of CBS services is that monthly regular charges can be a convenient way for households to smooth out the costs of paying for a reliable sanitation solution over time.⁴

Prices charged to customers, though comparable to other options offered in CBS service areas, can be significantly higher than what is charged to customers in areas where sewerage services exist, especially when the latter benefits from public subsidies. If the centralized water supply and sewerage services could be brought to households in the peri-urban areas of Lima, for example, the total water and sewerage cost would be around US\$7 per month or US\$84 per year (based on current social tariffs for water and sewage). This is less than the US\$10 to US\$15 per month that people are currently paying for water alone, and it is less than the US\$9 to US\$12 per month that they would pay for CBS services which cost between US\$9 and US\$12 per month.

This indicates that because residents in informal settlements are facing much higher sanitation and water supply charges, and because those living in areas serviced by the centralized water supply and sewerage systems are already comparatively better off in general, water supply and sewerage subsidies in Lima could be better targeted.

Customer Satisfaction is High

The customers of the four CBS service providers reviewed were positive about the quality of service.⁵ In particular, customers liked the services for the improved hygiene and the lack of smells and flies, which are associated with alternative sanitation options such as OSS. In Ghana, some government officials associate CBS with bucket latrines, which are now illegal there; the customers interviewed for the case study, however, had not made such an association. In Haiti, many of the customers live in low-lying, coastal parts of Cap-Haitien and Port-au-Prince, where several of the people interviewed in the focus groups⁶ mentioned the fact that they can use their EkoLakay (CBS) toilets during flooding episodes, whereas pit latrines overflow and contaminate the streets, was a distinct advantage.

Customers had been waiting a long time for sewerage network expansion or for the provision of other adequate sanitation services did not see CBS services as a transitory solution but rather as a long-term, reliable solution.

The few complaints raised regarding the CBS services largely related to quality issues with the consumables associated with the services. Some of Clean Team's customers raised concerns about the switch from collections three times a week to twice a week, saying that this can result in maggots or insects developing in the sawdust. This could potentially be due to the quality of the sawdust or humidity levels, as similar complaints were not found in x-runner's service area, where collections take place on a weekly basis. However, observations during the undertaking of the Clean Team case study

suggested that user behavior could also be at least part of the cause, with some toilets showing signs of not being properly cleaned and maintained (for example, two of 15 inspected were found to be flooded with urine). This highlights the importance of including hygiene promotion in the CBS sales and customer support processes, as well as having mechanisms to maintain standards and possibly sanction customers who do not maintain adequate standards. x-runner uses biodegradable bags but found that they can become weak and break in the summer months due to heat. Thus, it provides two bags (so that they can be switched before one got too full), and in early 2017, it replaced the biodegradable bags with used plastic bags for several months as they have a lower risk of breaking down.

Customer Complaints are Promptly Handled

Collection teams making regular visits provide the main point of contact and opportunity for feedback on CBS and present a first point of contact for households to report problems.

The CBS service providers studied have well-functioning mechanisms for receiving customer complaints and respond quickly with remedies when they arise.

Customers are provided the telephone numbers of customer support staff or account managers. Complaints are logged, passed on to operations teams for action, and tracked to resolution. Sanergy designates target resolution times for different categories of complaints and tracks the percentage that is resolved within the specified time target. As Sanergy's direct "customers" are franchised toilet operators, landlords, and schools, and the toilets have a higher number of daily uses, it deals with a significant number of maintenance requests. The percentage of Fresh Life Toilet-related complaints that were dealt with within the assigned time limit improved from 20 percent (when tracking began in July 2016), to a little less than 80 percent in April 2017, showing that the adoption of clear targets can accomplish a lot in terms of raising service quality.

Notes

- 1 These assessments were based on the observations captured under the study as well as external assessments by external academics.
- 2 As of May 2018, a WWT facility that was previously operational in Port-au-Prince had closed.
- 3 As of May 2018, x-runner had contracted a new service provider for the collections, allowing for more spacious trucks and flexibility, and has improved its collection efficiency.
- 4 Similar results can be achieved through providing financing access to households interested in investing in sanitation infrastructure. However, microfinance solutions for sanitation or housing are still limited in many countries, particularly those where borrowing costs are deemed high.
- 5 This feedback was gathered through focus group discussions with customers and based on satisfaction surveys carried out by the CBS service providers as part of their regular assessments. In Sanergy's

case, both franchisees (that is, toilet operators) and users were interviewed. Specifics of the surveys are reported in the case studies.

- 6 See appendix A for details on the focus groups.

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CHAPTER 4 • FINANCIAL PERFORMANCE

This section analyzes the financial performance of container-based sanitation (CBS) service providers using data from the field studies that took place in April and May 2017.¹ From this, the CBS service providers demonstrated a clear understanding of their businesses and cost elements, the likely evolution of their costs with expansion, as well as their projected funding needs.

All of the CBS service providers reviewed in the case studies are funded through a mix of user charges for the toilet services, revenues from reuse activities (where these are undertaken), and external subsidy funding. Even though they are not covering their total costs, all four have strived to boost revenues from the first two and reduce costs in order to reduce their dependency on the latter. To that end, they have sought to improve the efficiency of their operations, in some cases by deliberately slowing down expansion while first focusing on improving their business models. However, according to their own projections, they will continue to require external funding for the foreseeable future in order to remain financially afloat, as is often the case for sanitation services.

Revenues from User Charges and Reuse Product Sales Cover a Small Portion of Costs

None of the CBS service providers had been able to achieve financial viability by the time of the field studies. All received significant external support for their activities, in the form of funds and technical assistance, which accounted for 80 to 90 percent of their total costs. The remaining 10 to 20 percent came in through revenues, which include fees from service users (either final consumers or Fresh Life Toilet operators in the case of Sanergy) and revenues from reuse. Reuse activities generate revenues for Sanergy and Sustainable Organic

Integrated Livelihoods (SOIL) but not for x-runner, which faces regulatory constraints on selling its reuse product. For SOIL, reuse is a net cost to the overall operation and does not cover its production costs.

In Nairobi, Sanergy's revenues from toilet operators cover a modest percentage of total costs (an estimated 18 percent as of May 2017). However, the operator is planning to reduce the subsidy requirement by controlling costs and increasing scale. The Fresh Life Toilet services managed by Sanergy had total budgeted costs of a little less than US\$1.5 million for 2017, with 11 percent (a little less than US\$160,000) recovered via fees from operators and eight percent (close to US\$130,000) from the subsidy for the excreta paid by the for-profit operation.² Revenues from the fees charged to the toilet operators alone were a little less than US\$160,000 in 2017, covering 11 percent of total costs. The for-profit operation does not currently cover all its costs, but it is scaling up operations and reconfiguring its process flow to achieve profitability.

Sanergy intends to demonstrate a low per capita cost through a major expansion coupled with cost-efficiency gains. It also reduces the cost of collection services with the market value of the treated feces as a feedstock for fertilizer and animal feed production. As of May 2017, Sanergy estimated that its total budget would rise to a peak of approximately US\$4.2 million by 2023, when full market penetration is achieved, before dropping and stabilizing at approximately US\$3.4 million thereafter. Revenues are projected to rise steadily to a plateau of approximately US\$2.3 million, leading to 56 percent cost recovery in 2023 and 69 percent from 2024 onward (due to lower total costs). The net costs—that is, the annual subsidy requirement for the Fresh Life Toilet service—are projected to increase to about US\$1.9 million in 2018, stay between US\$1.8 million and US\$1.9 million

until 2024, and then drop to a stable level of a little less than US\$1.1 million beyond that. However, this subsidy requirement would be spread over a much larger number of customers, with the goal of getting the annual subsidy per person down to a level that can be funded sustainably by the government. These levels of subsidies rely on assumptions about the scaling up of the reuse product sales and the continued payment of user fees.

The majority of external funding for Sanergy to date has been provided by 15 family and corporate foundations (the median contribution being US\$93,000). Sanergy is aiming to transition to funding from the government and international financial institutions as the scale of its operations grows and, eventually, transition to a system that would mobilize funding from the city's tax base.³ In 2017, Sanergy raised US\$12.5 million for the for-profit arm through a mix of debt, equity, and grants.

In Haiti, according to SOIL's own analysis, the user fee of G 200 (US\$3.00)⁴ remains less than the cost needed for covering the costs of containment (US\$1.37), collection (US\$2.90), and transport (US\$2.75). In May 2017, SOIL intended to increase the user fee though it feared customers might be unable to pay. As of May 2018, SOIL had conducted a willingness-to-pay survey in Port-au-Prince, leading to fee increases from G 250 to G 350 with an 80 percent customer retention rate and was considering how to adapt this approach in Cap-Haitien. At the end of the chain, SOIL compost sales are not sufficient to cover processing costs: The revenue generated from them currently covers an estimated 20 to 40 percent of operational costs at the compost site (less if taking into account overhead costs, as noted above) (Preneta et al. 2017). SOIL is reluctant to increase the sales price of compost, however, out of fear that most of the customers would change suppliers, given that compost use is already low despite considerable soil erosion.

In Lima, the total cost of x-runner's operations in 2017 was US\$336,458, with 18 percent (a little less than US\$60,000) recovered via fees from users.

Revenues from the fees charged to service users covered about 38 percent of the costs of providing the service. Reuse activities generated some operating costs but not corresponding revenues due to regulatory restrictions on the sale of reuse products. x-runner's operation has been funded by private and government foundations for as much as US\$400,000 per year since its creation. It also benefits from toilet units purchased at a highly discounted price from Swedish manufacturer Separett. The cost of toilet units is an important component because toilet purchase and installation represent the most expensive part of x-runner's operation—a little less than 20 percent of its 2016 budget. Treatment, on the other hand, represents a relatively low portion of its operations costs—about 6 percent—and does not seem to present opportunities for significant cost-cutting. If corresponding regulatory changes were to allow x-runner to reuse the treated feces, it could look into generating revenue from its activities.

In Kumasi, Clean Team is also focusing on reducing costs while maintaining service performance. Clean Team was expecting to recover 20 percent of total costs from customers in fiscal year 2016–17 (with the remaining 80 percent covered by external subsidies) but is planning to increase this portion to 40 percent in 2017–18 and to stop subsidizing its operational costs by October 2018. It is looking to achieve this through a combination of service charge increases and cost efficiencies. Although no reuse is currently taking place in Kumasi, the Water & Sanitation for the Urban Poor (WSUP) has commissioned a study to build the business case for investment in appropriate waste-to-resource solutions for all excreta produced in Kumasi, including feces collected by Clean Team.

Some evidence shows that, as these services become better known and established in their respective service areas, there is potential for recovering a higher proportion of total costs via service charges. A study for Clean Team recommended focusing on reaching the “working poor”⁵ (as opposed to the extreme poor)

to achieve higher service charges and boost gross margin (Ernst & Young [EY] 2017). Partly based on these recommendations, Clean Team raised the price of its services in April 2017 without a noticeable loss in the number of customers. Clean Team increased prices by 8.5 percent for mobile payment subscribers and 23 percent for cash payment subscribers. This doubled as a way to encourage people to adopt the mobile payment option, which enables Clean Team to save on operating costs.

CBS Service Providers Deploy a Mix of Strategies to Reduce Costs

The CBS service providers reviewed as part of the study are managed as businesses and deploy a mix of strategies to reduce costs, including:

- Improving efficiency to reduce the main cost drivers;
- Expanding the customer base to achieve economies of scale and spread fixed costs over a larger basis; and
- Generating additional revenues (mostly from reuse activities) to cross-subsidize the loss-making toilet services.

Sanergy, for example, maintains a close focus on operational efficiency and the elimination of idle capacity, including in its toilet manufacturing facility, transport network, and excreta composting facility. Densification of the customer base is a key strategy it deploys to reduce the time needed for excreta collection so that those involved in collection can also work on consolidating the feces into larger drums for final transport to the treatment site.

Clean Team has been working with WSUP and Ernst & Young (EY) to identify ways to boost its gross margin. It made changes to the toilet technology (switching from wet to dry toilets and using sawdust as a cover material), reduced the frequency of collections, and promoted a switch to mobile payments.

CBS service providers are already either using or looking into mobile payments to reduce the costs associated with fee collection, and some are offering discounts to customers who adopt such a payment method. In Kenya, Sanergy has been using M-Pesa as a mobile payment platform, given its widespread use in the country. However, in countries where mobile payments are less widespread, such as Haiti, this can be more difficult to achieve and requires specific communication campaigns. SOIL has put in place several strategies to increase mobile payment uptake with successful results: Mobile payment rates have reached 30 percent in Cap-Haitien and 65 percent in Port-au-Prince as of May 2018.

Expansion and network densification is also seen as a key way to achieve economies of scale and reduce costs. Most CBS service providers have identified potential areas for expansion and have ambitious plans for increasing their customer bases. Some have spread to different service areas: For example, SOIL started offering a paid service in Cap-Haitien in 2013 (prior to this, it was experimental and free) and expanded into Haiti's capital, Port-au-Prince, in 2015. Although the operation there is still comparatively smaller than the one in Cap-Haitien, SOIL is anticipating a substantial share of its planned growth to come from there. To achieve that, it is planning to hand over part(s) of the service chain to private enterprise(s), such as the local collection and transportation from the transfer points to the treatment sites.

Since 2016, x-runner started outsourcing transportation to the waste disposal site to a national waste management company, EcoCentury, which has all the regulatory approvals necessary to function as a sanitation service provider (which x-runner does not yet have). This has significantly reduced the logistical and regulatory risks for x-runner's collection services and has improved its operations. x-runner is focusing on gaining new customers by applying a range of marketing techniques, including specific discounts for communities where 50 percent or more of the households use its services

and promote its services through female ambassadors. x-runner is also unique in that members of the households themselves carry their sealed buckets of feces to the collection truck as it passes through the area. When customers cannot be at the collection point at the scheduled time, they can leave their full buckets in a custom-made locker, installed by x-runner, at a centrally accessible point when leaving home. The hygienic safety of such an approach would need to be thoroughly investigated but, if deemed appropriate, could be extended to other CBS service providers to cut excreta collection costs.

Revenues from Reuse Are Also Seen by Some of the CBS Service Providers as a Way to Reduce the External Funding Requirement

None of the CBS service providers reviewed have yet been able to cover their composting costs and generate a positive margin from these activities. Sanergy has been focusing on extracting revenues from reuse, which it treats as a for-profit activity. It is able to get the highest price of all the CBS service providers for its compost (US\$400 per ton) and is exploring other reuse products, such as animal feed using a black soldier fly larvae (BSFL) treatment process. It charges the nonprofit for treating its feces, but this charge is based on the cost of the best alternative feedstock (pig manure) and does not cover the collection and treatment costs of the overall service chain. This means that the for-profit in effect cross-subsidizes the nonprofit managing the toilet services. In 2017, however, Sanergy's revenues from composting were equivalent to 40 percent of the costs of treating the feces, not including sales, marketing, and distribution.

In Haiti, SOIL also produces compost, which it sells at US\$280 per ton to agricultural companies, foundations, nongovernmental organizations (NGOs), and private individuals. However, as mentioned above, the price it gets for the compost does not fully cover the costs of the compost plant, which means that the possibility of cross-subsidizing the toilet activities has so far proved elusive.

Not all of the CBS service providers reviewed are monetizing reuse activities. Clean Team transfers the feces to the Kumasi septage treatment plant, where it has access to space for disposing of the material on non-engineered drying beds. x-runner treats the feces using a bokashi anaerobic composting system followed by a two-week aerobic windrow composting process. This overall process allows it to reduce the amount of land needed for the final disposal of the treated feces but generates costs with no corresponding revenue source.

More Reliable Sources of Subsidies Will Likely Be Required to Sustain the Operations

None of the CBS operators reviewed have yet obtained cash subsidy funding from domestic public funders in the countries where they work, but some are receiving in-kind subsidies. For example, Clean Team disposes of collected feces at the septage treatment facility operated by the Kumasi Metropolitan Assembly (KMA), which provides an in-kind subsidy by charging only for renting equipment to move the feces to the landfill rather than charging for the full cost of disposal.

Some of the CBS service providers reviewed have developed strategies for bringing in sustainable subsidies—including from local authorities—but so far with limited success. For example, Sanergy is looking for ways to enter into a pilot in which the Nairobi County government would subsidize services to a small number of beneficiaries. SOIL has been in discussions with the Haitian government, the World Bank, and the Inter-American Development Bank for several months about developing innovative public financing for transportation, treatment, and composting through a “payment for results” mechanism or a social impact bond. This would result in financing being leveraged from development banks, subsidies being disbursed by the Haitian government, and services being implemented by SOIL or a private company. In this proposed scheme, the volume of compost produced would be used as a key performance indicator and payment trigger. In 2017,

Sanergy used the fact that it runs a for-profit operation for part of the service chain to secure financing through debt (US\$5 million) and equity (US\$5 million from four investors). It also secured grant funding from the Bill & Melinda Gates Foundation. The other CBS service providers could explore similar financing mechanisms to further bridge the gap between their revenues and costs.

Notes

- 1 As Clean Team had completed an in-depth financial analysis in May 2017 with the support of EY and in collaboration with WSUP, it did not want to duplicate these efforts. The financial analysis for Clean Team is, therefore, based primarily based on the EY-WSUP report, which had been conducted to advise Clean Team on pathways toward achieving financial sustainability and reduce dependency on external funders.
- 2 The for-profit cross-subsidizes the nonprofit CBS toilet service by providing free treatment of the excreta and paying a “fair” market rate for it as a composting feedstock. The cost (to the for-profit) of collection between January and April 2017 was between US\$0.06 and US\$0.07 per kilogram of feces, roughly double the amount charged to the nonprofit (hence the subsidy). The nonprofit entity,

referred to as “Fresh Life Initiative,” rolls out a public toilet service by setting up toilet business franchises. The for-profit entity, “Sanergy,” provides excreta management services to the nonprofit arm and produces branded fertilizer and animal feed that incorporate feces as a core feedstock.

- 3 As of May 2018, and despite significant efforts, this system had not yet materialized.
- 4 The user’s fee of G 200 corresponded in 2014 to US\$5 and a little more than US\$3 in June 2017.
- 5 EY (2017) defined the *working poor* in this situation as “customers who have a steady income, somewhere in the range of US\$50 to US\$150 a month, but who are nonetheless not wealthy enough to install their own septic tank or sewer-connected toilet, or who live in circumstances where these are impractical.”

References

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CHAPTER 5 • EMERGING LESSONS AND AREAS FOR FUTURE WORK

This review of the four container-based sanitation (CBS) case studies has generated emerging lessons for governments and external funders and has helped identify a number of areas for future work, which should be undertaken as CBS approaches begin to scale up around the world.

Emerging Lessons

CBS approaches should be considered as part of a menu of citywide inclusive sanitation (CWIS) options. The specific planning and rollout of CBS services will vary based on location but, as is the case for other CWIS approaches, it should be articulated closely with urban planning and development priorities. One option could be to identify geographical areas where CBS approaches would be most appropriate—or would be the best fit, given local conditions—and support their development accordingly.

The introduction of CBS services could be considered especially for poor urban populations for whom alternative on-site or sewer-based sanitation services might not be appropriate. These include dense slums and areas that are flood-prone or hard to reach (such as hilly terrains or settlements above or very near to water courses). CBS services can also be considered for areas where:

- The housing density and/or the size of the living quarters prevent the construction of pits or septic tanks or the laying of sewers and most of the population lives far (that is, more than 50 meters) from existing shared toilets, which means that some people, notably women and girls, do not have safe access at night and disabled people might not have access at all;¹
- The ground conditions are not suitable for the installation of latrine pits, septic tanks, or sewers (for example, flood plains);
- Landlords are not willing to invest in toilets;
- Water shortages make sewer-based solutions more challenging;
- The majority of households do not lie on roads or paths that are large enough or otherwise suitable for the installation of sewers (including simplified/narrow diameter sewers, though these can be installed in very dense slums with minimal access ways) or are not accessible for proper fecal sludge management (FSM) access and collection; or
- Existing sanitation planning does not foresee the rollout of more conventional sanitation services in the short to medium term.

Some CBS service providers (such as Sanivation in Kenya) have also started expanding in refugee camps, where such solutions can be particularly well-suited as the CBS units are rapidly movable and can be deployed—and redeployed—quickly to meet unplanned influxes of people.

Adopting a conducive policy and regulatory environment could be an important first step for governments looking to foster CBS services in areas where they could be suitable. Regulation of CBS and FSM services would ideally be done in conjunction in order to regulate public health and environmental aspects up to the point where the pathogen and nutrient parameters meet the national/local standards for discharge to a water body, disposal to a landfill, or transformation into a reuse product. This would include clear procedures for operators in the emptying and transportation processes

to ensure that all CBS and FSM service providers are held to the same standards in mitigating potential health and pollution risks. Regulatory oversight should also ensure that the CBS service providers adequately monitor the operation and management of CBS toilets by customers and react swiftly and appropriately where hygiene is substandard.

Where it does not exist, a regulatory framework should be developed for the reuse of treated feces/excreta, including for agricultural and other uses, which have sometimes been limited by health concerns—such regulation would serve for both CBS and other FSM services. The development of overall service standards could enable broader replication of CBS service models and benchmarking of service quality, thus promoting consistency and further confidence in the CBS approach. It would also provide a level playing field to allow for the development of CBS approaches alongside other sanitation services, especially on-site sanitation (OSS) and FSM. A better definition of the institutional framework required for developing and monitoring standards could help improve the safety of services and overall service quality.

Recognizing that CBS service providers will likely not be covering their full costs in the short term—and that most urban sanitation services around the world are subsidized to one degree or another (be it subsidies for their capital costs or their running costs)—public authorities and/or water supply and sanitation (WSS) service providers could explore ways to ensure that CBS services are sustainably financed. Examples include cross-subsidies from services provided in more affluent service areas, including other types of sanitation provision and other related services (for example, water supply or solid waste management) or direct subsidies from public sources. In situations where governments contract CBS service providers for service delivery in specific areas, such arrangements could be structured as performance-based contracts so as to introduce incentives for greater efficiency, cost reductions, and greater accountability.

The customer-oriented nature of CBS services means that the providers offer a way for new customers to begin accepting to pay for sanitation services and to practice better household hygiene which, in turn, is more widely beneficial. As and when other sanitation solutions are rolled out in the future, forerunner CBS services can fill more than a temporary access gap as they also build the mindsets of customers who subsequently value sanitation services and who are used to interacting in a responsible way with service providers.

Areas for Further Analysis

Although this report indicates that CBS can effectively provide safely managed sanitation in urban areas, there are currently a small number of operators providing CBS services in different parts of the world, each at a relatively limited scale. As these existing CBS operators scale up their services, it will be important to continue carrying out operational research to explore the following questions, among others:

- What constitutes a safe CBS service, and what are its essential features? Can a broadly accepted definition of “safe CBS services” be developed to provide the basis for their inclusion as part of the improved sanitation options for achieving sustainable development goal (SDG) 6?²
- How can CBS services be integrated within a broader menu of options for WSS and CWIS service provision so as to facilitate service integration, promote services to the poor, and encourage cost recovery?
- What management models can be considered to ensure the safe provision of CBS services, ranging from dedicated CBS service providers to the incorporation of CBS as part of a menu of options provided by larger utilities?
- How do CBS approaches compare financially and economically to other available sanitation alternatives in the cities where CBS service providers currently operate or could potentially enter?

- How can existing CBS service providers be supported to scale up service provision in existing service areas or to expand into new areas, where applicable?
- How could performance-based contracts be designed for CBS services? What could be suitable service standards and “payment triggers” as a part of results-based financing arrangements?

Notes

- 1 C.f. SGD 6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- 2 In the SDG 6.2 definition and according to the Joint Monitoring Programme (JMP), “Improved sanitation facilities are those designed to hygienically separate excreta from human contact.” (JMP 2018) Defining a safe CBS service could ensure that the solution is counted among those improved sanitation facilities in SDG monitoring.

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APPENDIX A • PEOPLE INTERVIEWED

SOIL

Focus group discussions: With the support of local organizations working with Sustainable Organic Integrated Livelihoods (SOIL)—to balance logistical issues with potential bias of answers—three focus group

discussions were organized: one in the Saint Michel area with nine participants and two in the Aviation area with five participants each. All groups were mixed by gender. Discussion topics included customers’ motivations to sign up for the service, existing alternatives, customer satisfaction, and affordability.

Key Informants

Organization	Position	Name
Direction Nationale de l’Eau Potable et de l’Assainissement (National Directorate of Water and Sanitation ; DINEPA)	DINEPA director of sanitation	Edwige Petit
Office Régional d’Eau et d’Assainissement (OREPA)	Responsable OREPA OUEST	Raphael Hosty
DINEPA	Cap-Haitien	Eng. Gustave
DINEPA	SOIL board member, previous director for sanitation, DINEPA	Ingrid Henry
Ministry Environment	Cadre de Vie et Assainissement director	Dr. Evans Louis
Ministry Public Health and Population	Promotion de Santé et de la Protection de l’Environnement director	Dr. Jocelyne Pierre Louis
GRET	Program coordinator	Caroline Benard
Municipality Limonade	Responsable urban planning direction	Name not available
Municipality Cap-Haitien	General director	Frantzy Jean
CBO ADF (Fosenmichel (Cap-Haitien)	Several CBOs ADF representatives	Names not available
Community Based Organization OCDEL/MPBK (Cap-Haitien)	Several CBOs representatives	Names not available
Place Cazeau (Port-au-Prince)	Several CBOs representatives	Names not available

table continues next page

Organization	Position	Name
CBO Sakala; Cité Soleil (Port-au-Prince)	CBOs leader	Daniel Tillias
Center for Investments	Former staff	Ivy Kuperberg
	Independent consultant	Anthony Kilbride
	Independent consultant	Pierre Yves Rochat
Jedco	Cap-Haitien local director	Name not available
Manual emptier	Business owner (informal)	Name not available
SOIL	Bloc coordinator, Fosenmichel	Yvrose Pailleur
SOIL	Payment collector, Fosenmichel	Junior Bonhomme
SOIL	Responsible depot, Fosenmichel	Pierre Reginald
SOIL	Bloc manager, Avyasyon	Algate Joseph
SOIL	Compost site operator, Cap-Haitien	Markindy Etienne
SOIL	Compost director, Cap-Haitien	Job Etienne
SOIL	Ekolakay director, Cap-Haitien	Erinold Frederic
SOIL	Regional director, Cap-Haitien	Romel Toussaint
SOIL	Collector (daily worker)	Benik Nordeus
SOIL	Ekolakay adviser	Claire Remington
SOIL	Ekolakay director, Port-au-Prince	Herby Sanon
SOIL	Compost director, Port-au-Prince	Jean Marie Noel
SOIL	Regional director, Port-au-Prince	Baudeler Magloire
SOIL	Executive director	Sasha Kramer

Satisfaction survey: The 2018 “Customer Satisfaction with the EkoLakay Household Toilet Service, Northern Haiti, and Port-au-Prince” survey sampled 281 customers in the EkoLakay service area in Northern Haiti

(representing 33 percent of customers at that time) and 88 customers in the Port-au-Prince service area (representing 52 percent of customers at that time).

x-runner

Key Informants

Organization	Designation	Name
x-runner	Chairperson	Isabel Medem
x-runner	Chief executive officer	Raúl Briceño
x-runner	Chief financial officer	Mónica Ramos
x-runner	Chief operating officer	Maria Pia Quiroz
x-runner	Customer relationship manager	Natalia Benavides
x-runner	Head of installations	Celi Sedano
x-runner	Head of sales	Esther Calderón
x-runner	Waste treatment plant manager	Nemecio Córdor
World Bank Lima Office	Water and sanitation specialist	Malva Rosa Baskovich
Via San Juan	Community leader	Rogelio
Servicio de Alcantarillado y Agua Potable de Lima (Lima Sewerage and Water Supply Services; SEDAPAL)	Head of Investigations, Innovation, and Standardization Team	Oswaldo Hernán Vargas Cuellar
Ministry of Housing, Construction and Sanitation	National sanitation director	Oscar Pastor
Superintendencia Nacional de Servicios de Saneamiento (National Superintendence of Sanitation Services; SUNASS)	Tariff Regulation Management Supervisor II	Ana Vergara
SUNASS	Tariff Regulation Management	Luis Acosta
SUNASS	Tariff Regulation Management	Arturo Lázaro
SUNASS	Tariff Regulation Management	Gretelina Castañeda
Grand Challenges Canada	Consultant	Alyse Schrecongost

Sanergy

Focus group discussions: Two schools were selected, and short focus group discussions were conducted at each with a group of five girls and a group of five boys.

Toilet facility data: Locations, opening dates, and the type of service model was obtained from Sanergy and plotted against a Nairobi road map in QGIS. Purposive sampling was then used to select toilets with the following characteristics:

- Two “new” commercial toilet operators, operational for fewer than six months
- Two “old” commercial toilet operators, operational for more than 12 months
- Two “new” residential toilet operators, operational for fewer than six months
- Two “old” residential toilet operators, operational for more than 12 months

- One school with Sanergy toilets, operational for fewer than six months
- One school with Sanergy toilets, operational for more than 12 months

For each of the first four categories, one male and one female operator were selected, though interviews were often with the husband, wife, daughter, co-operator, or employee of the registered Fresh Life Operator (FLO). This way, in the end, six of the interviewees were female and two were male. The FLOs were operating between one and three toilets each. The period of time that these FLOs had been operating the toilets did not have any noticeable impact on their level of satisfaction or responses in general.

While visiting an FLO, users leaving the toilets were asked if they were willing to be interviewed. The consultants identified the users, and the FLO would make the request. Many were busy during the workday, and only five were interviewed.

Key Informants

Organization	Position	Name
Sanergy	Co-founder/director	David Auerbach
Sanergy	Co-founder/director	Lindsay Stradley
Sanergy	Co-founder/director	Ani Vallabhaneni
Sanergy	Chief financial officer	Sanj Sanampudi
Sanergy	Customer support manager	Joseph Githinji
Sanergy	Fresh Life chief operating officer	Titus Kuria
Sanergy	Fresh Life services manager	Eric Machango
Sanergy	Government relations manager	Alex Manyasi
Sanergy	Head of operations	Michael Lwoyelo
Sanergy	Residential customer support assistant manager	Florence Mwikali
Sanergy	Commercial customer support assistant manager	Peter Khaemba

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Organization	Position	Name
Sanergy	Schools customer support assistant manager	Polycarp Sifuna
Sanergy	Treatment site manager	Kennedy Okwany
Nairobi City County	Public Health deputy director	Jairus Musumba
Nairobi City County	Water and Sanitation director	Kainga Mario
Ministry of Health	Public Health director	Kepha Ombacho
Ministry of Water and Irrigation	Sanitation director	Rose Ngure
National Environment Management Authority	Compliance and enforcement officer	Maurine Njeri
Imara Daima location	Assistant chief	Mark Nyasera
Mukuru Kwa Njenga location	Senior chief	Jonathan Musila
Shauri Moyo location	Assistant chief	Hezekiah Obongita
Shauri Moyo location	Chief	Florence Mbwika
Land Mawe (Kayaba) location	Chief	Solomon Muragori
Goeta School, Mukuru	Teacher	James Mutonga
Goeta School, Mukuru	Boys' focus group (five, from classes 4–7)	Anonymous
Goeta School, Mukuru	Girls' focus group (five, from classes 4–7)	Anonymous
Pilot School, Mathare	Head teacher	Aloyss Oyoma
Pilot School, Mathare	Boys' focus group (five, from classes 6–8)	Anonymous
Pilot School, Mathare	Girls' focus group (five, from classes 6–8)	Anonymous
FLOs	FLOs (eight: three residential, three commercial, two hybrid)	Anonymous
Community	Fresh Life users (five) and non-users (one)	Anonymous
Bill & Melinda Gates Foundation	Demand-Led Sanitation senior program officer	Jan Willem Rosenboom
World Bank Kenya Office	Senior water and sanitation specialist	Chris Heymans
World Bank Kenya Office	Operations analyst	Lewnida Sara
Osprey Foundation	Managing director	Louis Boorstin
Vitol Foundation	Head of Water, Sanitation, and Hygiene	Regis Garandeau
Vitol Foundation	Board member	Richard Carter

Clean Team

Key Informants

Organization	Position	Name
World Bank Ghana	Water supply, sanitation, and hygiene (WASH) advisers	Emmanuel Nkrumah
Sanitation/Environmental Health and Sanitation Directorate (EHSD)	Program Officer	Kweku Quensah
Kumasi Metropolitan Assembly (KMA)	Waste Management Department director	John Gorkeh-Miah
KMA	EHSD director	Don Awantungo
Greater Accra Metropolitan Area (GAMA)	Waste Management Department director	Anthony Mensah
Water & Sanitation for the Urban Poor (WSUP)	Head of sanitation	Georges Mikhael
WSUP Ghana	Social business lead	Faustina Ashante
Public toilets	Owner	Name not available
Sewerage network	Operator	Name not available
Manual emptier	Drivers	Names not available
Clean Team	Chief executive officer	Peter Townsley
Clean Team	Head of operations	Abigail Aruna
Clean Team	Sales manager	Eric Yeboah
Clean Team	Finance officer	Name not available
Clean Team	Account manager, Asawase	Janet Harrison
Clean Team	Account manager, Adukrom	Lovia Boakye
Clean Team	Account manager, Sabon Zongo	Beatrice Agyemang
Clean Team	Account manager, Tafo	Name not available
Clean Team	Sales officer	Names not available
Clean Team	Collector, Asawase	Alidjah
Aygiya community	Traditional leader	Name not available
Aygiya community	Traditional leader	Name not available

Interviews were also organized with 14 customers from Asawase and Tafo and five noncustomers from Oforikrom and Asawase.

