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Evaluating the Potential of

Container-Based Sanitation

SOIL in Cap-Haitien, Haiti

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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

This case study, along with three others, is a component of a wider study by the World Bank on container-based sanitation (CBS) models. 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.[1] Rather than having to build a sanitation facility, households (or public toilet operators) can sign up for the service. The CBS service provider then installs a toilet with sealable excreta receptacles (also referred to as *cartridges*) and commits to emptying them (that is, removing and replacing them with clean ones) on a regular basis.

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 citywide inclusive sanitation (CWIS).

This study is focused on Sustainable Organic Integrated Livelihoods (SOIL), a U.S.-based nongovernmental organization (NGO), and its operations mostly in Cap-Haitien and to a lesser extent in Port-au-Prince. The objective of this case study is to better understand how SOIL's CBS business model fits in the overall context of the low-income settlements in which it operates. SOIL presents itself as a research and development nonprofit organization that is developing sustainable sanitation services and business models to increase access to safely managed sanitation in vulnerable urban communities.

Overview of SOIL Business Model

In the cities of Cap-Haitien and Port-au-Prince in Haiti, SOIL programs include three elements that meet service needs along the sanitation service chain. These programs are:

- EkoLakay, the service managing containment—which uses urine-diverting container-based toilets—and local collection of feces;
- Konpòs Lakay, which supports transport from the transfer stations, treatment of the feces, and transformation of feces into compost; and
- EkoMobil, which offers mobile container-based toilet rental services.

The report discusses SOIL's CBS activities (EkoLakay and Konpòs Lakay) in Cap-Haitien.

SOIL, through its container-based program known as EkoLakay, operates mainly in the eastern part of Cap-Haitien in low-income areas characterized by a high population density, irregular alley layout, and higher exposure to floods (compared to the rest of the city). Its area of intervention covers about one-third of the territory of the city. SOIL has a smaller EkoLakay program in Port-au-Prince.

In areas where the EkoLakay service is being offered, customers can sign up for the CBS service. The monthly fee provides the client with the following benefits:

- Toilet installation
- Weekly collection of filled feces containers
- Repairs as necessary
- Provision of a carbon cover material (called bonzodè or "good smell")
- Final treatment at a SOIL composting waste treatment facility

All material is eventually transformed into compost through a carefully monitored thermophilic process,

which adheres to World Health Organization (WHO) standards for excreta treatment. This final compost, branded by SOIL as Konpòs Lakay, is then sold to recover some of the costs of the treatment process.

SOIL Operating Context

Reported and observed rates of open defecation and use of plastic bags (from 40 to 50 percent) in low-income urban areas of Cap-Haitien are much higher than the official figures for urban Haiti (8 percent). There is little data on containment, transport, and treatment of fecal sludge in the city. Pit latrines are most frequently emptied by private manual emptiers, who are likely to dispose of the collected fecal sludge into the environment without treatment.

Water and sanitation reform, as voted by the Haitian parliament in 2009, created a regulatory body—Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation; DINEPA)—and laid out its organizational structure, as well as its funding, evaluation, and control mechanisms. The reform also placed responsibility for oversight of sanitation (both off-site and on-site) within DINEPA, which is part of the Ministère des Travaux Publics, Transports et Communications (Ministry of Public Works, Transport and Communications; MTPTC). However, management, regulation, and governance over sanitation services are shared by DINEPA, the Ministère de la Santé Publique et de la Population (Ministry of Public Health and Population; MSPP), the Ministère de l'Environnement (Ministry of Environment; MdE), and local governments (municipalities). Despite ongoing discussions, regulation, education, and enforcement, responsibilities are not clearly allocated among the ministries involved in the sanitation sector, and responsibilities for financing, training of staff, and implementation at the local level have yet to be decided. On the ground, there are no incentives or enforcement (either documented or observed) that promote uptake by the local population of improved sanitation facilities or safe management of fecal sludge.

Since 2012, DINEPA has been developing technical reference guidelines that include standards to be respected for water and sanitation interventions. The framework discusses shared/community ecological sanitation but does not directly cover CBS approaches. The activities of SOIL are recognized and authorized by the municipalities in which it intervenes. DINEPA acknowledges the expertise of the organization in terms of composting excreta. Concerning the containment solution, DINEPA does not have an explicit position and considers CBS approaches to be a transitional intervention as opposed to a permanent solution. From its perspective, subscribing to CBS services does not necessarily mean that one house has gained a toilet in the long term. However, given the fact that traditional sanitation interventions are technologically infeasible in some of the communities where EkoLakay is offered, DINEPA is not yet offering any alternatives.

Assessment of SOIL's Services

Within this sanitation landscape and since 2012, SOIL has developed a CBS service. In Cap-Haitien, the EkoLakay service reportedly had 849 customers in April 2017. Customers can choose between two urine-diversion models: a wooden version that costs approximately US$50 to produce and a ferrocement model that costs approximately US$27. Both models are produced locally, and there are currently no additional installation costs associated with the service. Toilets remain the property of SOIL, and customers rent them by paying a monthly service fee of G 200 (US$3.20).

SOIL's stated intention is to increase its number of customers per neighborhood, especially in the areas of Cap-Haitien where there is a high density of housing and potential customers. The objective is to reach about 3,500 EkoLakay toilets in 16 neighborhoods by 2020. This slow initial scale-up represents an upfront focus on cost reduction and improving gross margins and should be followed by a much more rapid scale-up once positive margins have been achieved.

The long-term objective is to reach more than 60,000 households in both Cap-Haitien and Port-au-Prince, with the largest part of customer growth taking place within the capital city.

Customers expressed satisfaction with the toilet technology and did not highlight issues regarding smell or the presence of maggots or flies in the buckets. This outcome is potentially related to the way customers use and maintain their toilets, including not only how they carry out maintenance but also the quality of the organic cover material used. Made primarily of bagasse, the cover material supply is not guaranteed in the long term, which could jeopardize part of the operations as the service goes to scale.

Affordability is a key issue for customers and non-customers. SOIL uses a single tariff for the EkoLakay service in Cap-Haitien: G 200 (US$3.20) per month (in Port-au-Prince, it is G 250 or US$4 per month). The majority of customers pointed out that most of the neighborhood inhabitants cannot afford the monthly user fees. However, other customers disagreed, explaining that some individuals have different priorities, influencing their willingness to pay. Payment rates each month are between 60 and 80 percent.

Critically, the user fee is unlikely to cover all costs of the sanitation service, which includes excreta treatment and transformation. In 2016, the provision of services by SOIL had a total annual cost of a little less than US$435,000, with about 10 percent (US$43,900) recovered via fees from toilet users and from sales of the reuse product. Revenues from the fees charged to users amounted to a little less than US$25,000 in 2016—5 percent of the total costs and 27 percent of the cost of providing the toilet service (when taking overhead costs into account). Reuse activities generated revenues that covered only 10 percent of the costs of producing the reuse product. External funding to cover the gap is provided by several institutional funders, philanthropic organizations, and individual donors.

Future Expansion Plans

SOIL intends to increase the density of customers within the neighborhoods it already serves. This will enable the organization to evaluate the efficiencies created by dense collection and transport areas and gather more robust information about expenses associated with provision of the service. Increasing customer density is also important to maximize the public health impact of the intervention. The information will be used to refine cost projections, identify opportunities for greater cost recovery, and refine the service delivery business model.

The ambitious goal of reaching 60,000 households is based on assumptions that once SOIL has refined its service delivery business model, the organization will be able to hand over part(s) of the service chain to private enterprise(s)—for instance, neighborhood collection services and transport from transfer points to treatment sites—and create a public–private partnership (PPP) model for transport, treatment, and reuse. The management of the treatment site could also be delegated to public institutions such as the Office Régional d'Eau et d'Assainissement (OREPA) with support from DINEPA or managed as a PPP. However, there is concern about the technical capacity of both private companies and the public sector to provide services of an adequate standard.

As there are several organizations interested in replicating SOIL's CBS and treatment models elsewhere in Haiti, there is a potential role for SOIL in providing training, monitoring, and developing a franchise and/or supporting standardization. SOIL leadership is evaluating these possible roles, though finalizing the business model will necessarily precede any decision-making in this regard.

SOIL points out that in countries with well-developed sanitation sectors, public sector subsidies of excreta treatment is the rule, not the exception. Although SOIL is working to ensure that revenues from customer fees can cover the cost of containment and collection, the

organization does not intend to place the entire responsibility of covering the cost of transport, treatment, and reuse on the toilet customers or compost purchasers. SOIL suggests piloting a payment-for-results model, where the amount of feces treated or compost produced would be used as a key performance indicator. This appears judicious as the quantity of produced compost is a direct byproduct of the quantity of people served with sanitation services.

CBS services provided by SOIL offer a sound alternative to other forms of sanitation in areas where difficult access and restrictions on water availability create challenges for these alternatives. When interviewed, customers, community leaders, and local organizations highlighted the lack of adequate alternatives. According to some sources, most customers were not using toilets before subscribing to the service, instead relying on plastic bags for defecation. In addition, several customers describe positive changes in their neighborhoods, noticing less excreta thrown around, and they emphasized the importance of the service reaching a greater number of clients to increase its impact.

Key Lessons

SOIL is the only service provider in Cap-Haitien (and in Haiti at large) that is able to manage a sanitation system that covers the whole sanitation service chain. In Cap-Haitien, and in a context of poor regulation, none of the other existing solutions seems to guarantee safe containment, transport, and disposal or reuse of the excreta.

CBS is a particularly suitable approach for the segment of the urban population living in high-population-density areas. In these areas where infrastructure is limited and where customers have little disposable income and are used to "free" or pay-per-use services, SOIL has managed to introduce a safe, paid, subscription-based sanitation service.

Another important feature is SOIL's principle of providing the full-cycle ecological sanitation, where excreta is treated and transformed into compost, benefiting agricultural projects and development. It does not expect the cost of transport, treatment, and reuse to be covered by service fees from its low-income customers nor the sale of compost. Demand for compost has been high, but the price point cannot be increased significantly without jeopardizing the client base. As such, SOIL is looking at mechanisms to cover transport, treatment, and transformation costs, such as payments provided by the Haitian government through output-based aid.

SOIL intends to transfer implementation and scale-up of its CBS business models to the public and private sectors in Haiti. Therefore, an important aspect of its CBS approach is to develop a viable and replicable business model. According to its figures and projections from May 2018, customer fees may soon be able to cover the cost of containment and collection of feces, thereby permitting potential replication by the private sector.

Beyond the current service sector, CBS services could be expanded in a number of areas in Haiti, with a particular focus on high-density urban neighborhoods, which often offer little space for construction of septic tanks or even pit latrines, as well as a particular focus on flood-prone areas or hilly neighborhoods, desludging trucks cannot easily access.

To meet its ambitious target number of customers in Cap-Haitien and Port-au-Prince, SOIL will need to continue to influence the institutional environment, along with other organizations and donors in the sector. SOIL is considering transferring parts of its operation to the private and public sectors. Success of such a strategy will depend on financial and human resources available to those sectors. To improve the chances of success, the sanitation policy and related bylaws need to strengthen the mandates and responsibilities of the public institutions (ministry and municipality), including how these would be implemented on the ground. The influence of

SOIL would potentially continue to be expressed through the demonstration of its success in reaching low-income customers, as well as through capacity-building of public and private sanitation providers.

Note

1 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 and the main report, feces and urine are separated using urine-diverting toilet technologies. Cases where the CBS service provider collects only feces is referred to accordingly as *feces.* Also note that cover material (for example, sawdust or carbon cover) is added to the excreta in all cases.

Reference

Tilley, E., L. Ulrich, C. Lüthi, P. Reymond, and C. Zurbrügg. 2014. *Compendium of Sanitation Systems and Technologies.* 2nd rev. ed. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).

ABBREVIATIONS

AECID	Agencia Española de Cooperación Internacional para el Desarrollo (Spanish Agency for International Development Cooperation)
CAMEP	Centrale Autonome Métropolitaine d'Eau Potable (Autonomous Metropolitan Drinking Water Plant)
CBO	community-based organization
CBS	container-based sanitation
CRM	customer relationship management
CWIS	citywide inclusive sanitation
DHS	Demographic and Health Survey
DINEPA	Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation)
FSM	fecal sludge management
GDP	gross domestic product
IDB	Inter-American Development Bank
IHSI	Institut Haïtien de Statistique et d'Informatique (Haitian Institute for Statistics and Data Processing)
JMP	Joint Monitoring Programme
MdE	Ministère de l'Environnement (Ministry of Environment)
MSPP	Ministère de la Santé Publique et de la Population (Ministry of Public Health and Population)
MTPTC	Ministère des Travaux Publics, Transports et Communications (Ministry of Public Works, Transport and Communication)
NGO	nongovernmental organization
OREPA	Office Régional d'Eau Potable et d'Assainissement (Regional Potable Water and Sanitation Office)
OSS	on-site sanitation
PPP	public–private partnership
SNEP	Service National d'Eau Potable (National Potable Water Service)
SOIL	Sustainable Organic Integrated Livelihoods
UNICEF	United Nations Children's Fund
US$	United States dollar
WASH	water, sanitation, and hygiene
WHO	World Health Organization

Exchange rate: US$1 = G 61.92, as of June 10, 2017.

INTRODUCTION

Background

This case study, along with three others, is a component of a wider study by the World Bank of container-based sanitation (CBS) models. CBS models have emerged over the past 10 years as an alternative to network-based sanitation or on-site sanitation (OSS) services. This case study focuses on the operations of Sustainable Organic Integrated Livelihoods (SOIL), a CBS service provider operating in Haiti since 2011.

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.[1] Rather than having to build a sanitation facility, households (or public toilet operators) can sign up for the service. The CBS service provider then installs a toilet with sealable excreta receptacles (also referred to as *cartridges*) and commits to emptying them (that is, removing and replacing them with clean ones) on a regular basis. Transport methods can vary (and may involve *tuk tuks,* motorcycles, hand carts, and donkey carts) and adapt to a variety of space and logistical constraints. Some CBS entrepreneurs build and operate resource recovery facilities, taking advantage of the high-nutrient content of the relatively "fresh" and undiluted excreta, to produce biogas, fertilizers, or protein for animal feeds. Some CBS operators manage the entire cycle themselves, whereas some partner with other groups or local authorities to implement parts of the sanitation service chain.

Study Objectives

The objectives of the overall study are to document and assess existing CBS approaches with a particular focus on evaluating their safety, reliability, affordability, and financial viability. The study also seeks to identify the circumstances in which CBS approaches are most appropriate. The ultimate objective is to identify whether these solutions could be considered as part of a mix of options for citywide inclusive sanitation (CWIS).

The objective of this case study is to better understand how the SOIL CBS business model fits in the overall context of Cap-Haitien and Haiti. Where relevant, the case study also discusses SOIL's operations in the capital city of Port-au-Prince.

Study Methodology

The field work for this case study was carried out in early 2017 based on interviews with key SOIL staff, covering the range of activities and functions of the organization, and local stakeholders, as well as focus group discussions. Relevant data and documents were collected and analyzed until May 2017, though major developments and updates through May 2018 are reflected.

The case study was based on the analysis of primary and secondary data. This includes scientific papers written by SOIL staff and researchers, project proposals, SOIL activity reports, policy documents, statistical data form a range of organizations, and nonpublished material from consultants and nongovernmental organizations (NGOs). In order to further assess this information, a field visit was organized during the first two weeks of May 2017 to Cap-Haitien and Port-au-Prince. Questionnaires common to all four cases studies were used to interview ministry representatives, local authorities, water and sanitation directorate, SOIL staff, other sanitation service providers, international NGO representative, and independent consultants (2). Appendix A provides details on the interviewees.

Due to fieldwork constraints, the majority of customers and non-customers were interviewed through focus groups organized with the support of SOIL (that is, translation and meeting points), which may have introduced bias.[2] Meetings were also organized with representatives of community-based organizations (CBOs) active in two neighborhoods of Cap-Haitien and two neighborhoods of Port-au-Prince.

The fieldwork contributed to providing an overview of the urban sanitation conditions in the case study locations, highlighting how access to sanitation is currently provided, by whom, and at which service level.

Report Structure

Chapter 1 describes the CBS operation's service area and the basic geographic, economic, and demographic characteristics of Cap-Haitien. Chapter 2 provides an overview of the CBS operation, with a technical description of the different components of the operation as well as the management strategies, systems, and processes behind them. The impact of the policy and regulatory environment is briefly examined. Chapter 3 assesses the performance of the service from the customers' points of view and reviews customer growth. Chapter 4 presents a financial analysis of the operation and briefly discusses the main cost drivers. Chapter 5 summarizes key lessons.

Notes

1 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, feces and urine are separated using urine-diverting toilet technologies. Cases where the CBS service provider collects only feces is referred to accordingly as *feces.* Also note that cover material (for example, sawdust or carbon cover) is added to the excreta in all cases.

2 With the support of local organizations working with 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, customers satisfaction, and affordability.

Reference

Tilley, E., L. Ulrich, C. Lüthi, P. Reymond, and C. Zurbrügg. 2014. *Compendium of Sanitation Systems and Technologies.* 2nd rev. ed. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).

CHAPTER 1 • CBS SERVICE AREA CONTEXT

Implementation of SOIL in Cap-Haitien and Haiti

Sustainable Organic Integrated Livelihoods (SOIL) is a U.S.-based nongovernmental organization (NGO). SOIL describes itself as a research and development nonprofit organization that is developing sustainable services and business models to increase access to safely managed sanitation in vulnerable urban communities. These business models consist of a private sector business for containment and collection of feces, with costs covered by user fees, and a public–private partnership (PPP) for transport, treatment, and reuse of feces, with costs covered by a combination of compost revenue, tipping fees, payment for results, and carbon credit revenue. Like Sanergy in Kenya and x-runner in Peru, SOIL intends to build a circular sanitation business model where collected excreta is safely transformed into compost, which is sold to partially cover the cost of treatment.

The organization is active in Cap-Haitien and Port-au-Prince, where the main office is located. The 84 staff members working for SOIL are divided between both cities and across different departments, including direction and research, administration, logistics, and operations (collection and transport of containers, compost production, and mobile toilet deployment). More details are provided in appendix B. SOIL, unlike other container-based sanitation (CBS) businesses that have reached more than 500 customers, operates in two different cities and faces a range of challenges related to context, from flood-prone areas in Cap-Haitien to hilly and rocky soil in some areas of Port-au-Prince.

General Context of Haiti

Haiti remains the poorest country in the Americas, and one of the poorest in the world, with a gross domestic product (GDP) per capita of US$740 in 2016[1] and significant needs relating to basic services. According to the latest household survey (Institut Haïtien de Statistique et d'Informatique [IHSI] 2014), more than 6 million out of 10.4 million (59 percent) of Haitians live under the national poverty line of US$2.42 per day. Haiti is also one of the most unequal countries, with a Gini coefficient of 0.61 (as of 2012). Unemployment affects 40 percent of the urban workforce and almost 50 percent of the female workforce; underemployment is also an issue. Haitian youth face unemployment rates of more than 60 percent, triggering not only economic but also social concerns (World Bank 2014).

Although the country has the formal structures of a democracy, many have yet to become fully functional, as evidenced by recurring periods of political and institutional instability. Haiti's state institutions are under-resourced and provide only limited services to a small percentage of the population (United States Agency for International Development [USAID] 2017). Progress in recent years has been hampered by natural disasters and disease epidemics.

In January 2010, Haiti was hit by a magnitude 7.0 earthquake that "killed over 220,000 people, injured 300,000, left well over one million homeless, and destroyed infrastructure, services and homes" (Clermont et al. 2011). Haiti has suffered significant environmental degradation, contributing to poor sanitation and water quality. As a result, various public health risks exist for Haitians (Gracia et al. 2017). The lack of basic water and sanitation services has contributed to the spread of waterborne diseases, including the largest and most virulent cholera outbreak in recent global history in 2010.

According to the World Health Organization (WHO)/ United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) for Water Supply and Sanitation, coverage of improved drinking water in Haiti remained stable—at about 60 percent between 1990 and 2012—leaving 3.8 million people drinking from unimproved sources in 2012. In the same period, improved sanitation coverage rose only from 19 to 24 percent

nationally, still excluding 7.7 million people (WHO and UNICEF 2014).

Haiti, given its geographical location, exposure to climatic events such as hurricanes, and its economic situation, is considered as particularly vulnerable to the effects of climate change. According to the World Bank, "Poor quality of housing, transportation networks, communication infrastructure, and access to health services all exacerbate Haiti's vulnerability to natural disasters and climate change" (2011).

Urban Context of Cap-Haitien

Cap-Haitien is the second largest city in Haiti with a population of 250,000 in 2009. Cap-Haitien used to be the historical center of Haiti, and today, tourism remains an important source of income to the city, together with development of the port (trade). The majority of the economy, however, consists of informal trade activities (UN-Habitat 2012).

Urban development planning has been limited, and a large part of the population lives in the cités—informal neighborhoods characterized by poor access to services such as water, electricity, and sanitation. Cap-Haitien, similar to Port-au-Prince, is a large coastal city where settlements are expanding in the hills located around the city center and in flood-prone areas close to river mouths. Since 1970, poverty and rural emigration have transformed the city, leading to the expansion of low-income urban areas. In Cap-Haitien, more recent low-income urban areas are expanding on the east side of the airport (see map 1.1).

Map 1.1 • Aerial Picture of Cap-Haitien and Part of SOIL's Intervention Area

Source: SOIL.

SOIL's area of intervention covers approximately one-third of the territory of Cap-Haitien city, as shown by the areas highlighted in blue in map 1.1. SOIL is also present in the south of the city in peri-urban areas, such as Tilari or Katye Moren, and in the smaller city of Limonade, where SOIL has its regional office and its composting site. It is not active in the hilly sections of the town (located in the north and west).

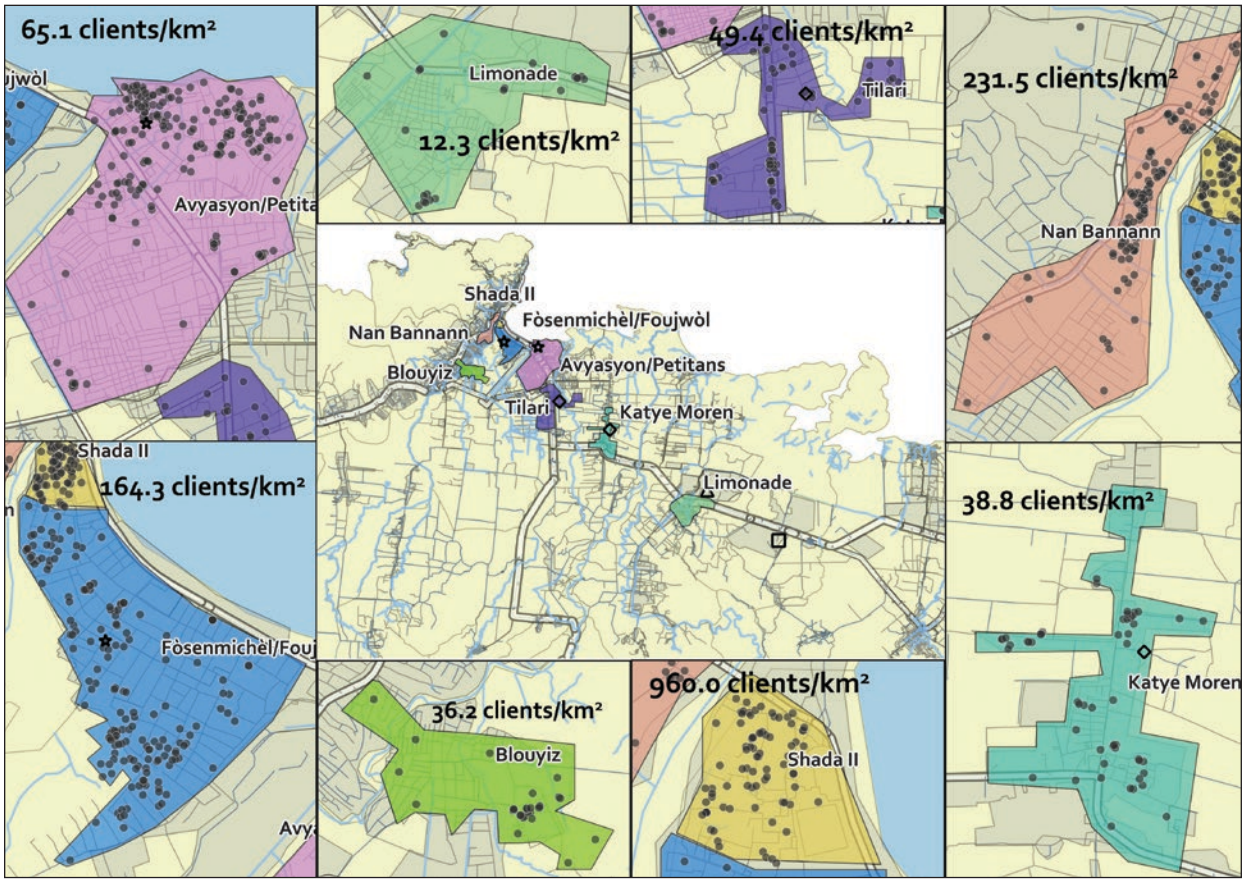
SOIL's container-based program, known as Eko-Lakay, operates mainly in the eastern part of Cap-Haitien in the neighborhoods of Avyasyon, Nan Bannann, Fosenmichel, and Shada, as shown in map 1.2. These neighborhoods share some common features, including high population density and irregular alley layout. They are also more exposed to flooding than the rest of the city.

A baseline survey carried out among three cohorts of the population (two from Shada and one from Avyasyon), with a total of 366 participants, provided some information on income levels of the population. Results across cohorts showed that one-third of the population owns a television and has access to electricity, and more than three-quarters own mobile phones. The median reported monthly expenditures of US$152 and US$141 for the two cohorts from Shada and US$136 for the cohort from Avyasyon (Russel et al. 2015).

Water and Sanitation Services in Cap-Haitien

There is no disaggregated data or recent studies regarding access to drinking water specifically in Cap-Haitien. Data on urban areas in general show that

Map 1.2 • Map Locating EkoLakay Customers in Cap-Haitien Neighborhoods (as of April 2017)



the majority of the population gets its drinking water from water sachets and water kiosks, which are present in all neighborhoods. Water kiosks are most often owned by individuals or private companies, and water is delivered by water trucking and pumped from boreholes outside the city.

There are also no recent statistics of sanitation coverage in Cap-Haitien. The Demographic and Health Survey (DHS) data from 2013 provides statistics for urban Haiti as a whole (see table 1.1) but does not disaggregate these data by city.

In Shada, one of the areas where SOIL operates, it is reported that approximately one-third of the inhabitants are using their own or their neighbors' private latrines, 50 percent are using public toilets, and 40 percent are practicing open defecation (Russel et al. 2015).[2] Although SOIL operates three free public toilets in Shada, public toilets are generally not present in other neighborhoods of the city. Sharing toilet facilities among tenants and neighbors is a common practice in urban Haiti, especially in low-income urban areas. Reported (Kaupp 2006)[3] and observed (GRET 2016) rates of open defecation and use of plastic bags in low-income urban areas of Cap-Haitien are much higher than the official figures describing sanitation facilities in urban Haiti. Wealthier households in the northern part of the city, hotels, or institutions are the primary parties with access to septic tanks.

As for emptying/collection and transport, there is little data describing services along the sanitation chain. In Cap-Haitien, two desludging firms report carrying out mechanical emptying of septic tanks for organizations and individuals. As a large percentage of facilities in Cap-Haitien are pit latrines, manual emptiers are reported to be numerous, but no specific numbers are available. These manual emptiers are not formally organized.

Given the lack of functioning public treatment sites in Cap-Haitien, manual emptiers are likely to dispose of most of the collected fecal sludge in the environment without treatment, sometimes burying it. One desludging company reports disposing of and treating septic tank content in their privately owned ponds, but there was no evidence available on treatment, according to an interview between the authors and an employee.

In both Cap-Haitien and Port-au-Prince, wastewater treatment plants are built with external funds and managed by the public sector (see Policy/Regulatory Environment for Sanitation Services). There is a septage treatment plant in Cap-Haitien that was built in 2013 that worked for only a few months but is now nonoperational (GRET 2016; field observation).[4] In Port-au-Prince, there were two government-run treatment stations built after the 2010 earthquake, though one of them closed down in 2014. The other station, Morne à Cabrit, is the only operational government treatment site in the country. Secondary data and observation indicate that there is no treatment in Cap-Haitien other than SOIL's compost site. As a result, safe management of excreta collected outside of SOIL's services is negligible.

Table 1.1 • Sanitation Facilities for Urban Areas in Haiti

	Sewer	Septic tank (and cesspool)	Improved pit latrine	Non-improved pit latrine	Shared toilet (often pit latrine)	No toilet
Percentage	1[a]	16	24	10	41	8

Source: Cayemittes et al. 2013.
a. The 1 percent identified as sewer is likely to include essentially toilets connected to a pipe. In several cases, the pipe is not connected to any treatment and discharges in a nearby open ditch. Very few simplified sewerages connected to a septic tank exist in Haiti.

Policy and Regulatory Environment for Sanitation Services

Reform of the water and sanitation sector was voted unanimously into law by the Haitian parliament and published in March 2009 (Le Moniteur 2009). The intent of the reform was to generate a new focus on the sector and take the first step toward spurring development and investment plans.

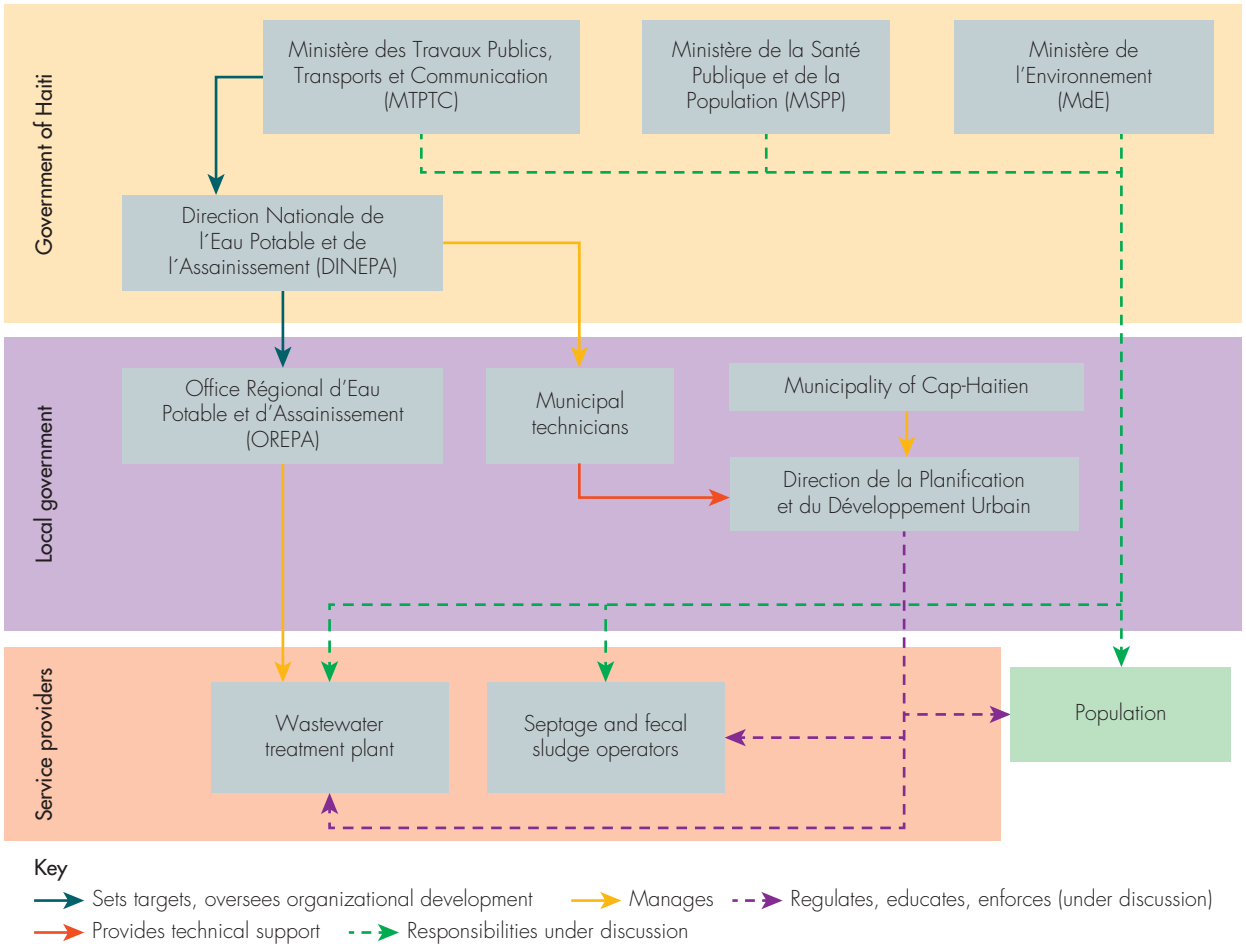
The reform created a regulatory body, Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation; DINEPA), and laid out its organizational structure, as well as its funding, evaluation, and control mechanisms. The reform also placed responsibility for oversight of sanitation (both off-site and on-site) within DINEPA, which had not been in the mandate of previous water authorities (Gelting et al. 2013). The Offices Régionaux d'Eau Potable et d'Assainissement (Regional Potable Water and Sanitation Offices; OREPAs) are regional offices—deconcentrated structures of DINEPA—in charge of managing water systems and wastewater treatment plants. Before 2009, the distribution of drinking water for urban areas was under the responsibility of two public agencies: the Centrale Autonome Métropolitaine d'Eau Potable (Autonomous Metropolitan Drinking Water Plant; CAMEP), from 1964 to 2009, and for the rest of Haiti, the Service National d'Eau Potable (National Potable Water Service; SNEP), from 1977 to 2009. Sanitation was not clearly allocated to any agency.

Institutional Arrangements for Sanitation

DINEPA is part of the Ministère des Travaux Publics, Transports et Communications (Ministry of Public Works, Transport and Communications; MTPTC). In 2014, DINEPA issued a revised version of the strategic document for sanitation in Haiti. The main areas of intervention of the public authorities are development of public institutions' capacities and roles on both national and local levels; demand stimulation; and public services development for desludging services and treatment. However, management, regulation, and governance over sanitation services are shared by DINEPA, Ministère de la Santé Publique et de la Population (Ministry of Public Health and Population; MSPP), Ministère de l'Environnement (Ministry of Environment; MdE), and local governments. The MSPP, for example, has the role of "ensuring the regulation and control of any public or private action within its fields of competence." (MSPP 2018) In the sanitation sector, the MSPP is working with DINEPA to develop standards and quality control of services while MdE provides guidance on quality of effluents to be released in the environment. The framework law mentioned above envisages the transfer of responsibility either by decentralization (for example, transferring responsibilities to municipalities and their urban planning departments) or deconcentration (for example, transferring responsibilities to the OREPAs) (Oxford Policy Management [OPM] 2017). As illustrated in figure 1.1, regulation, education, and enforcement responsibilities are not clearly allocated among the ministries involved in the sanitation sector.

In February 2016, DINEPA signed a tripartite agreement with the MSPP and the MdE for the coordination of the sanitation sector for 2016–21. The agreement focuses on three axes: a central regulatory structure within DINEPA with guidance, coordination, and regulatory roles in the sanitation sector; development of the sector and deconcentration of services at the level of OREPA and operators in the private sector; and decentralization or transfer of fecal sludge management (FSM) to town halls (while infrastructure remains state property). As of May 2017, the specific allocation of responsibilities for financing, training of staff, and implementation at the local level was still to be decided. As a result, the sanitation policy cannot be fully implemented and some questions remain—for instance, on the roles and resources (financial and human) of municipalities and different ministries.

Figure 1.1 • Key Institutional Relationships for Sanitation Services in Cap-Haitien



In Cap-Haitien, interviews with the different institutions highlight disparities between perceived responsibilities of DINEPA, the municipality, and the private sector. Stakeholders do not agree on their responsibilities regarding desludging, treatment, or environmental control.

On the ground, there are no incentives or enforcement (either documented or observed) that promote the uptake of improved sanitation facilities or the safe management of fecal sludge. Cap-Haitien, and most areas of Port-au-Prince, lack regulated FSM at the city/neighborhood level. Most emptiers operate without authorization, environmental controls are not effective, and there is no monitoring of the volume and quality of fecal waste transported and disposed. Despite the stated intentions of the sanitation policy, there is no enabling environment to encourage uptake of sanitation facilities. Roles and responsibilities, as well as corresponding funds and financial mechanisms, are not well-defined among the different ministries and municipalities. For instance, authorities responsible for education and enforcement have neither a strong mandate nor the human and financial resources to undertake their responsibilities.

Financing Arrangements

In Haiti, the majority of the water, sanitation, and hygiene (WASH) sector is funded by donors. DINEPA reports that, of the total funding for the sector between 2006 and 2015, only 1 percent is contributed

by the Haitian government. DINEPA's monthly expenditure for the salary of its employees equals more than US$660,000. More than 50 percent of the salary is paid by donors. Major donors of the overall WASH sector include the Agencia Española de Cooperación Internacional para el Desarrollo (Spanish Agency for International Development Cooperation; AECID) and the Inter-American Development Bank (IDB). Several other bilateral donors provide additional funding (USAID 2014).

Notes

1 World Bank Open Data database, https://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

2 Multiple responses permitted for each household.

3 Reported rate of open defecation and use of plastic bags in Shada went as high as 75 percent of the population resorting to it.

4 A truck of oil has deposited its loading in one of the tanks, and the rehabilitation work on the site has not been completed.

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CHAPTER 2 • OVERVIEW OF EXISTING CBS SERVICES

Background: Brief History of SOIL

Sustainable Organic Integrated Livelihoods (SOIL) started operating in 2006 with the intention to promote ecological sanitation in Cap-Haitien. Sasha Kramer, a co-founder of SOIL who was living in Cap-Haitien, told the authors in an interview that she wanted to "address urban sanitation challenges in a mid-sized city undergoing rapid growth." The first intervention included the construction and management of 50 double-vault public ecological toilets in three years. These community-managed public toilet blocks were reported to be difficult to manage and fell into disrepair.

Jointly with Oxfam, a household ecological sanitation pilot was initiated in 2009. The project was put on hold following the 2010 earthquake in the Port-au-Prince area. SOIL restarted the project in 2011, adapting the container-based sanitation (CBS) approach it had piloted during the emergency response for household use (Kilbride, Kramer, and Preneta 2013). The goal was to develop social business models around specific ecological sanitation services, and in 2013, customers began to pay a monthly fee for the service. Today, SOIL's programs (see photo 2.1 for pictures) include (Remington et al. 2016) the following:

- EkoLakay, the service managing containment through household urine-diversion container-based toilets and local collection and supporting the customers and population through education and training sessions on EkoLakay use, as well as general water, sanitation, and hygiene (WASH) issues.
- EkoMobil, which offers rental services of mobile urine-diversion, container-based toilets outside of the EkoLakay service zones and during events such as festivals.
- Konpòs Lakay, which assists in the transport and treatment of feces collected from EkoLakay and EkoMobil toilets, as well as other fecal sludge (toilet pit/septic tank contents from others, disposed of at SOIL's site for a fee), and transforms all fecal sludge into agriculture-grade compost.

Overview of Services Provided

In areas where the EkoLakay service is offered, customers can sign up for the CBS service. The service fee covers the installation of the toilet as well as a weekly exchange of filled feces containers for clean, empty ones; provision of a carbon cover material termed bonzodè, or "good smell;" toilet repairs as needed; and final treatment at a SOIL composting treatment facility. All material is eventually transformed into compost through a carefully monitored thermophilic composting process that meets World Health Organization (WHO) standards for safe treatment of fecal sludge. This final compost, branded by SOIL as Konpòs Lakay, is then sold to recover some of the costs of the treatment process (Remington et al. 2016).

Figure 2.1 summarizes the key elements of the sanitation service chain in Cap-Haitien with a focus on CBS services.

Demand Creation

SOIL's approach to demand creation and its sales strategy are changing to focus on densification. The sales strategy in the past relied heavily on door-to-door sales combined with some community events. The current strategy is to densify the number of customers in areas already served and focus demand creation on promoting referrals and reaching out through community meetings and community leaders.

Photo 2.1 • Pictures Presenting Different Services Provided by SOIL in Cap-Haitien

Source: SOIL.

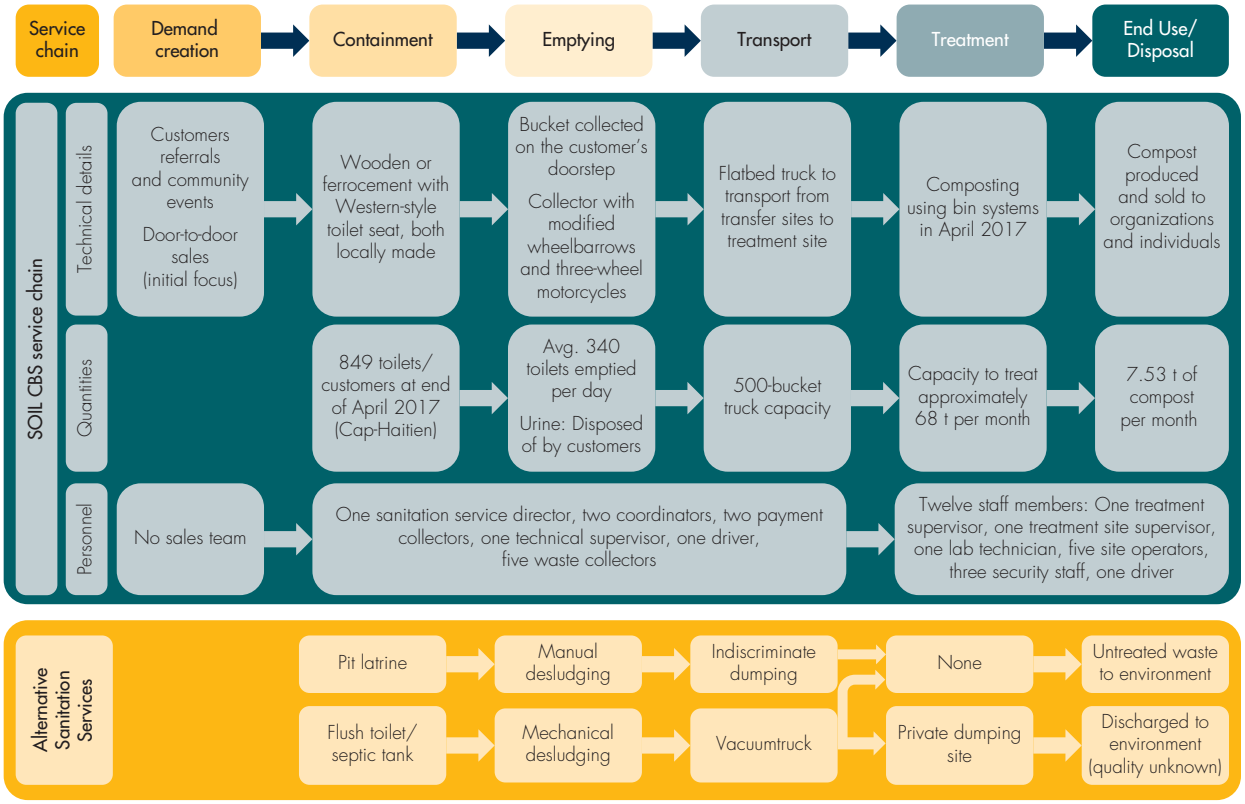
There is no dedicated sales team; instead, all team members are responsible for marketing efforts. As shown in figure 2.2 below, it is reported that half of the leads are created by the service coordinators, who each supervise half of the service area. A significant number of sales is made through referrals (customers referring new customers get a reward of G 100 or US$1.6) and word of mouth. These three methods facilitate reaching new customers in areas where EkoLakay is already implemented and, therefore, allow densification of the service area without a significant marketing investment.

At the time of the case study, EkoLakay was not aggressively looking at increasing sales as the team was focused on slow and sustained growth in strategic geographic areas. The short-term objective is to reach positive margins for the collection phase of the service by optimizing operations to reduce costs and improve economies of scale. A shift to establishing a dedicated sales team may be made once positive gross margins are achieved.

Containment

The EkoLakay toilet is a urine-diversion container-based toilet, which houses both a 20-liter container that captures the excreta and a 3-liter container that captures the urine. The separation of urine and feces is achieved by the installation of a plastic funnel in the forward section of each seat. Each toilet has a hatch in the front that allows customers to easily monitor the level of urine within the 3-liter container so as to avoid any overflow (Remington et al. 2016). After defecation, excreta is covered with carbon materials—sugarcane

Figure 2.1 • Sanitation Service Chain for Sanitation Options in Cap-Haitien (as of April 2017)



Note: Avg. = average; t = ton.

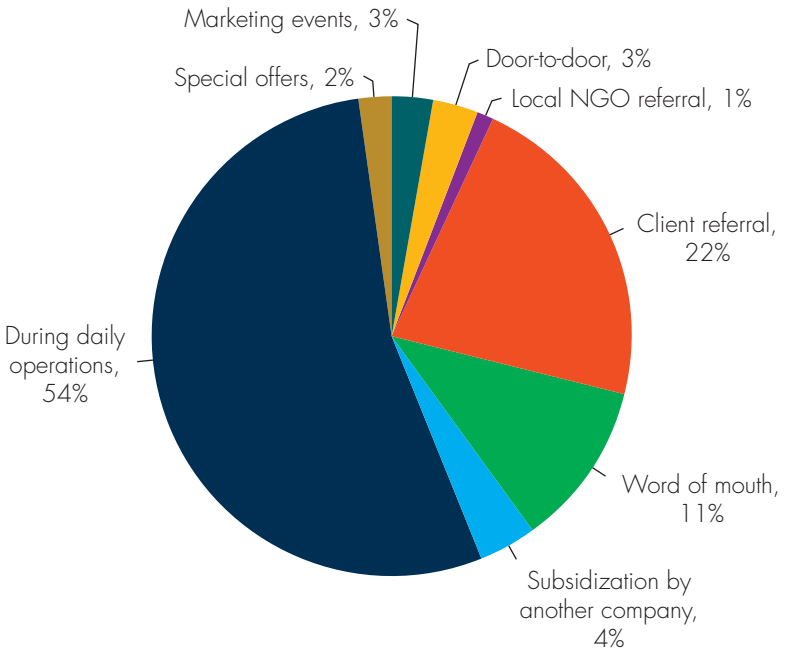
bagasse (pulp residue), ground peanut shells, or other dried agricultural waste—provided by SOIL.

Customers can choose between two different models: a wooden version that costs US$50 to produce and a ferrocement model that costs US$27, as seen in photo 2.2. All materials used to build the EkoLakay toilets are sourced locally, and toilets are built by local contractors in SOIL's workshops. Generally, one bucket can serve one family of five members for one week. Larger families can request a second bucket for free. For the EkoLakay service, customers pay a monthly fee of G 200 (US$3.20) in Cap-Haitien and G 250 (US$4) in Port-au-Prince. Customers do not currently pay a separate installation fee—only monthly fees. New customers receive training on proper toilet usage, sign a service contract, and make an upfront payment for the first month.

Emptying

On the day of collection, customers seal the buckets themselves with the cover provided; they then place the bucket on their doorstep. Collection is done once (in 43 percent of cases in Cap-Haitien in April 2017) or twice per week on scheduled days, though SOIL is moving toward once-weekly collections across its service area. The once-weekly collection was first introduced in Port-au-Prince and then to new customers in Cap-Haitien, and it is now progressing to earlier customers. SOIL plans to move to once-weekly collection for all customers in the coming year. Although this does not require an adjustment of the toilet design, customers can ask for a second bucket. One SOIL collector proceeds door to door to exchange the buckets containing feces with clean containers filled with the covering material (bagasse and peanut shells).

Figure 2.2 • Sales Channels through which EkoLakay Customers Signed Up in 2015–16



Source: Author elaboration based on interview data.
Note: NGO = nongovernmental organization.

Photo 2.2 • Pictures of EkoLakay Toilet, Wooden and Ferrocement Models

Source: SOIL.

Management of the urine container is done by the customers themselves, who can choose to dispose of urine into the informal drainage canals or reuse it after dilution for farming purposes. There is presently no organized collection or commercialized reuse of urine.

Transport

Cap-Haitien, the geographical area where the EkoLakay service is implemented, is divided into two blocks, and each block is divided into zones. On each block, there is one transfer station or depot. Depots are used to store (for two days maximum) buckets of feces and buckets of cover material, but they also serve as an office where customers can interact with the operations coordinators and make their monthly payments.

Collections are conducted in an area, zone by zone, over five days (Monday to Friday). The collections start at 6 a.m. and last as long as five hours. In most cases, collectors push a modified wheelbarrow (32-bucket capacity) from collection zones to the depot. In cases where the zones are too far from the depot, buckets are gathered at temporary seating points until they are collected by a pickup truck (70-bucket capacity). In more peri-urban areas, buckets are collected by motorized three-wheeled vehicles (60-bucket capacity). Twice a week, one flatbed truck (500-bucket capacity) transports the filled containers from the depots and pickup points to the centralized composting facilities (located 15 kilometers away from Shada and the center of Cap-Haitien).

Treatment

SOIL's composting process is made up of three phases: a passively aerated static pile phase; a windrow-turning phase where the compost is turned and aerated; and a final curation phase. At the beginning of the process, sugarcane bagasse is added to the compost piles as a bulking agent and for vector control. Upon entering the compost site, containers are emptied into bins made of modified wooden pallets, which allows for passive aeration of the compost. Important characteristics of these bins include sloped cement foundations to facilitate removal of leachate from the pile, metal roofs to protect against the elements, and a mesh cover for vector control. The temperatures throughout each pile are monitored to ensure they exceed the WHO standard of eight consecutive days at sustained temperatures higher than 50°C. After two and a half months, SOIL confirms treatment by testing each pile for *Escherichia coli.*

The compost is then moved to windrows, which are roofed and protected from flooding by a cement block frame but are otherwise laid on bare ground. The compost piles are turned and watered at two-week intervals for three months, at which point they are tested again for *E. coli* before being moved to a curing windrow. Here, the compost remains until mature, which is confirmed by additional tests (pH, conductivity, and germination) (Preneta et al. 2017).

End Use

All compost is sieved, bagged, and sold as Konpòs Lakay either in 18-kilogram bags (US$6/bag) or in bulk (US$280/ton) (Preneta et al. 2017). From the start of operations to May 2017, SOIL sold 206 metric tons of compost to clientele made up of large agricultural companies, foundations, nongovernmental organizations (NGOs), and private individuals. SOIL currently is unable to meet the demand for compost and sells out regularly. According to calculations by SOIL, the revenue generated by compost sales covered an estimated 20 to 40 percent of SOIL's operational costs at the compost site in 2016 (see Chapter 4).

Legal and Policy Environment and Impact on CBS Services

Since 2012, Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation; DINEPA) has been developing technical

reference guidelines that include standards to be respected for water and sanitation interventions. This framework forbids the use of shared/community ecological sanitation in urban areas unless the interest for use of compost is guaranteed and demand comes from users rather than an external organization. Management of the whole sanitation chain—from toilet construction to final reuse—also needs to be ensured (DINEPA 2013).

DINEPA and SOIL have continuously discussed the principles of CBS in Haiti, but the framework does not directly address CBS. DINEPA considers SOIL to be a social business and recognizes its intervention and its valuable knowledge concerning composting of human excreta. Thus, it is briefly mentioned as a source of information in the reference documents.

SOIL reports an ongoing discussion with DINEPA concerning the inclusion of CBS in the next version of the technical reference framework. DINEPA acknowledges the interest of several organizations and individuals to copy or adapt the CBS model introduced by SOIL in different areas of the country. The representatives of DINEPA are considering how such initiatives would be supported and controlled in the future. The role of SOIL as a training or quality certification entity are options under discussion, as well as the franchising of part of the activities.

In its strategy to raise demand, awareness, and toilet construction, DINEPA indicated it would probably include CBS as a potential solution. However, DINEPA representatives insisted on what they see as the transitional nature of CBS approaches—it is concerned that the mobile nature of EkoLakay toilets may undermine the ultimate goal of guaranteeing that each house has one permanent toilet. Yet for houses that already exist and present technical constraints for the construction of a permanent toilet, CBS is an accepted transitory solution. In addition, the duration of this transitory phase is not clearly defined, even though DINEPA acknowledged that in some contexts, it could mean more than two decades. It is important to note that DINEPA has neither implemented nor demonstrated a viable alternate solution in the low-income urban areas and/or transitional areas.

One representative of the municipality of Cap-Haitien indicated his approval of the use of CBS in low-income settlements. The representative praised the organization for its capacity to create a willingness to pay for sanitation in the "poorest" areas of the city. However, he indicated that such settlements do not have legal tenure or the right to remain and will be modernized within five years, making CBS a transitional approach. The only alternative the representative proposed was the relocation of the population in another area of the town, without providing more details.

In general, the authorities (municipalities of Cap-Haitien and Limonade as well as DINEPA) and other sanitation providers do not currently identify SOIL as a provider of toilets or desludging operator but rather as an organization with expertise in fecal sludge treatment and composting. On the treatment and reuse side, composting of excreta is considered as an acceptable form of treatment if proper management, including storage time, is guaranteed.

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CHAPTER 3 • CBS SERVICE PERFORMANCE

This section examines the EkoLakay service's growth, the factors affecting this progression, as well as customer perceptions concerning the service.

SOIL Customer Growth

In April 2017, Sustainable Organic Integrated Livelihoods (SOIL) had 849 EkoLakay customers in Cap-Haitien and 164 in Port-au-Prince. Historically, an average growth rate of 290 clients per year has been observed in a relatively slow but steady growth path.

The sanitation situations of EkoLakay users before signing up for the service differ. Some customers had pit latrines in their houses but could not afford the desludging and chose to abandon their latrines. Elements of dissatisfaction with pit latrines include bad smells, spread of insects, lack of comfort, and difficulties of cleaning. Some moved into a rented house with no toilet. Others were sharing a pit latrine in a multihousehold block and preferred to have their own service. In general, the decision of becoming an EkoLakay customer is fostered by attending a marketing meeting, which raises awareness of health and hygiene issues, and hearing positive feedback from other EkoLakay customers.

During fiscal year 2015–16, EkoLakay installed 417 toilets and uninstalled 167 in Cap-Haitien, serving a total of 687 customers by year-end. The churn rate that year was 2.6 percent. The reduction in the number of users observed during the first trimester of 2017, shown in figure 3.1, stems from the explicit focus on reducing costs through, for instance, terminating services to customers who were not paying.

Assessing the Value of SOIL Services to Customers

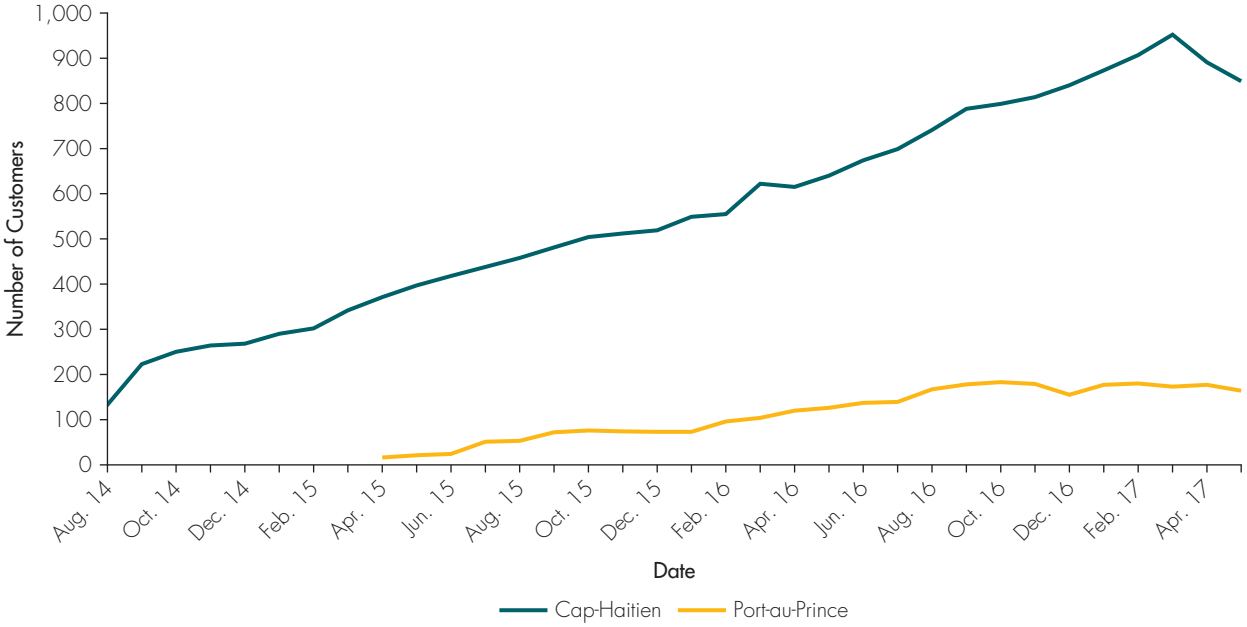
This analysis shows that container-based sanitation (CBS) services provided by SOIL offer a sound alternative to other forms of sanitation in the urban areas of Cap-Haitien. The majority of the population in the target area cannot afford sanitation systems and services that guarantee a safe sanitation chain (for example, a well-built septic tank emptied by a truck transporting sludge to an end site with a proper treatment service). Furthermore, difficult access and restrictions on water availability in these areas create challenges for alternatives such as pit latrines or septic tanks.

Quality and Reliability of Services

Comfort

The majority of the EkoLakay service customers expressed high satisfaction with the toilet itself and the collection service and did not highlight issues of smell, maggots, or flies in the buckets.[1] The absence of odors was mentioned by several customers and stakeholders as a key element not only for them to accept the toilets in their houses themselves but also for the population to accept the conveyance of the buckets in the streets. This outcome is potentially related to how customers use and maintain their toilets (which, in turn, is potentially related to the quality of training and monitoring provided by the EkoLakay team), as well as the quality of the organic cover material. Customers report that all members of the house normally use the toilets except for children younger than five (who use chamber pots—the content is disposed of later into the EkoLakay toilet).

Figure 3.1 • Evolution of Numbers of EkoLakay Customers



Source: SOIL.
Note: Data prior to 2014 was not shared.

Customers interviewed did not report sharing their EkoLakay toilets with neighbors.

High levels of satisfaction are also observed with the transfer point (depot). Although neighbors in close proximity to the depot did not initially welcome it, they relaxed their stance upon the absence of offensive odors and other nuisances.

Reliability

The customers interviewed did not report any significant delays from collectors. Collection of feces is done regularly on the day and time agreed upon in advance. SOIL reported receiving very few complaints. Between March and May 2017, there were only two complaints (out of approximately 870 customers) for missed collection services. Where collection services had been missed, the issue was addressed by collecting buckets in the next collection.

Collection Frequency

The weekly feces collection appears to be satisfactory for customers. Some did not welcome the change from twice-weekly to once-weekly collections as they feared the bucket would be filled before the collection day. However, for these customers, SOIL provides the option of an extra bucket.

Impact on the Surrounding Environment

Several customers described positive change in their neighborhood, including less excreta strewn around, and they emphasized the importance of the service reaching a greater number of clients to increase its impact. Ecological aspects and potential to reuse excreta to produce compost was not widely discussed in Cap-Haitien, unlike in Port-au-Prince where the ecological motivation was pointed out by two customers and a local leader. Finally, for those customers living in flood-prone areas, customers

consulted during the focus group discussions mentioned that they preferred the EkoLakay toilets compared to any other alternative as they could still use their toilets during floods. Several customers commented observing feces from pit latrines or defecation plastic bags floating during flood events.

Challenges with Cover Material

The organic cover material is a mix of bagasse and peanut shells. Bagasse is an essential element of the mix, but the sourcing of cover material at scale constitutes a significant risk as supplies are limited. Additionally, sugarcane producers now provide it for free (with SOIL responsible for transport charges), but should bagasse become of interest to other companies (for instance, as biofuel), it become costly—and this would increase the cost of the EkoLakay service. As of May 2018, SOIL was looking into alternative cover material with more secure supply chains, such as compost.

Constraints to Accessing the Service for Non-Customers

A number of people interested in the service during marketing efforts were unable to subscribe to the service for two main reasons: space (there is not enough space in their house, or in the section of the house they rent, to install the toilet) and affordability (they are not able to regularly pay the monthly fees). It seems, according to interviews with two non-customers with functioning on-site sanitation (OSS) systems, that people who already have in-house toilets with septic tanks are not interested in EkoLakay toilets as long as their systems function well and they are able to pay for desludging services (or the landlords if they are in a rented house).

Cost to Service Users

Payment Options

Several customers report that the payment system could be improved with more flexibility. Apparently, customers are not used to reporting issues about the service regularly (through collectors or at the depot) and report only severe issues, such as elements of the toilet being broken or missed collections.

Customer Tariffs and Affordability

Affordability is a key issue for customers and non-customers. In Cap-Haitien, SOIL offered a single tariff for the EkoLakay service, which was G 200 (US$3.20) per month in May 2017. The majority of customers who were interviewed in Cap-Haitien for the case study expressed the wish for the service tariff to be halved. SOIL coordinators and staff engage in regular dialogue with customers to explain why the tariff cannot be reduced in order to preserve service quality. The majority of customers pointed out that most of the neighborhood inhabitants could not afford the monthly user fees. However, other customers disagreed, explaining that those who are already paying for the services were not better off than the non-customers. They estimated that most people could pay the user fees and have a CBS toilet at home but that some individuals have different priorities, influencing their willingness to pay.[2]

SOIL Services vs. Available Alternatives in the Service Area

Customers as well as community leaders and local organizations highlight the lack of adequate alternatives. According to community-based organization (CBO) representatives and local leaders, most customers were not using toilets before subscribing to the service, instead relying on plastic bags for defecation.

As mentioned, some customers moved from a pit latrine to CBS service. This change often happens at the time of desludging. In urban areas where SOIL operates, characteristics of pit latrines vary significantly: size and depth, water table levels, type of slabs, and so on. In Cap-Haitien and Port-au-Prince, a latrine (digging, eventual lining, and slab) costs between G 20,000 and G 30,000

Table 3.1 • Qualitative Comparison of CBS and Alternatives

	Safety of sanitation service chain					Potential reach
	Containment	Emptying	Transport	Treatment	Disposal/ reuse	
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

Note: Green = safe; yellow = partially safe; red = unsafe. Sewer-based alternatives are not mentioned as these solutions would not be implementable in the near to medium-term. CBS = container-based sanitation; FSM = fecal sludge management.
Note on potential reach: Potential to provide defined sanitation service to all households in specific targeted geographical area.

(an average of US$404) (GRET 2016; consultant's field-work data).

Depending on the size of the pit, the height of the water table, and the number of users, desludging of pit latrines may happen every two to 10 years. Manual emptiers (referred to as bayakou) empty the pit latrines in low-income areas. In some cases, content is buried in a new pit, but often the fecal sludge is discharged into the environment without treatment (into either water bodies or free land). According to interviewed service providers, tariffs for manual desludging depend on the techniques used by the emptiers and volume of sludge, usually between G 3,000 and G 6,000 (average of US$73). Fees for mechanical emptying in Cap-Haitien range from G 20,000 to G 25,000 (average US$310) for 3,000 gallons.

In Cap-Haitien, there is no sewerage system, and local authorities did not share plans for sewerage rollout in the future. Facing few other available options, CBS services appear for several of the customers interviewed as an acceptable mid-term solution (that is, for the next five years). Several customers hope to be able to upgrade to a modern toilet, which is perceived as a flush toilet supposedly connected to a septic tank, in the future. The associated cost of a flush toilet would be more than G 25,000 (US$404) without guarantee on the quality of the septic tank.[3]

Table 3.1 compares the safety of SOIL's CBS service with the alternative at each point in the sanitation service chain, as well as their potential reach—that is, how well they can penetrate the informal settlements.

Notes

1 This assessment was based on satisfaction surveys conducted by SOIL, focus group discussions, and interviews conducted for the purpose of the case study.

2 In Port-au-Prince, SOIL carried out a willingness-to-pay survey, which led to fee increases from G 250 to G 350 (US$4 to US$5.65) with an 80 percent customer retention rate. As of May 2018, they were considering following a similar process for Cap-Haitien.

3 The interviewed representative of the desludging company reports a significant variation of the quality of the septic tanks in the city, both in terms of design and construction.

Reference

GRET. 2016. *Etude sur la Gestion des Excrétas dans les Quartiers Précaires en Haiti. Livrable n´2: Etat des Lieux.* GRET, Oxfam, and Direction Nationale de l'Eau Potable et de l'Assainissement.

CHAPTER 4 • FINANCIAL PERFORMANCE

This section reviews the financial performance of Sustainable Organic Integrated Livelihoods (SOIL). The organization has documented its business model, including its cost drivers, through a number of publications (Remington et al. 2016; Remington et al. 2017). In addition, specific financial analysis was conducted for the case study to assess SOIL's current financial position, its sources of funding, as well as potential ways to increase cost recovery.

Current Costs and Financing Sources

The provision of services by SOIL had a total annual cost of a little less than US$435,000, with about 10 percent (US$43,900) recovered via fees from toilet users and from sales of the reuse product. Revenues from the fees charged to toilet users were a little less than US$25,000 in 2016, amounting to 5 percent of the total costs and 27 percent of the costs of providing the toilet service (when taking overhead costs into account). Reuse activities generated revenues that covered only 10 percent of the costs of producing the reuse product.

To recover its full costs (including overhead and research and development costs), SOIL relies on a combination of earned income (compost and service fees) and external subsidies.

To inform strategic decisions around the operational model, SOIL has quantified costs for each activity, providing a cost per household.[1] Treatment and production of compost is identified as the costliest process before collection and transport, but it is also one of the processes generating some revenue. Within the transport component, the most expensive item is the rental of depots used as transfer stations, but the model has proved these transfer stations reach an economy of scale when the density of customers situated around that depot is high enough.

Critically, the user fee does not currently cover all costs of the sanitation service. According to SOIL's own analysis—and excluding the cost of transport, treatment, and transformation—the user fee of G 200 (US$3.20)[2] remains below the cost needed for containment (US$1.37) and collection (US$2.90) (total of US$4.27). SOIL's business model has also been negatively impacted by the devaluation of the Haitian gourde as the staff is paid in U.S. dollars but revenue is generated in Haitian gourdes. In 2013, when the service fee was set at G 200, it was equal to US$5; however, in 2016, the value of G 200 dropped to US$3.20.

At the end of the chain, compost sales are not sufficient to cover processing costs; the revenue generated by compost sales currently covers an estimated 20 to 40 percent of SOIL's operational costs at the compost site (less if taking into account overhead costs, as stated previously) (Preneta et al. 2017). SOIL is reluctant to increase the tariff for the compost, however, as Konpòs Lakay is currently the most expensive organic amendment on the market.

SOIL receives support from a wide variety of institutional funders, philanthropic organizations, and individual donors. Previously, SOIL has received significant funding from the following groups: 11th Hour Project, Swedish Postcode Foundation, Grand Challenges Canada, Inter-American Development Bank (IDB), American Red Cross, and Open Road Alliance. In addition, SOIL funds more than 10 percent of its annual budget through individual contributions.

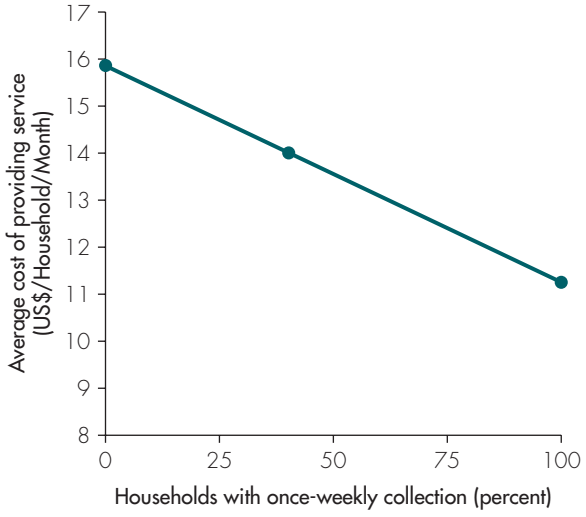
SOIL has been deploying various approaches to reduce its external funding requirement, including improving its operating model and generating efficiency

gains, growing the operations to generate economies of scale, and seeking to generate revenues from its reuse activities. Despite these strategies, however, securing reliable flows of external subsidies (potentially through results-based financing contractual arrangements) will be critical to ensure the financial viability of the operation.

Improving Operational Efficiency

To improve the efficiency of its operations, and following its own analysis, SOIL decided to implement several changes in its operations in 2017, which included an overall switch to a once-weekly collection and the use of mobile money. According to projections, the increased percentage of households served once per week was expected to have a direct impact on the cost of providing the service, as shown in figure 4.1 (Remington et al. 2017). Customers are provided with more than one bucket if one is not sufficient for a weekly collection. Several customers are already using more than one bucket and seem to have the capacity to store their filled extra bucket until the weekly collection.

Figure 4.1 • Relation between Cost of Service and Number of Collections Per Week



Source: Remington et al. 2017.

To reduce payment collection costs, SOIL is introducing mobile phone payments to reduce door-to-door visits and their associated costs. At the time of the visits, few customers had chosen this option. Mobile money is less common and developed in Haiti than where other container-based sanitation (CBS) service providers operate, such as Kenya or Ghana. Therefore, this process may take longer and require targeted communication campaigns.[3]

SOIL is also implementing a new software to support customer relationship management (CRM). This is done through an integrated solution using TaroWorks (for offline mobile data collection) and SalesForce (a CRM software for reporting and analysis). This solution is already facilitating better management of the sales pipeline with new prospects and more market insights, addressing customers' complaints, resolving customer debts, and making data collection and analysis more efficient and effective.

Plans to Achieve Economies of Scale through Expansion

SOIL intends to increase the density of customers within the neighborhoods it already serves. This will enable the organization to evaluate the efficiencies created by dense collection and transport areas and gather more robust information about expenses associated with service provision. The information will be used to refine cost projections, identify opportunities for greater cost recovery, and refine the service delivery business model. The objective is to reach approximately 3,500 EkoLakay toilets in 16 neighborhoods by 2020 (from 14 neighborhoods to date, including operations in Port-au-Prince; see box 4.1). The long-term objective is to reach more than 60,000 households in both Cap-Haitien and Port-au-Prince, with the largest part of the growth in the capital city.

The customer map for Cap-Haitien updated in April 2017 helps identify where SOIL intends to increase density of customers. The zones of Avyasyon, Fosenmichel,

Box 4.1 • Operations and Customer Expansion in Port-au-Prince

In Port-au-Prince, SOIL is operating in a single neighborhood 'Ti Plas Kazo. This neighborhood had been chosen partly for reasons of convenience as it is located between the office and the treatment site but also because it presents different features than the ones in Cap-Haitien. Most notably, it is a higher income neighborhood, thereby providing an opportunity to test the viability of this solution in a more aspirational setting.

Ti Plas Kazo is a planned settlement built in 1985 for local factory workers and initially provided with infrastructure including sewers connected to large shared septic tanks. Today, the population and number of houses have significantly increased and the sanitation systems have rapidly deteriorated due to lack of maintenance and investment. In terms of income, the population is more heterogeneous than that of the areas of Cap-Haitien where EkoLakay operates. Within the neighborhood, some customers have septic tanks regularly emptied by vacuum trucks from known desludging companies; some still use the 1985 sanitation system that has, in one section, been rehabilitated by a NGO; some use EkoLakay; and others rely on pit latrines. In this hilly neighborhood, EkoLakay has to use motorized vehicles to do the collection of buckets, which increases the cost of collection. The heterogeneity of household income in these neighborhoods means that the density of potential customers is lower. In the future, EkoLakay will expand its activities in Port-au-Prince in areas with a high density of potential customers (although optimal density has not been identified) and in areas located in the North of the city in order to be close to the Titanyen treatment site.

Nan Bannann, and Shada are low-income urban areas located in the center of Cap-Haitien characterized by a high population density of housing and prevalence of flood-prone areas.[4] These territories are identified by SOIL as its representative service areas where inhabitants have few, if any, alternatives and fewer safe sanitation alternatives. It is anticipated that 25,000 households are potential CBS customers in Cap-Haitien, as discussed in box 4.2.

In the capital, the number of potential CBS customers is much higher than in Cap-Haitien. In Canaan (an area created after 2010 to rehouse people affected by the earthquake), located close to SOIL's treatment site on the outskirts of Port-au-Prince, the population is estimated to be more than 250,000 people, and the vast majority does not have improved sanitation facilities.

EkoLakay also has customers in peri-urban areas such as Katye Moren and Limonade (the municipality where SOIL's office and compost site are located). These areas are characterized by a lower density of customers. Most of these customers are beyond walking distance from the transfer or treatment sites and, therefore, need to be served by motorized three-wheelers, which increases the cost of collection per customer.

The ambitious scenario of reaching 60,000 households is based on assumptions that once SOIL has refined its service delivery business model, the organization will be able to hand over part(s) of the service chain to private enterprise(s)—for instance, transport from transfer points to treatment sites and provision of toilets and weekly collection of buckets. SOIL's current focus is on reducing costs so that the service fee can cover the cost of toilet production and weekly collection of feces. Once it does this, there is potential for private entrepreneurs to replicate the local service in new neighborhoods, thereby allowing rapid scaling through the private sector.

Box 4.2 • Estimation of Potential CBS Customer Base in Cap-Haitien

Using population data (IHSI 2015) for the whole communal section of Petite Anse (EkoLakay is active on the whole area) and for 30 percent of the communal section of Haut du Cap, the population of the SOIL's intervention area is around 150,000 people. Considering, based on secondary data that 75 percent of the population do not have access to improve toilets and considering an average of 4.5 members per households, there is a total number of 25,000 households not using an improved sanitation facility and therefore being potential CBS customers. This number is highly dependent on the number of people per household which could reach 6 as per latest estimates.

On the other hand, SOIL anticipates that transferring fecal sludge treatment operations to the public sector would be a lengthy process. The management of the treatment site could be delegated to public institutions such as the Office Régional d'Eau et d'Assainissement (OREPA) (with support from Direction Nationale de l'Eau Potable et de l'Assainissement; DINEPA) or managed as a public–private partnership (PPP). But there are some concerns about the technical capacity of some private sector actors to manage services at an adequate standard. Similarly, though the public sector is in charge of the management of other treatment plants, it may not have the capacity to take on additional sites or operate the specific treatment processes SOIL uses. As of May 2018, SOIL was working on developing a PPP model that could be used to replicate its compost sites (currently just outside of Port-au-Prince and Cap-Haitien) countrywide and transfer its composting skills and capacity to DINEPA. This transfer process had been moving slowly, however. In 2016, SOIL and DINEPA signed an agreement to set up a composting site within the treatment site in Port-au-Prince where the two institutions could collaborate on testing processes for composting the solids from the wastewater stabilization ponds as well as fecal waste (to avoid it going directly into the ponds). As of May 2018, this had not been implemented as the government had not yet reopened its adjacent site.

As there are several organizations interested in replicating SOIL's CBS and treatment models elsewhere in Haiti, SOIL could play a role in providing training, monitoring, franchising, and/or standardization.

Finally, expansion plans depend on SOIL's financial and technical capacity to develop the size of its treatment sites and the number of depots as the number of customers grows. Involvement of the municipality is essential to keep renewing the authorization to operate but could also facilitate allocation and rental of the land and depot through in-kind contributions. Previous experience has demonstrated that unstable local and national governments can result in slow approval processes.

Boosting Revenues and Identifying Reliable Subsidies

To boost revenues from user charges, SOIL intends to increase the user fee, though customers might be reluctant or unable to pay a higher fee. Unlike in Ghana, where residents of low-income areas are used to paying for public toilets, most of the population in the low-income urban areas in Haiti are not used to paying for sanitation. As stated above, as of May 2018, SOIL had increased user fees from G 250 to G 350 (US$4 to US$5.65) in Port-au-Prince, following the results of a willingness-to-pay survey, and was looking at how to adapt this approach for Cap-Haitien.

To bypass some of the financial difficulties of the target market, SOIL is considering enabling diaspora payments so that overseas relatives could pay EkoLakay

fees on behalf of family members in Haiti (at a higher price of US$5 to US$10 per customer per month). As of May 2018, this process was at the initial stage and had not yet been implemented.

SOIL is also exploring the diversification of its treatment revenue streams. One possibility would be to accept fecal sludge from pit latrines, which would generate additional revenue from treatment or tipping fees and possibly produce more compost. As of May 2018, this had not yet been explored. In Cap-Haitien, some private providers of desludging services (both mechanical and manual) had expressed interest to discuss such options without providing more details. Such options require technical testing and financial modeling.

SOIL is not receiving subsidies from the Haitian government. DINEPA has established a strict policy of no subsidies for household toilets in Haiti to force households to take responsibility for their toilets, including sustaining and maintaining their chosen sanitation system. Concerning the rest of the services provided by SOIL, the ministries are not in a position to support them financially but are open to the idea of public sector subsidization of the transport, treatment, and reuse parts of the sanitation chain.

SOIL is in the process of seeking output-based aid financing. SOIL pointed out that in countries with well-developed sanitation sectors, subsidization of fecal sludge treatment by the public sector is the rule, not the exception. Although SOIL is working to ensure that customer fees and compost sales can cover the cost of containment and collection, the organization does not intend to place the entire responsibility of covering the cost of transport, treatment, and reuse on the toilet customers or compost purchasers.

SOIL has also been exploring the possibility of piloting a payment-for-results model, where the volume of compost produced would be used as a key performance indicator, as described in box 4.3. An external partner (such as a development bank) would finance the organization directly or it would operate through a government intermediary, such as DINEPA.

Box 4.3 • Compost Volume as a Performance Indicator in a Payment-for-Results Proposed Project

Sustainable Organic Integrated Livelihoods (SOIL) has discussed the implementation of a payment-for-results mechanism with a number of stakeholders, including the Haitian government, the World Bank, the United States Agency for International Development (USAID), and the Inter-American Development Bank (IDB). The proposed financial mechanism would entail financing from development agencies via performance-based disbursements, regulated by the Haitian government and implemented by SOIL or a private company.

SOIL keeps records on a range of performance indicators (including households and individuals served, as well as waste contained and treated). It suggests that compost produced is the ideal performance indicator as it appears to be easy and straightforward to quantify and can be measured with reduced uncertainty. The quantity of produced compost is a direct byproduct of the quantity of people served with sanitation services and the amount of waste safely treated.

Additionally, SOIL suggests that if the financial partner chooses to finance a government intermediary as part of this project, SOIL could provide compost in exchange for payment. This would mean this payment-for-results mechanism is essentially an agreed bill of sale for the compost SOIL generates from the expansion of sanitation services in SOIL's current service zones.

Notes

1 The majority of the data was collected over a period of five months when about 600 to 700 clients were being served (in 2016).

2 The user's fee of G 200 corresponded in 2014 to US$5 and US$3.20 in June 2017.

3 As of May 2018, SOIL had put in place several strategies to increase mobile payment uptake with successful results: Mobile payment rates had increased to 30 percent in Cap-Haitien and 65 percent in Port-au-Prince.

4 Flood risks are reported in the Mairie du Cap-Haitien Plan de Financement des Services Publics Communaux.

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CHAPTER 5 • KEY LESSONS

Sustainable Organic Integrated Livelihoods (SOIL) is the only service provider in Cap-Haitien (and in Haiti at large) that is able to manage a sanitation system that covers the whole sanitation service chain. In Cap-Haitien, and in a context of poor regulation, none of the other existing solutions seems to guarantee safe containment, transport, and disposal or reuse of the excreta.

Container-based sanitation (CBS) is a particularly suitable approach for the segment of the urban population living in high-population-density areas. In these areas where infrastructure is limited and where customers have little disposable income are used to "free" or pay-per-use services, SOIL has managed to introduce a safe, paid, subscription-based sanitation service.

Another important feature is SOIL's principle of providing the full-cycle ecological sanitation, where excreta is treated and transformed into compost, benefiting agricultural projects and development. They do not expect the cost of transport, treatment, and reuse to be covered by service fees from its low-income customers nor the sale of compost. Demand for compost has been high, but the price point cannot be increased significantly without jeopardizing the client base. As such, SOIL is looking at mechanisms to cover transport, treatment, and transformation costs, such as payments provided by the Haitian government through the payment-for-results modality.

SOIL intends to transfer implementation and scale-up of its CBS business models to the public and private sectors in Haiti. Therefore, an important aspect of its CBS approach is to develop a viable and replicable business model. According to its figures and projections from May 2018, customer fees may soon be able to cover the cost of containment and collection of feces thereby permitting potential replication by the private sector.

Beyond the current service area, CBS services could be expanded in a number of areas in Haiti, with a particular focus on high-density urban neighborhoods, which often offer little space for construction of septic tanks or even pit latrines, as well as a particular focus on flood-prone areas or hilly neighborhoods, which desludging trucks cannot easily access.

To meet its ambitious target number of customers in Cap-Haitien and Port-au-Prince, SOIL will need to continue to influence the institutional environment, along with other organizations and donors in the sector. SOIL is considering transferring parts of its operation to the private and public sectors. Success of such a strategy will depend on financial and human resources available to those sectors. To improve the chances of success, the sanitation policy and related bylaws need to strengthen the mandates and responsibilities of the public institutions (ministry and municipality), including how these would be implemented on the ground. The influence of SOIL would potentially continue to be expressed through the demonstration of its success in reaching low-income customers, as well as through capacity-building of public and private sanitation providers.

APPENDIX A • PEOPLE INTERVIEWED

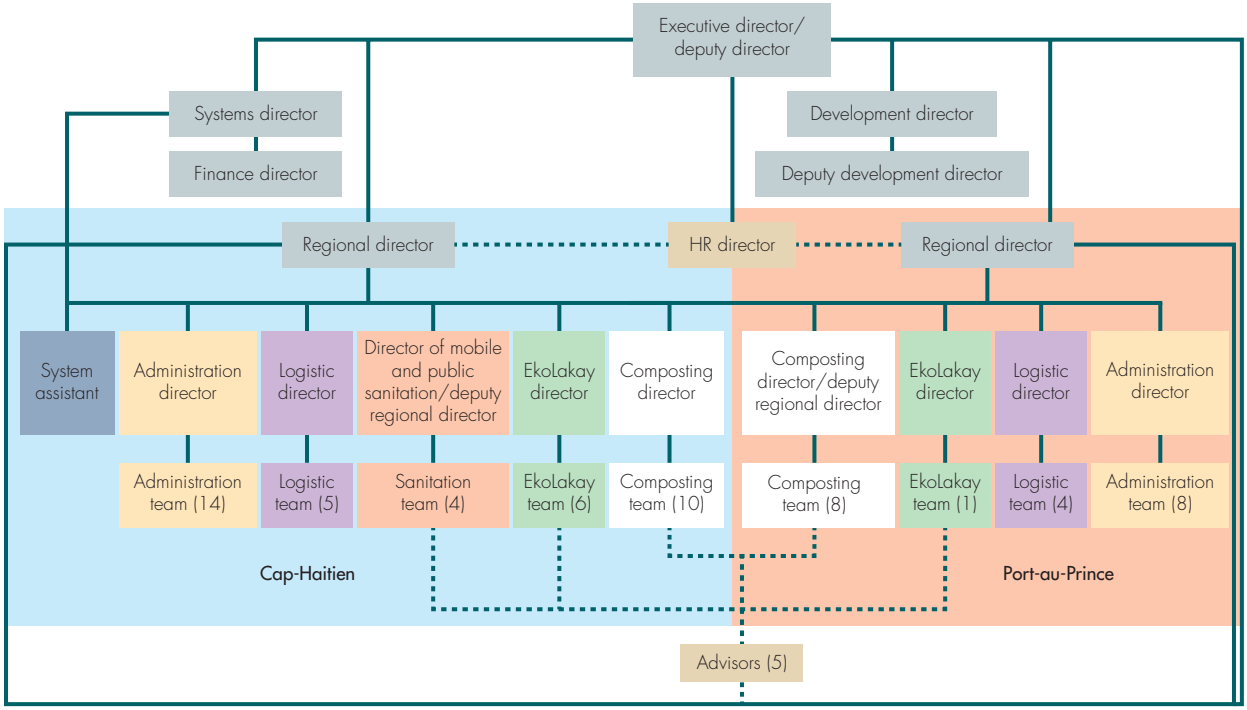
Organization	Position	Name
Direction Nationale de l'Eau Potable et de l'Assainissement (National Directorate of Water and Sanitation; DINEPA)	DINEPA director of sanitation	Edwige Petit
Office Régional d'Eau et d'Assainissement (OREPA)	Responsible OREPA OUEST	Raphael Hosty
DINEPA	Cap-Haitien	Eng. Gustave
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	Responsible urban planning direction	Name not available
Municipality Cap-Haitien	General director	Frantzy Jean
Community-based organization (CBO) ADFFosenmichel (Cap-Haitien)	Representatives of several CBOs ADF	Name not available
CBO OCDEL/MPBK (Cap-Haitien)	Representatives of several CBOs	Name not available
Place Cazeau (Port-au-Prince)	Representatives of several CBOs	Name not available
CBO Sakala; Cité Soleil (Port-au-Prince)	Leader of CBOs	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

table continues next page

Organization	Position	Name
Manual emptier	Business owner (informal)	Name not available
Manual emptier	Business owner (informal)	Name not available
Sustainable Organic Integrated Livelihoods (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).

APPENDIX B • SOIL ORGANOGRAM



Note: HR = human resources.

GWSP
GLOBAL WATER
SECURITY & SANITATION
PARTNERSHIP

WORLD BANK GROUP

W18039