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TRANSFORMATION TOWARDS SUSTAINABLE
AND RESILIENT WASH SERVICES

Process cost analysis for the optimization of a container-based sanitation service in Haiti

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A process cost analysis methodology was developed to calculate the per capita operational costs of the container-based sanitation service in Haiti operated by the non-profit research and development organization Sustainable Organic Integrated Livelihoods (SOIL). SOIL's sanitation service covers the entire sanitation value chain, including containment, collection, transport, treatment and reuse. The results showed that around 30% of the service's operational costs were covered with operating revenue. The researchers then used the detailed results to identify productive areas for cost reduction and further innovation. Findings also contributed to the development of a hybrid funding model that will enable increased access to sanitation while building relationships with public institutions and reinforcing a business mindset to encourage cost-effectiveness with scale.

Introduction

Urban environments are heterogeneous and thus demand a variety of sanitation options appropriate to different contexts (Reymond, 2016). A key component of responsible urban sanitation planning is knowing the relative costs of various sanitation options, as well as knowing the ideal context for each technology and service (Parkinson, 2014). Most urban sanitation initiatives have focused primarily on sewers and onsite sanitation options, such as pit latrines and septic tanks. However, as cities continue to expand at staggering rates it has become clear that there are many urban environments in which these traditional technologies are either infeasible or unsafe. One sanitation intervention which has been gaining global traction as an effective and affordable service for low-income urban households is household-level container-based sanitation (CBS) (Russel, 2015; Tilmans, 2015). CBS, like other fecal sludge management systems, offers opportunities to manage sanitation from a resource recovery perspective (Seck, 2015). However, very little work has been done to establish the costs of operating fecal sludge management systems (Balasubramanya, 2017; Dodane, 2012) like CBS.

SOIL is a non-profit research and development organization working in Haiti to increase access to cost-effective full-cycle household sanitation services in urban communities. Over the last 10 years, SOIL has pioneered approaches to sustainable sanitation in Haiti that combine innovative service delivery models and new technologies with a strategic, catalytic approach to financial sustainability. Since 2012, SOIL has been operating a household container-based sanitation (CBS) service in Haiti. While the service has scaled to over 1,000 households, SOIL has engaged in constant iterative experimentation to optimize the service to maintain a high quality of customer service, ensure the protection of public and environmental health, and prove the cost-effectiveness of CBS relative to other sanitation interventions. SOIL's objective is to establish CBS as a sanitation intervention that can be incorporated into citywide sanitation plans and help address the global sanitation crisis by providing a uniquely appropriate and cost-effective improved sanitation solution for densely-populated urban communities.

SOIL's EkoLakay service is marketed to households in dense urban settlements and comprises the following: households pay a monthly fee to rent a urine-diversion toilet, receive a carbon-based cover material used to "flush" the toilet, and benefit from weekly waste collection services (Remington, 2016). All solid waste is safely transported in sealed containers to a SOIL composting waste treatment facility where it is then treated and transformed into rich compost in a thermophilic treatment process that respects World Health Organization standards (Piceno, 2016; WHO, 2006; Preneta, 2013).

This paper presents a methodology used to conduct a cost analysis of CBS at the process level based on SOIL's EkoLakay service in urban Haiti. The objective was to provide detailed cost information that SOIL could use to identify cost drivers and opportunities for cost savings, and to support strategic thinking around viable long-term financial and management structures for the service.

Methodology

An adaptation of a process cost analysis methodology (Tornberg, 2002) was used to calculate the average operational costs and revenue per household for all EkoLakay process activities during the 2015/2016 fiscal year (August 2015 to July 2016).

Operational costs were defined as all variable input costs critical to performing an operational activity and include material expenses, vehicle gas and maintenance, cost of labour time, and depreciation. Capital expenses were included as a variable expense if they varied based on number of households in the service (e.g. number of toilets, number of compost bins needed to treat and transform the waste) or if the asset could be allocated to a specific operational activity (e.g. pressure washer used to wash containers). The capital cost of vehicles involved in bucket collection (3-wheel motorcycles and modified wheelbarrows) and transport of buckets to and from the waste treatment site (large flatbed truck) was included as depreciation normalized to a per bucket basis. Other overhead and shared capital expenses (e.g. composting site fencing) were excluded.

Early results showed that there were five key cost categories driving operational costs for the full-cycle service: gloves, other materials, gas and maintenance, labour, and depreciation. Both the calculations and cost summary are broken down along those five categories in the final version of the analysis.

The methodology comprised three main steps:

1. **List, describe, and categorize activities by sanitation service chain process (i.e. containment, collection, transport, treatment, and transformation):** All activities involved in the service chain are categorized within a sub-process in a MECE fashion (mutually exclusive and collectively exhaustive).
2. **Quantify operational costs of each activity:** The input costs of performing each activity are itemized such that activity-level costs are calculated dynamically, i.e. inputs can change with scale. Costs are calculated in USD, normalized at a per container (20-liter bucket) or per household level, and aggregated to sub-process level. Data was collected via interviews, time-and-motion studies to estimate cost of labour per activity, field observation to understand inputs and outputs of individual activities, and review of accounting spreadsheets.
3. **Aggregate and report:** After quantifying costs for each activity, per household costs are aggregated to create reports that can inform strategic decisions including scale-up goals, input alternatives, and process optimization decisions.

Results and discussion

Activity-based costing and process modelling results in cost and performance information that is based on actual operations and accurately reflects the true costs of providing the service. More research needs to be done to evaluate the costs and performance of different fecal sludge management systems (Balasubramanya, 2017; Dodane, 2012), however what the researchers found from this analysis was that safe household sanitation services could be provided in vulnerable communities at very low cost and that user fees and sales of by-products can help offset the cost of providing the service. This research also found that there are productive areas to further reduce costs and continue to innovate within the CBS household model.

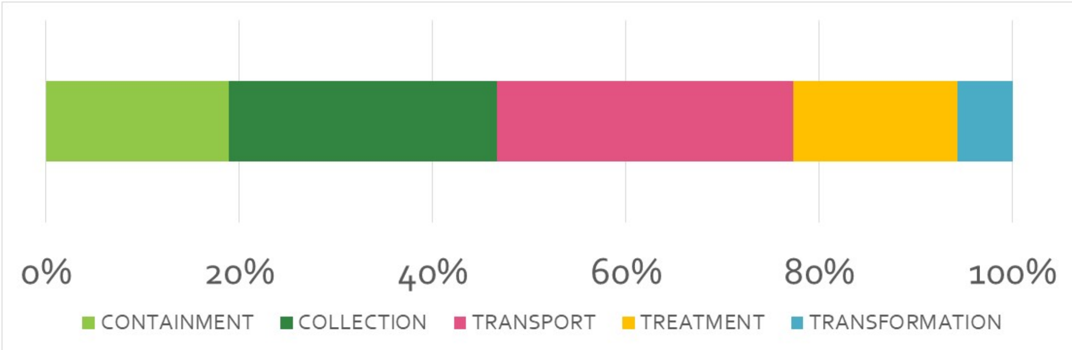

Figure 1. Breakdown in costs by service chain segment

SOIL's final process cost analysis gave an estimate of $14.92 per household per month for providing full cycle sanitation service from the toilet through to waste treatment and reuse. The two most costly activities identified are transport of buckets to and from the waste treatment site and local bucket exchange at the households. This indicates that bucket collection logistics are a key process that needs optimization. The analysis also showed that use of gloves represented a non-negligible 6% of total operational costs. SOIL is now exploring the possibility of using sturdier reusable gloves to both reduce our waste and reduce costs.

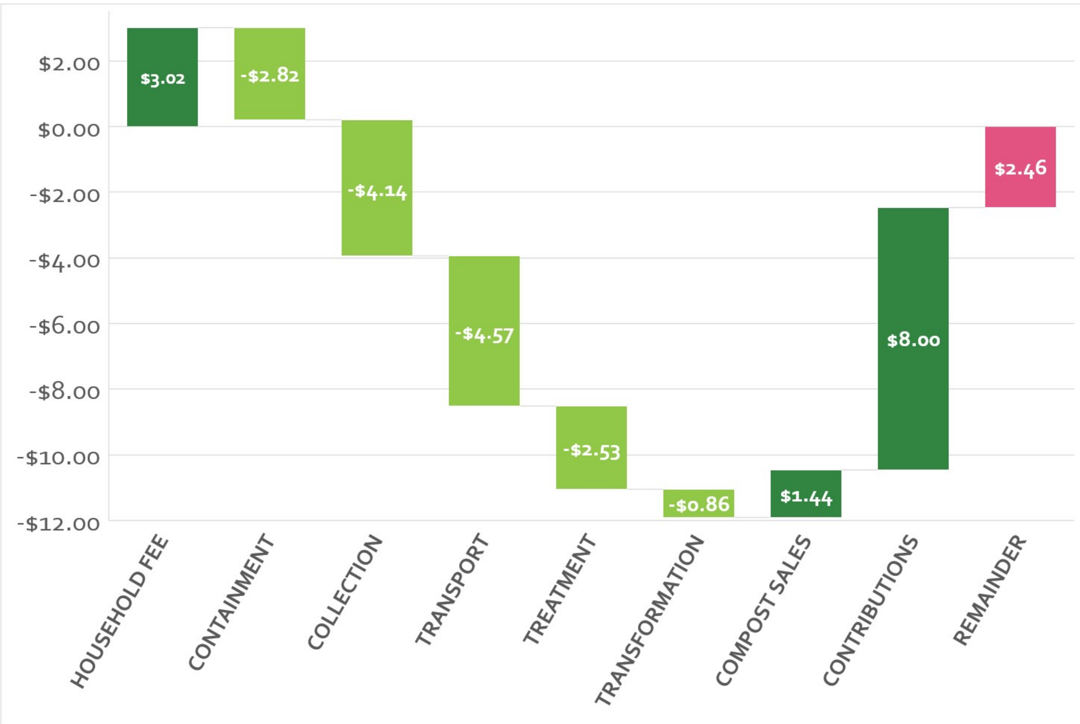

Figure 2. Waterfall diagram of revenues and operational expenses along SOIL's full-cycle sanitation chain. The estimate of operating expenses is $14.92 per household per month compared to earned revenue of $4.45 per household per month. While working to reduce costs and put long-term public financing mechanisms in place, SOIL offsets the remaining $10.50 in unmet need with $8 per household in individual monthly charitable contributions and is seeking to raise an additional $2.46 per household in monthly charitable contributions as an interim financing strategy.

To offset these costs, SOIL brings in ~$4.45 dollars of revenue per month per household from toilet user fees and compost sales, leaving an unmet need of ~$10.50 per household per month (or ~$21 per person per year) that is not covered by users and compost clients. SOIL anticipates that this cost will be significantly reduced over time with process optimization and economies of scale, identified in large part by this process cost analysis. The long-term sustainability of this model is reliant on public sector financing though contractual performance based payments however, given the challenges of mobilizing public sector funding in the context of Haiti, SOIL is now working on strengthening EkoLakay's financial sustainability by establishing and mobilizing multiple interim revenue streams. These include monthly charitable contributions from individuals (which represent a stable cash flow currently covering the majority of direct costs of the service, as seen in Figure 2) philanthropic grants and corporate donations to invest in infrastructure and grow the service while public sector financing mechanisms are established in partnership with international financing institutions. Findings from this process cost analysis informed these developments in SOIL's business model and supported ongoing efforts to undertake operational efficiencies and technological innovations to further refine the EkoLakay service.

Since the ascendancy of neoliberal ideology in the 1990s, there has been an increased emphasis on cost recovery through user fees in the water and sanitation sectors because unreliable public funding was considered to lead to deferred system maintenance, poor performance, and incomplete coverage (Checkley, 2008). This is problematic because there is an expectation that households in developing countries bear the full cost of sanitation and waste treatment, despite these being heavily subsidized public goods in developed countries. While the neoliberal emphasis on private sector solutions to the global sanitation crisis has had a positive effect on reducing costs, increasing operational efficiency, and driving innovation, it ignores the many 'public good' aspects of sanitation such as those related to public health and the environment. It has also promoted the unrealistic and unethical expectation that those in extreme poverty should pay for their own sanitation services, while in higher income countries these services are invariably supported by public funding. The pressure to develop sanitation solutions based on user fees for the world's most vulnerable populations can put an undue burden on providers to raise fees to the point where the poorest households are priced out, or to cut costs through reduced service quality. Ultimately the sanitation sector will benefit tremendously from an increased focus on cost efficiency, and we believe the process cost analysis tool described in this research will be a valuable contribution in this regard. However, it is important to remember that as well as having private benefits, safely managed sanitation is a public good and the most effective and equitable solution to the global sanitation crisis will likely involve innovative blended revenue models which ensure that services are accessible to everyone.

Over 6.3 billion people are expected to reside in cities by 2050, and it is anticipated that more than a quarter of the urban population will be living in informal urban settlements (UN, 2014; UN, 2015). CBS solutions, such as EkoLakay, represent an elegant public health and environmental intervention for rapidly expanding urban areas that is safe, cost effective, and adheres to the Sustainable Development Goal's definition of safely managed sanitation. This research represents an early step in gaining a clear understanding of the costs of CBS in the context of Haiti, and the authors hope that it will provide a methodology that can be used by other sanitation actors to better understand service costs, driving increased efficiency and accountability in the sector.

Comparison of Process Cost Analysis Results

Concurrent with the final stages of the process cost analysis research, the SOIL team collaborated on a more traditional cost analysis of the CBS service with global consulting firm EY and its not-for-profit Enterprise Growth Services (EGS). While not the direct focus of this paper, the results from the EY-EGS analysis resulted in an estimate of $13.57 per household per month in operational costs from the period of August 2016 to February 2016. EY-EGS used a more limited accounting-level analysis, relying on SOIL's program budget reporting (i.e. a top-down methodology relative to the process cost analysis' bottom-up methodology). It is encouraging that this finding was within a reasonable margin of error of the cost number achieved by SOIL's bottom-up process cost analysis ($14.92) as it demonstrates that we've accurately approximated the actual true cost of providing household toilet and waste treatment services.

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Note

To access the full cost analysis, including results and methodology, please contact the authors.

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