

Introducing safe FSM services in low-income urban areas: lessons from Lusaka

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There is an ever-strengthening consensus in the WASH sector that servicing on-site sanitation requires urgent attention from city authorities across Africa. Despite this widespread acknowledgement, examples of safe and commercially viable Faecal Sludge Management (FSM) services remain few and far between. This Topic Brief sets out the process and learning from a recent project - completed with funding from the Stone Family Foundation (SFF), and led by Lusaka Water and Sewerage Company (LWSC) - which aimed to introduce a complete FSM service in the peri-urban areas of Kanyama and Chazanga. It argues that FSM services are given the best possible chance of success when embedded within a mandated local service provider that is willing to innovate and continuously adapt.

1. Introduction: why FSM, and why Lusaka?

1.1. The urgent need for FSM services in Lusaka's peri-urban areas

The rationale supporting the introduction of safe FSM systems in urban contexts has been well-documented, but bears repeating to place this project in its proper context. In Lusaka, only 16% of the population are connected to sewers, with the remainder depending on various forms of on-site sanitation. The situation is particularly pronounced in the peri-urban areas (PUAs) of Lusaka, where 95% of inhabitants rely on pit latrines. Combined with the lack of affordable FSM services, the very high prevalence of on-site sanitation poses a major source of public health risks: when pit latrines become full, landlords typically choose to bury the sludge nearby, contributing to the contamination of open areas and shallow wells.

The situation in the PUA of Kanyama is reaching saturation point due to a combination of rapid population growth and the physical nature of the settlement. Frequent flooding, flat topography and lack of drainage lead to near-annual outbreaks of cholera and other sanitation-related diseases, the latest of which was typhoid in June 2015. In the long-term, the Zambian government aspires to extend sewers to all PUAs to address this issue. To achieve this, there are considerable financial, technical and institutional capacity barriers to overcome. It is seen as a particularly difficult option in Kanyama because of the challenging geology of the settlement characterised by surface rock outcroppings.

1.2. Opportunities to maximise value from the sludge chain

At the other end of the FSM chain, the capacity to treat sludge and create value for the end-products helps ensure stronger services. A market assessment determined strong demand for biosolids in Lusaka, alongside other non-chemical and chemical fertilizers (Mikhael and Clouet, 2012). The most significant market segment - the one most likely to have highest demand - was found to be urban gardening specialists (e.g. nurseries, landscapers, household gardens, etc). There was limited interest from small to large-scale farms for multiple reasons, mainly around the more competitive cost of transporting and applying chemical fertilizers (ibid).

1.3. A favourable institutional arrangement for FSM services

The case for introducing a safe FSM service in Lusaka's peri-urban areas was further supported by the presence of a favourable institutional environment. Provision of water and sanitation services to Lusaka's PUAs is the responsibility of Lusaka Water and Sewerage Company (LWSC), who currently delegate service provision for 11 PUAs to community-based legal entities known as Water Trusts. Kanyama Water Trust (KWT) is the largest of these entities, with the mandate to serve 167,000 customers. Furthermore, LWSC stands out as one of very few leading institution in Africa that acknowledges and actively embraces its mandate to provide on-site sanitation services. Through LWSC's leadership, and KWT's local knowledge and capacity, this arrangement offered the potential to introduce a sustainable and scalable FSM service able to respond to the needs of the local population. As a central partner in the project, LWSC were extensively consulted and played a leading role in defining the objectives of the project, which also met with the full approval of Zambia Environmental Management Agency (ZEMA) who approved the environmental project brief (Makamo Enviro Consultancy, 2013).

2. The FSM service

2.1. Developing and Introducing the Service

Prior to the project, LWSC had already identified FSM services as an urgent priority to be addressed in Lusaka's peri-urban areas. Through their existing partnership, LWSC and WSUP embarked on an effort to address this gap in services in the two purposefully selected PUAs of Kanyama and Chazanga, with the partnership extending to the Water Trusts mandated to serve these areas. The decision to introduce the service was influenced by baseline surveys which forecast variable levels of demand in each of the areas. As mentioned, it was essential that LWSC and the Water Trusts were in the lead position to promote local ownership and ensure conditions for scale-up were in place from the outset: the experience of this project confirms the relevance and effectiveness of such an approach to partnerships (Tiberghien, 2015).

A brief summary of the steps undertaken by LWSC, WSUP and the Water Trusts in developing and introducing the service are outlined in Figure 1 (page 3) .

2.2. The Service offering

To develop the service offerings, the cost recovery price of the FSM service had to be set. Financial modelling and a willingness to pay (WTP) survey were undertaken in the Business and Service Design phase, before the service was launched. Assumptions and estimates made to support the financial modelling proved to be conservative, with an estimated emptying cost of US\$ 112/m³, assuming regular increases in the service fee in line with inflation (Mikhael, 2012). The willingness to pay of target customers ranged between approximately US\$ 40 - 60 per emptying event (ibid).

Figure 1. Steps undertaken to develop and introduce the FSM service



Using this information, three service options were developed using a human-centred design (HCD) process undertaken by the social innovation lab, 17 Triggers. In close consultation with LWSC, customers were offered the following initial service offerings (see Figure 2, page 4):

- 12, 60-litre barrels (720 litres) for \$ 40
- 24, 60-litre barrels (1,440 litres) for \$ 60
- 32, 60-litre barrels (1,920 litres) for \$ 70

While set at lower than the estimated cost, this was thought to be necessary to drive initial demand. A revised financial analysis was then undertaken after the service was launched, during the Monitor, Learn and Adapt phase, using real rather than estimated data. This resulted in a revised cost estimate of approximately US\$ 78/m³, much closer to the price set.

A third financial analysis is currently underway to again inform the principle stakeholders of any increases in efficiency (thus reduced cost), or if further action is required to achieve full cost recovery.

Figure 2. Promotional material produced by 17 Triggers outlining the service offerings



2.3. The FSM chain

The entire FSM chain was managed by and the responsibility of LWSC, delegated to the Water Trusts. The front end of the service (emptying, primary transport and transfer) was undertaken by contract workers, while secondary transport was undertaken by private independent operators of vacuum tankers. Treatment and reuse was managed directly by Water Trust employees (see Figure 3, page 6). As per the existing delegated management contract between LWSC and KWT, the former played a technical support and oversight role.

With the support of local partners Water and Sanitation Association of Zambia (WASAZA), Bremen Overseas Research and Development Association (BORDA) and Institute of Eco-Strategies and Toxicology (IESTO), the technical aspects of the FSM chain were developed. This resulted in the six-step process detailed below, and presented in Figure 3 (Page 6).



Manual emptying of a pit latrine using modified garden tools

1. Emptying: It was decided that two teams of five emptiers would be responsible for providing emptying services for each locality (situated around a transfer station). Each team was provided with a daily schedule by the service manager at the Water Trust after coordinating with customers. The service itself was designed to suit the type of latrines in Kanyama, the vast majority of which are elevated both to avoid flooding during the rainy season and because digging into the rocky terrain is extremely challenging: given the raised position of the latrines, the emptying teams would break a hole in the outside wall of the containment structure, empty sludge using modified garden tools, decontaminate the area with bleach, and seal the hole back with bricks and mortar. While the emptying process was fairly basic, it represents a significant improvement from previous informal services.

Several different mechanical and manual pumping technologies were trialled to minimise risk of exposure by the public and emptying team to the faecal sludge. However, due to the high presence of non-degradable solids (i.e. general rubbish), inefficient but effective modified garden tools were selected as the only viable option. Looking to the future, diverting such materials from pit latrines is thought to be the best way to further improve the efficiency and safety of the service (see Section 2.4).



Disposal of sludge at the decentralised transfer station

2. **Primary transport:** A number of manually-driven cart designs were trialled with regular input from the operators. Ultimately the lightest cart was selected, capable of carrying up to 6 barrels. While mechanised transport would have been more efficient, this was considered impractical due to the cost and initial level of demand which did not allow for a more expensive setup. In the future and when primary transport becomes a bottleneck for the service, mechanical transport will be considered.
3. **Transfer station:** A transfer station was designed by WASAZA/BORDA by adapting decentralised wastewater treatment system (DEWATS) technologies. The system allowed for easy decanting of the drums, separating the non-biodegradable solids from the sludge, and partial treatment of the sludge (anaerobic digestion and some solid-liquid separation). The aim was to test the process and cost of providing transfer stations in densely populated areas where larger-footprint decentralised facilities are difficult to site due to limited land availability, complex land tenure issues and 'not-in-my-backyard' reactions from local residents.

The major system components of the Kanyama transfer station included (a) a receiving bay with screens for non-biodegradable solids removal, (b) biogas digester with an effluent recirculation channel, and (c) a planted infiltration gallery for safe disposal of liquid effluent. Point (b) is particularly significant as this was the first time a biodigester had been used for treatment of sludge from pit latrines. Small adaptations were undertaken during the initial few months of operation to account for learning, notably the introduction of a roofed drying station with easy-to remove drying racks for faster drying of non-degradable solid waste. Compared to the actual cost of delivering the FSM service, the cost of disposing of the solid waste by transfer to a landfill was estimated at just 2% (Mikhael, 2013). Phased implementation allowed for improved design of the transfer station in Chazanga based on operational data collected from Kanyama.

4. **Secondary transport:** Because the transfer station provided only partial treatment, the settled and digested sludge from the biogas digester had to be regularly emptied and transported to a semi-centralised treatment facility by the aforementioned vacuum tanker operators. While not insignificant, the cost of emptying the transfer station was estimated at only 16% of the full cost of the FSM service (Mikhael, 2013).

One of the main challenges remaining at the transfer station is the extraction of the settled and digested sludge from the digester. The sludge forms an inverted cone around the extraction pipe, creating inefficiencies in the desludging process, and requiring the decommissioning of the facility roughly once a year to manually remove the sludge. The decommissioning has a negative financial impact on the services, as seen in Figure 4 (page 7). More regular removal of the sludge is being trialled to mitigate this and has produced positive results to date.



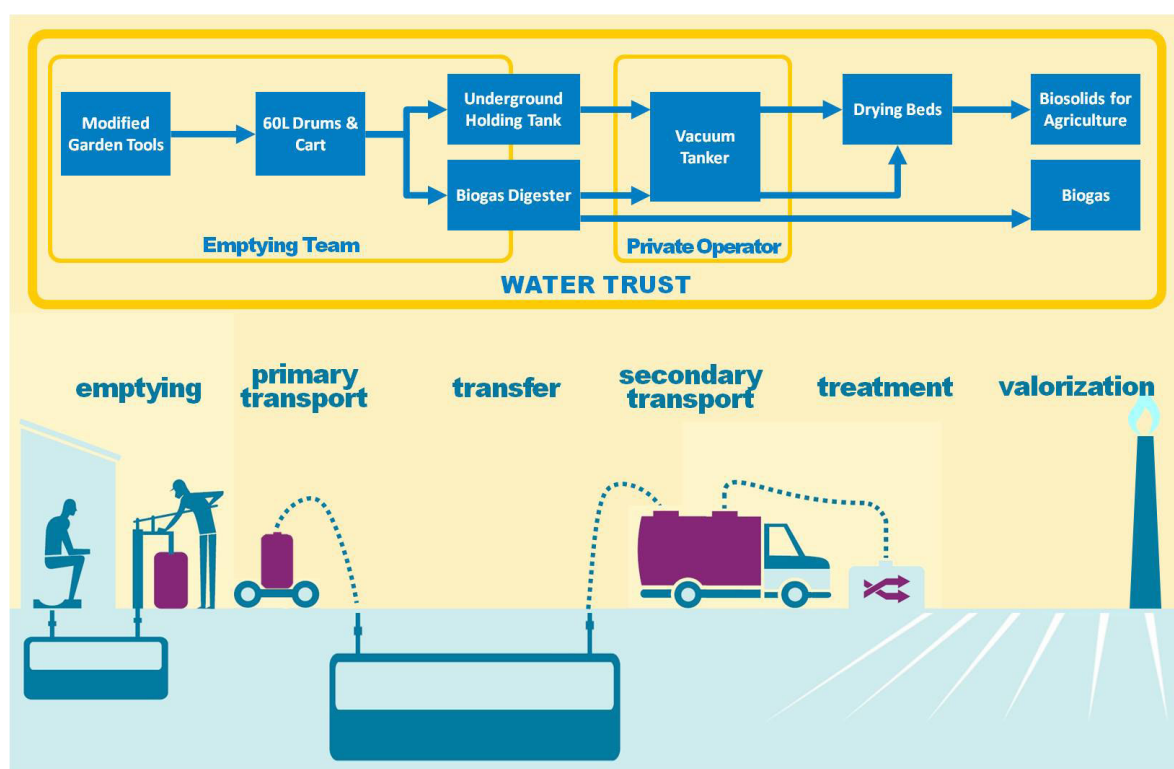
One of the lower-cost options of the drying beds tested

5. **Semi-centralised treatment:** A semi-centralised treatment facility located on the outskirts of Kanyama was constructed to provide 480m² of drying bed space. Twelve different designs were trialled and tested by IESTO, together with testing of the optimum treatment process for production of safe biosolids. The study concluded that the sludge should have a minimum residence of 15 days in the anaerobic digester, after which it would be transported and treated on covered drying beds for at least 50 days (Phiri, 2014). More studies on the process are required to further enhance efficiency.
6. **Valorisation:** In order to maximise value from the sludge chain, biogas collected from the digester at the transfer station continues to be used to cook at the Water Trust's communal kitchen, albeit not regularly or on a large enough scale to make it

financially attractive. While initial plans were to connect and charge neighbouring households for biogas use, the quantities of biogas produced were insufficient to justify the financial investment. Additionally, as there were too many new variables associated with introducing the new FSM service, it would have been impractical within the existing context to burden the Water Trust with delivering networked biogas services.

The decision was therefore taken to focus primarily on biosolids, which were relatively easier to manage and subject to higher demand. The biosolids were removed from the drying beds once deemed safe for agricultural reuse. The Water Trust was supported with branding and marketing, and has a vision to further add value to the product (e.g. by co-composting with organic solid waste) to increase revenues.

Figure 3. FSM service chain, adapted from WSUP's Urban Programming Guide, 2014.



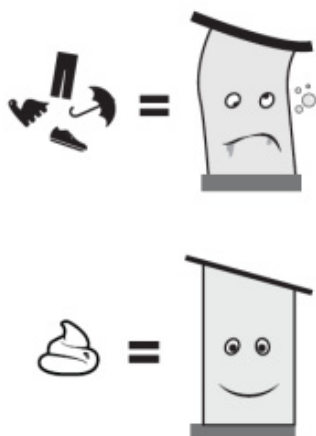
2.4. Driving sales and behaviour change

While a reasonable level of demand for FSM service was determined in a baseline survey (particularly in Kanyama), marketing of the service to drive up sales was essential. A dual approach was explored:

- 1. Participatory promotion:** In partnership with the Ministry of Health (MOH), and under their existing programmes, the door-to-door Participatory Hygiene and Sanitation Transformation (PHAST) approach was used by MOH's Environmental Health Technicians, LWSC and the Water Trusts to promote the service. The approach reached 43,000 households (195,000 people) in the two target PUAs. The partnership created with the MoH, which has significant experience in implementing PHAST, allows for easier scale up across other PUAs.
- 2. Commercial marketing:** Using a commercial, customer-driven approach to demand creation, 17 Triggers led the creation of the marketing messages and tools for the FSM service. Messages were disseminated by a variety of channels, including organised road shows/dramas, megaphones, flyers and posters.

Never throw trash in your latrine!

Throwing trash into your latrine can create blockages, making it fill up faster, which means you have to empty it more often – costing you money!



Excerpt from promotional materials for the FSM service produced by 17 Triggers

The external end-of-project evaluation concluded that awareness of the FSM service steadily increased through the course of the project; however sustained and active promotion of the service will be needed from the Water Trusts for the service to flourish, with a greater emphasis on promoting a strong business image (Tiberghien, 2015). In the future, consideration will need to be given to measuring the performance of each method and comparing their relative success.

The presence of non-biodegradable solid waste in the faecal sludge required the use of manual emptying methods, which had a significant negative impact on the cost of the service by reducing efficiency, as well as slightly increasing exposure to faecal sludge compared to nonviable mechanical emptying methods. It was estimated that each cubic metre of sludge emptied had approximately 16 kilograms of solid waste (Mikhael, 2013). Addressing this issue was necessary, and had to be done as part of a multifaceted and long-term approach of diverting such waste from pits. As well as promoting pour-flush toilets, which clog more frequently when large solids are disposed into them, sustained delivery of behaviour change messages will continue and evolve in the intervention areas using PHAST and commercial marketing methods.

3. Snapshot of performance

Data tells a story, and the data collected from the FSM service in Kanyama is no different. In this section, we present three different performance indicators of the service: (a) financial viability, (b) operational efficiency, and (c) sales.

Figure 4 presents a snapshot of cashflow: no revenue is seen in December 2013 when the transfer station was decommissioned to manually empty obstructive sludge; thereafter, low revenue and high expenditure is seen due to the expansion of the teams from 10 to 20 persons in preparation for the commissioning of an additional transfer station within Kanyama. Despite this difficult start, a recovery can be clearly observed from June 2014 onwards.

Figure 5 (page 8) presents the response times of the service team, which is the time between a customer requesting the service and it actually being delivered – a vital component of the customer experience. Most services (50%) are delivered within 2 days. Delays beyond one week (19%) were largely due to the shutdown of the transfer station for maintenance, and servicing clients that were located too far from the transfer station. Delays between 3 – 7 days (31%) are the obvious target for identifying bottlenecks and incremental improvement of the service.

Figure 4. Snapshot of cash flow of the FSM service

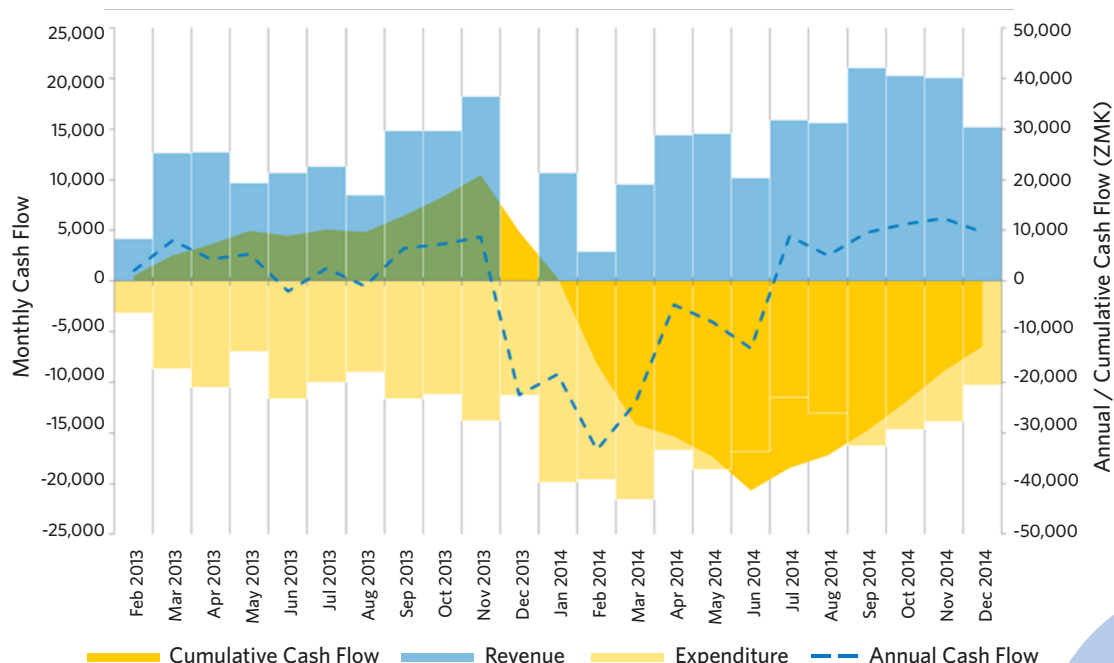
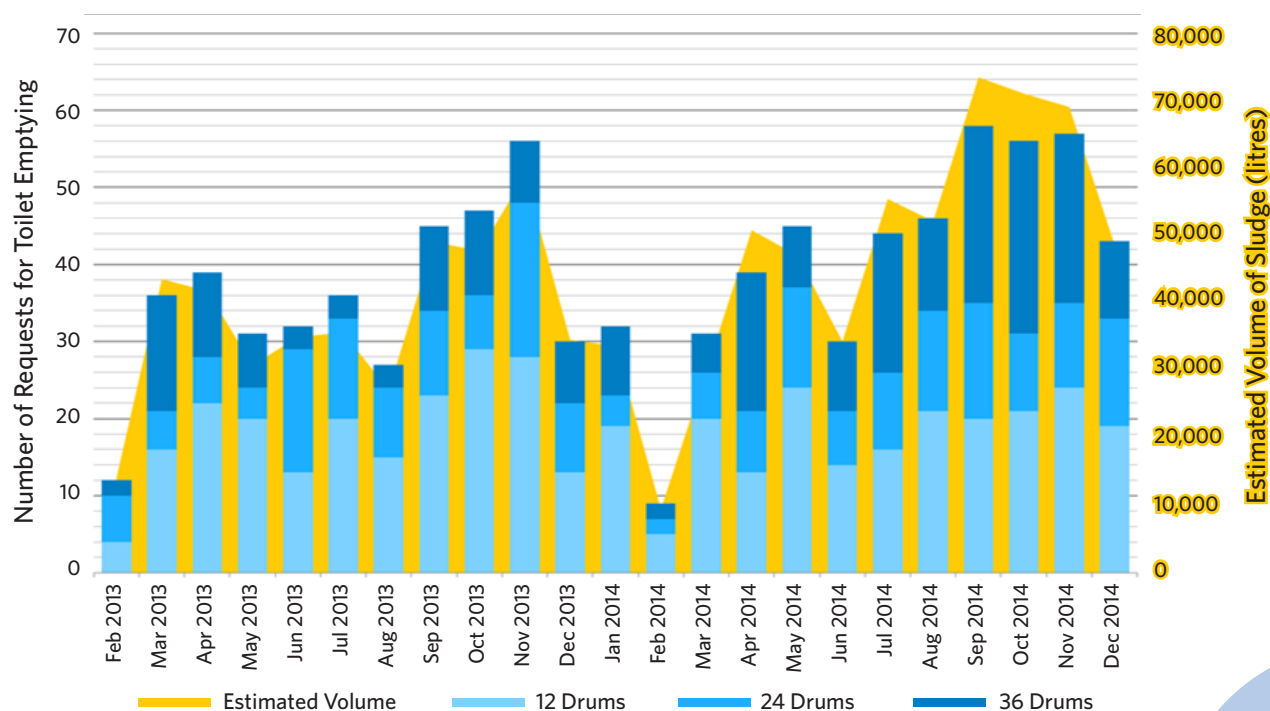


Figure 5. Customer response times for the FSM service



In the first 23 months of service, approximately 900 pits serving nearly 25,000 people were emptied. Figure 6 presents sales over time: demand can be seen to be relatively steady, but with some seasonality and a high season from September - November, just prior to the rainy season. It is clear that the lowest service band (12 drums) was the most popular among customers. The largest service band (32 drums) was more likely to be requested by institutional customers (e.g. schools or public toilets).

Figure 6. Histogram of demand for the FSM service





Monitoring service performance using mobile devices

4. Key learning

The FSM service now being offered in Kanyama and Chazanga is still at a formative stage. If successful, it will be one of the first safe FSM services introduced in Africa that is targeted at and funded by low-income customers – but there is a long way to go before we can claim ‘success’. In attempting to develop and introduce the service, LWSC, WSUP and the Water Trusts have encountered a wealth of challenges, and also made some significant breakthroughs. This section summarises the key learning that could be applied in other similar interventions.

4.1. Identifying and supporting FSM service providers

- In the past, WSUP and other WASH-implementing organisations have targeted existing pit emptiers and attempted to help them develop into co-operatives or small businesses. It needs to be recognised that **pit emptiers will often be highly skilled labourers, but with no experience in managing or marketing a business**. In such cases, implementing organisations should not shy away from working with them and supporting them in gradually ‘professionalising’ what they do, and leveraging their local knowledge – but it would be unfair to expect them to be or become skilled business people.
- It will be difficult for service providers to focus only on FSM due to the seasonality of demand. **Targeting service providers that can easily diversify into pit emptying would create a more resilient service**. In this case, the Water Trust is also providing water to households, which is relatively less sensitive to seasonal changes.
- **Sustainability and scale-up can only be achieved by working through local authorities**. These institutions need to be supported in undertaking whatever role they are mandated to play, be they service providers, licensing authorities, financiers or regulators.
- Adopt an **incremental approach** – going for ‘picture perfect’ from the outset will result in disappointment for all partners. In this connection, monitoring systems need to be established that are easy to implement and which provide indicators that help to troubleshoot challenges.

4.2. Technical

- Several manual and mechanical emptying technologies are available locally or internationally. **It is useful to try them out in your local context and see what works best**.
- Local capacity to develop and maintain equipment and infrastructure is crucial to sustainability. **Find and develop partnerships that could help build up that capacity**.
- There is no ‘mobile phone’ equivalent for the sludge emptying market - **do not expect technology to solve your financial problems**.

4.3. Engaging with municipalities and government

Sanitation authorities that want stronger private sector involvement in service provision of emptying services should consider these three approaches that are best applied simultaneously:

- **Level the playing field:** Without some kind of protection from informal businesses providing unsafe services, new businesses will struggle to succeed. Consider such activities as:
 - a) introducing progressive by-laws that favour safe and sustainable emptying;
 - b) gradually beginning to enforce by-laws with the support of appropriate agencies;
 - c) protecting formal emptiers from arrest; and
 - d) providing training and certification.

Cleaning
your latrine
really made
my day!

Starting from

250 ZMK



Marketing poster for FSM service

- **Break market barriers:** Identify and address the barriers that stop entrepreneurs from investing or offering pit emptying activities to the urban poor. For instance:
 - a) simplify registration/formalisation;
 - b) provide appropriately located decentralised disposal points;
 - c) consider appropriate Public-Private-Partnership (PPP) or service delivery contracts; and
 - d) provide performance-based subsidies for servicing the poor.
- **Catalyse the market:** Demand and supply for safe pit emptying services is generally suppressed in many low-income urban settings. To kick-start the market, it is important that progressive activities be considered such as:
 - a) support promotion of services; and
 - b) support financing of pit emptying businesses through cross-subsidy (e.g. sanitation tariff on water bills).

5. Moving forward and scaling-up

The FSM service was defined and implemented by LWSC, WSUP and the Water Trusts with a vision of 'scaling-up' the service in the future. This has been promoted from the outset through a variety of measures, including the financial and market analyses informing the design of the service; constant attention to the financial performance and viability of the service once operational; careful monitoring to gather evidence on the effectiveness of the approach; and perhaps most importantly, grounding the service within a well-functioning institutional framework. This promotes ownership by local service providers with adequate commitment and capacity to sustain and grow the service in the long term.

All of the above points are expected to support scaling-up of the service, if and when it is proven to be commercially viable and sustainable: as noted, the FSM service is still at a formative stage, and talk of scaling-up would currently be premature. Nonetheless, there is cause for optimism if the service becomes fully established. An independent end-of-project evaluation (Tiberghien, 2015) highlighted that the FSM model spearheaded by this project is already having a significant national influence on the wider enabling environment that bodes well for the future. This includes:

1. **Zambia's National Urban Sanitation Strategy (NUSS):** The NUSS is currently being developed by the Ministry of Local Government and Housing (MLGH), funded by the German Agency for International Co-operation (GIZ) and Kreditanstalt für Wiederaufbau (KfW) with the Government of the Republic of Zambia. The draft strategy takes into consideration learning from this service, and how best to support scale-up in different contexts (e.g. weaker local utilities). (MLGH/GIZ, 2014).
2. **Planned sanitation projects:** Multiple projects currently under consideration (e.g. Lusaka Sanitation Project of the World Bank) are considering the provision of FSM services and infrastructure similar to those implemented by this project. Through their experience with the FSM service in Kanyama and Chazanga, LWSC is now positioned to lead discussions on how best to position these investments.

To further increase potential for scale-up, WSUP recommends promoting the integration of FSM into strategic citywide sanitation plans. In many instances, local sanitation authorities view such services and infrastructure as temporary until citywide investment in sewers becomes feasible. Some service providers such as LWSC - aware that providing a sewer connection for everyone will not be possible in the short to medium term - are willing to take the risk of experimenting and innovating through an incremental approach, analogous to climbing a conceptual 'excreta management ladder' (WSUP Practice Note 17, 2014). Incorporating this incremental approach into strategic plans will ensure accelerated provision of citywide safe sanitation services.

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