FSM4

# CASE STUDIES

FIRST EDITION

स्वच्छ भारत
एक कदम स्वच्छता की ओर

सत्यमेव जयते
Ministry of Urban Development
Government of India

अमृत
Atal Mission for Rejuvenation and Urban Transformation

4th International
Faecal Sludge Management
Conference

19–23 February 2017
Chennai, India

# Contents

# Acknowledging FSM as a Utility Service

Worldwide, 2.7 billion people rely on onsite sanitation. Yet, there is still typically no management system in place to deal with the resulting faecal sludge (e.g. septage and pit latrine sludge). The result is that the waste typically ends up being dumped directly into the urban environment, with significant health and environmental implications. Creating faecal sludge management (FSM) infrastructure and public services that work for everyone, and keeping faecal sludge out of the environment is a major challenge for achieving universal sanitation access as acknowledged by the Sustainable Development Goals adopted by the United Nations at its General Assembly on September 25th, 2015.

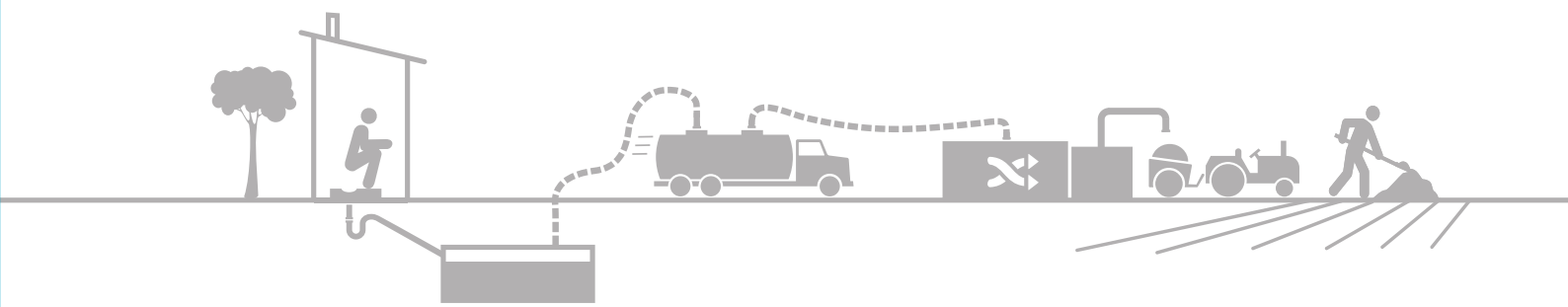
To address this challenge, a global platform for discussion on FSM was created in 2011 by leading global sector organizations. The aim was to share and brainstorm potential solutions, formulate policy recommendations that promote best practices, and to identify lessons learned in how to make FSM an integral part of sanitation service delivery. Building on the success of the first three International FSM Conferences in Hanoi (2015) and in Durban (2011& 2012), the FSM4 conference aims to bring together professionals working in the sector, including utilities, service providers, cities, governments, academics, scientists, consultants, donors and industries, to support the global initiative of disseminating sustainable solutions for FSM.

In order to support learning and dissemination of FSM solutions, I am pleased to introduce a number of Fecal Sludge Management case studies selected from abstracts submitted to FSM4 Conference for oral presentation and from invited authors. The cases studies were selected by the FSM4 program committee and authors were provided technical support to help document key lessons to be shared. The cases studies feature four initiatives led by private service providers; two examples of national FSM planning and execution, and 12 city-level FSM initiatives. The publications are available on the FSM4 conference website for downloads.

The examples are from:

- Africa: Madagascar (city of Antananarivo), Mozambique (Maputo), South Africa (city of Durban), Rwanda (City of Kigali), Zimbabwe (Norton);
- Asia: Bangladesh (Cities of Dhaka; Faridpur and Sakhipur); India (city of Warangal) Indonesia, Malaysia, Philippines (Dumaguete);
- and from the USA (a private service provider of the Washington State).

Each case study in this publication highlights a specific example of innovation for FSM service provision at community, city or national scale. The initiatives presented are led by National Governments, city authorities, private service providers or NGOs. The FSM stakeholders are very diverse, but when roles and responsibilities are clearly defined, FSM operates as a profitable utility service, lowering cost for government and cities, and reducing service fees for poor beneficiaries. These case studies are a compilation of the strong evidence that FSM as a business is profitable and financially viable. Success at scale is driven by the strong participation and recognition of the private sector for pit latrine and septic tank emptying and for the operating treatment plans. All the cases studies make a strong case for a FSM utility service where local and national Governments play key role as regulator, policy development, financing infrastructure; Private Service Providers operate and maintain the infrastructure (latrines, septic tanks, treatment plants), investment



in equipment (trucks) or treatment facilities; households pay for service and invest into containment systems (latrines, septic tanks or other toilet technologies). The papers presented in this publication discussed the viability of FSM private-public partnership (PPP) models and strategies to scale-up success in cities or at country level. I hope this publication will inspire more conversation during the conference and probably beyond to help our global FSM community fine tuning intervention models.

I also hope this compilation will encourage and inspire projects managers to capture their own learning to share on this FSM conference platform, and help building strong evidences and database for decision makers, investors and regulators. The FSM conference will certainly continue to support the sharing of experiences to promote what works at scale and affordable for poor communities. That is why I would to address a special thanks to all the authors and co-authors, the editorial team led by Isabel Blackett who supported all the authors in summarizing their several years of learnings in these short notes. I am also very grateful to the Chair of the FSM4 Program Committee members for leading this project: Dr Stefan Reuter (Chair Program Committee); Dr Roshan Shrestha, Ms. Susmita Sinha and Jennifer Williams for overall coordination.

**Doulaye Kone, PhD, Chair of the FSM4 Conference**
Deputy Director – Water, Sanitation & Hygiene
Global Development
Bill & Melinda Gates Foundation

# From Pilot Project to Emerging FSM Service: Scaling up an Innovative PPP Model for Citywide FSM Services in Dhaka, Bangladesh

Rosie Renouf, Habibur Rahman, Amirul Hasan, Nirjhor Rahman, Georges Mikhael and Sam Drabble

## EXECUTIVE SUMMARY

Dhaka is one of the world's megacities, with a population of around 16 million people. The clear majority of residents (80 percent) are dependent on on-site sanitation systems, yet until recently, no private operator existed to provide mechanical emptying services to this vast and largely untapped market. In 2015, a public private partnership (PPP) was established between Dhaka Water Supply and Sewerage Authority (DWASA) and a local small and medium enterprise (SME), based on a lease agreement for two DWASA-owned vacuum tankers. The partnership aimed at bridging the service gap through the operation of a new faecal sludge emptying service, marketed under the brand name SWEEP.

As of February 2017, SWEEP has been operational for nearly two years. During the first 18 months of operation alone (to October 2016), SWEEP reached 102,408 people and emptied 3,898m$^3$ of sludge. Significantly, it has also established itself as a viable business, becoming profitable five months after its launch, and generating a profit of BDT 691,837 (USD 8,788) to October 2016.

Key challenges include sustained demand creation, and adapting the service to reach out more effectively to low-income customers. SWEEP's current profit levels are the result of an initial focus on middle- and high-income customers, including institutional customers such as hotels. The SWEEP experience suggests a combination of institutional and household customers can be highly beneficial to a faecal sludge management (FSM) service in the start-up phase. SWEEP is now positioned to extend the service to customers in low-income areas of the city, who are charged a lower tariff. However, incentives are needed to ensure this transition in focus is consolidated.


*Figure 1: SWEEP team and vacuum tanker*

Having established SWEEP as an innovative PPP that meets the needs of multiple stakeholders, WSUP is now focused on supporting continued scale-up in Dhaka, including more effective targeting of low-income customers, and on replicating the model in Chittagong in partnership with Chittagong City Corporation, as the next step towards the objectives of rolling out similar arrangements in cities across Bangladesh. Another focus is contributing to sector-wide effort to improve the enabling environment for sanitation in Bangladesh, as a pre-requisite to achieving change at scale.

## CONTEXT AND BACKGROUND

Bangladesh experienced high rates of urbanization from the mid-1960s to the mid-1990s, as rural migration to towns and cities exploded and urban population growth far outstripped national population growth. Bangladesh is one of the most densely populated countries in the world, with a current annual urbanisation rate of 3.4 percent (World Bank 2015). Urban areas occupy less than 8 percent of the total land mass but house one third of the population. This trend will only increase as cities continue to attract

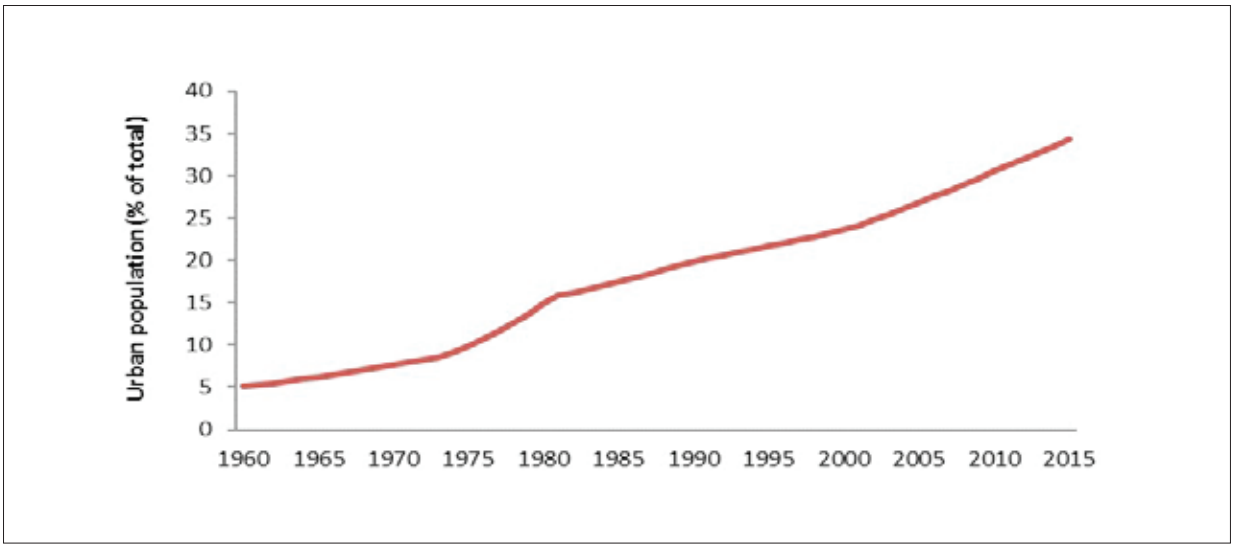



*Figure 2: Growth of urban population in Bangladesh, 1960–2015. Source: World Bank. http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=BD*

new migrants from Bangladesh's rural hinterlands, and more than half of the country's population is projected to live in urban centres by 2050 (UN DESA 2014). Bangladesh is one of the world's poorest countries, but its economy is dynamic: over the last decade, gross domestic product (GDP) has grown by an average of 6.2 percent per annum (WSP 2016). By 2015, GDP per capita had reached USD 1,212, a substantial increase from USD 486 in 2005. This progress notwithstanding, in 2010, 21 percent of the urban population of Bangladesh still lived in poverty (Riaz & Rahman 2016).

*Figure 3: Drainage in Dhaka*

Bangladesh is often cited as a South Asia sanitation success story, due to its reported eradication of open defecation in just over a decade. However, while most of the population can access a toilet or latrine, only around 60 percent use improved sanitation facilities that adequately separate faecal waste from users. On-site sanitation is by far the most prevalent sanitation method in Bangladesh, with the vast majority of households using septic tanks and various types of pit latrines. However, the full faecal sludge management chain is under-developed and under strain.

This situation will only continue to deteriorate as urban migration continues apace. New arrivals to cities and towns are often forced to live in informal settlements with inadequate sanitation facilities: nearly one third of Dhaka's population lived in slums in 2014 (Ahmed 2014). These low-income areas rely on septic tanks and pit latrines but are commonly low-lying, fringe areas of cities where multiple households use one latrine, which fill up quickly.

National policies and institutional mandates on sanitation are weak in Bangladesh. Nationally, drinking water and sanitation at the statutory level are under the purview of the Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C). The Department of Public Health Engineering takes functional responsibility everywhere except Dhaka and Chittagong (WSP 2015).

## FSM SERVICES (EXISTING OR PRIOR TO INTERVENTION)

Like the rest of Bangladesh, most of Dhaka's population has access to a toilet (improved or otherwise), but 99 percent of the waste produced in Dhaka returns to the environment untreated

(SFD Promotion Initiative 2016). Twenty percent of households and institutions are connected to the sewerage network, mostly in mid- to high-income areas. However, the only faecal sludge treatment plant in Dhaka runs at about one third of its capacity, serving around two percent of Bangladesh's total population. Dhaka's increasingly dense population combined with high water use and wastewater generation means that septic tank and soakpit overflow is a widespread problem, exacerbated by frequent flooding. It is common practice in non-sewered areas to discharge waste – typically unprocessed – into the storm drain network (WSP 2015). Raw sewage combined with storm water runs through these drains into low-lying areas, rivers and other water bodies.

Households in low-income and informal settlements use different forms of pit latrines and septic tanks. These neighbourhoods are much less likely to be connected to the storm drain network (let alone the sewerage or piped water supply systems) so are more likely to rely on desludging services. While most people living in Dhaka have access to a toilet, in practice this means that multiple households in low-income areas share a single latrine that becomes unusable if not emptied promptly. Reported open defecation rates in Dhaka are very low but within these areas a significant section of the population (up to 20 percent) are forced to practice open defecation – from time to time at least.

Manual emptying is by far the most common desludging method in Dhaka. There is no fixed rate for manual emptying services, and price can depend on the size of the pit or tank and the area. Lower-income areas will typically pay between BDT 4000 (USD 50.00) and BDT 40,000 (US 500.00), the latter more typical of

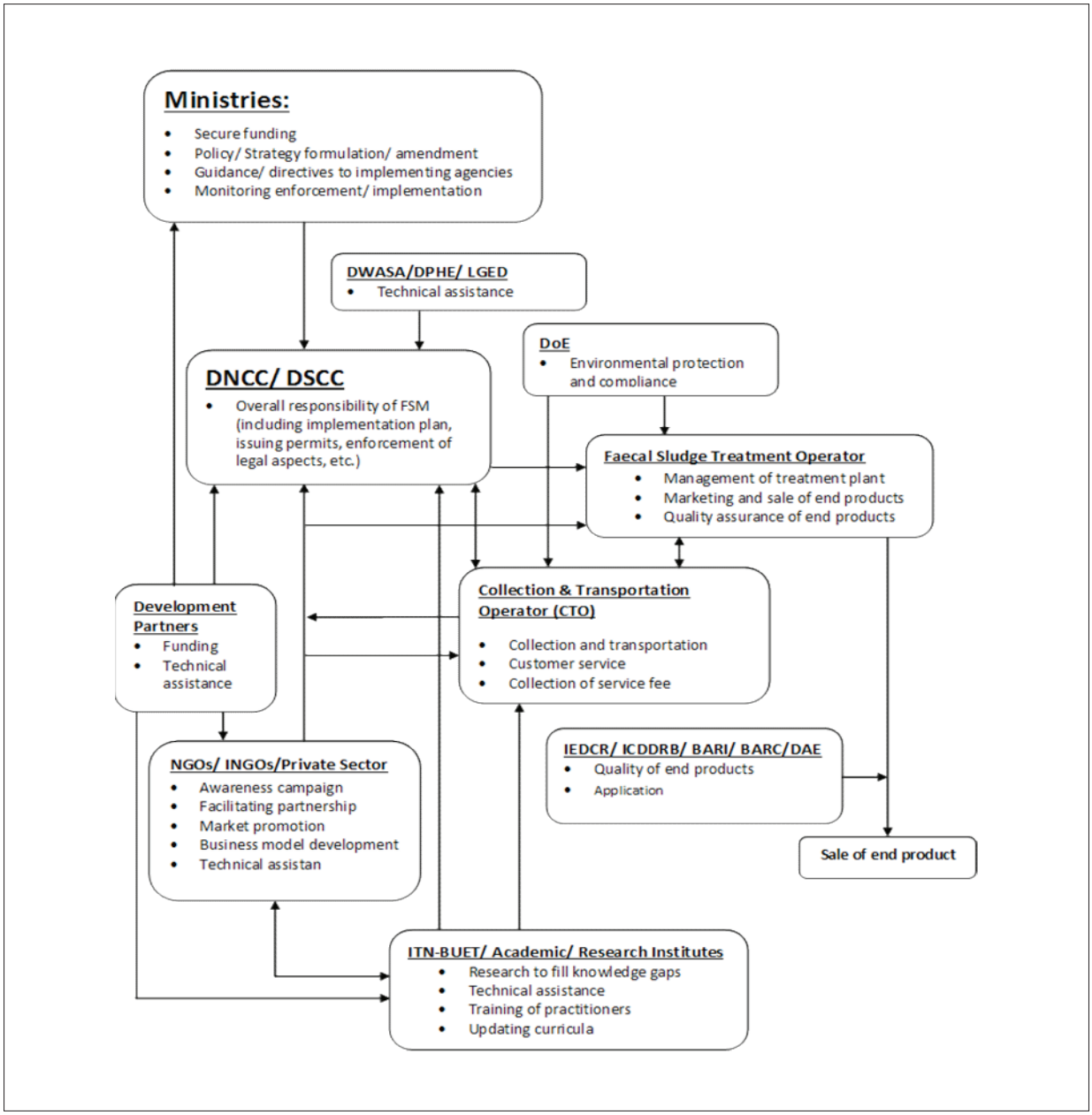



*Figure 4: Institutional arrangements for FSM in Dhaka.*[1]

larger tanks serving many households. Awareness of mechanical emptying is low and the layout of urban neighbourhoods can make access to pits and tanks challenging. Two non-governmental organisations (NGOs) have provided a mechanical emptying service for almost 15 years, supported by Dhaka Water Supply and Sewerage Authority (DWASA) and WaterAid Bangladesh, but only one of their vacuum tankers is operational and the service has yet to achieve financial viability in order to expand further. There were no private sector mechanical emptiers operating in Dhaka before WSUP's intervention, although the 2014 National Strategy for Water Supply and Sanitation includes 'enhanced private sector participation' as one of its key guiding principles (Policy Support Unit 2014).

Progress towards improving FSM in Dhaka is hindered by a lack of clarity around which institution takes responsibility for on-site sanitation: DWASA control sewerage and drainage on major streets, but the Dhaka North City Corporation and Dhaka South City Corporation have responsibility for solid waste and drainage in lanes. FSM is not obviously under the auspices of either body, although the Local Government (City Corporation) Act 2009 mandated city corporations to take ownership of the FSM chain. Dhaka's city corporations are nominally required to plan for and implement FSM services, and can issue orders to residents to maintain their toilets and enforce connections to sewers (if possible). The city corporations are supported nationally by MLGRD&C, which provides funding support for city corporations if required, and ensures that relevant national laws, policies, strategies and guidelines (such as they are) on FSM are followed. Dhaka's city corporations can collaborate with DWASA, the Department of Public Health Engineering, the local government engineering department, development partners and the private sector.

Despite a significant focus on household latrine access, consideration of the FSM chain beyond the household remains patchy and future targets have been not yet been set. Where there is regulatory consideration of FSM, there is a lack of enforcement

*Figure 5: SWEEP team prepare to empty a customer's tank*

capacity. In addition, there is no national independent regulator for sanitation services. The Local Government Division of the MLGRD&C recently formed a national working committee in order to formulate a draft 'Institutional and Regulatory Framework for Faecal Sludge Management', which has undergone a consultation process with stakeholders in government and beyond, including universities, NGOs and the private sector. The working group has produced a draft FSM regulatory framework for the ministry, which has been finalised and ready for approval for some time within parliament. It proposes that the mandate for urban FSM in cities in Bangladesh be definitively allocated to city corporations. However, in Dhaka the responsibility may end up split between DWASA and the Dhaka city corporations, with latter responsible for collection and transportation of faecal sludge, and the former responsible for treatment.

## WHO DID WHAT AND WHEN – SUMMARY OF FSM INTERVENTIONS AND CHANGES

In 2015, WSUP Bangladesh partnered with DWASA to develop an innovative FSM service delivery model. WSUP performed a financial analysis and designed a new PPP that brought together a range of stakeholders that could complement each other in delivering a new FSM service. Supported by WSUP and UNICEF, a lease agreement was signed between DWASA and one small and medium enterprise (SME) for two 2,000-litre vacuum tankers owned by DWASA. As well

| Regular Operational Activities | Regular Maintenance Activities | Infrequent Vehicle Maintenance Activities | Receiving Demand | Mass Marketing | Regulatory Activities | Replacing and Increasing Fleet | Disposal and Treatment |
|---|---|---|---|---|---|---|---|
| SME | SME | DWASA | SME | DWASA | DWASA | DWASA | DWASA |

*Table 1: Allocation of responsibilities for the FSM service between DWASA and the SME.*

as providing access to equipment, the agreement allowed the SME to provide safe and professional FSM services under the WSUP-created SWEEP brand. This delivery model allows multiple SMEs to operate under the SWEEP brand in a competitive environment. If necessary, DWASA could eventually introduce a fixed price, but at the moment with the limited information it has and limited enforcement ability, this is not advised. If the price were fixed too high by mechanical emptying services such as SWEEP, customers would abandon their services.

WSUP provided the SME with technical and business management training to improve their ability to deliver services safely and profitably; and supported DWASA to develop a promotion and marketing strategy for the SWEEP brand. This included an SMS, video, leaflet and poster campaign promoting SWEEP, and hiring 'brand promoters' to conduct door-to-door visits in target areas.

Table 1 demonstrates how the PPP operates in practice, and how responsibilities for SWEEP's service are allocated. As of January 2017, the service had been operational for 21 months.

SWEEP currently targets mid- to higher-income residences and commercial institutions, with lower-income customers making up 15 percent of their customer base. This is partly because higher-income customers are willing to pay more for desludging services and their tanks tend to be larger, enabling SWEEP technicians to completely fill vacuum tankers before making multiple trips to their official dumping points. Due to this initial focus on larger customers, the enterprise was able to cover its operational costs in full and became profitable five months after its launch in April 2015. As of October 2016, SWEEP had reached over 100,000 people in Dhaka and emptied nearly 4,000 $m^3$ of sludge.

## FINANCIAL AND ECONOMIC ASPECTS

By October 2016, SWEEP had made a total profit of nearly BDT 700,000 (USD 8,890) (see Figure 6). SWEEP's current profit levels are the result of the initial focus on middle- and high-income customers noted above, which includes institutional customers such as hotels. The SWEEP experience suggests a combination of institutional and household customers can be highly beneficial to a FSM service in the start-up phase. A price analysis conducted by WSUP in 2016 demonstrated that customers with larger tanks are often willing to pay more; these customers also account for 60 percent of SWEEP's revenue despite being only 15 percent of the customer base. However, the price analysis did not show a positive correlation between tank size and actual emptying price: to date customers with small tanks have been charged more per litre on average than customers with a medium-sized tank (Walcott, 2016a).

SWEEP customers living in low-income areas are charged a lower tariff. The tariff is typically USD 6.00–USD 7.50 per cubic metre for low-income customers and USD 10.00–USD 15.00 per cubic metre for middle/high-income and institutional customers. However, the pricing structure is not fixed, given the widespread practice in Dhaka of negotiation over price for services rendered. Despite this potential barrier, the vast majority of jobs performed by SWEEP technicians generate a profit, with jobs that made a loss mostly confined to the start-up period in 2015.

## DRIVERS OF CHANGE

Stimulating buy-in from the utility and sanitation entrepreneurs was vital during SWEEP's design and initiation, and ensured that scale-up and expansion are now possible. Both the public and private bodies involved in the PPP must be invested in the process and in the eventual success of the enterprise. In DWASA's case, leasing their vacuum tankers to private actors minimises risk, and the scalability of the model meant that the utility could enter the FSM market without having to undergo significant internal restructuring. DWASA also receives regular monthly revenue from leasing fees.

The SMEs take on the risk of entering the FSM market, but risks are lessened thanks to the structure of the PPP: start-up costs are lower, and the SME sees a faster return on its investment and operates under the legal authority of the utility. The contract also guarantees eight official disposal points and marketing support for the SME. A competitive bidding process overseen by WSUP ensured that the strongest sanitation entrepreneur was chosen to deliver the service to customers (Gulshan Clean and Care). WSUP presented a strong business case to entrepreneurs to convince them of the feasibility of balancing low-income customers with running a successful (and profitable) business. This required overcoming the commonly held perception that mechanical emptying businesses that focus on low-income areas will not be financially viable: SWEEP's experience to date demonstrates that such enterprises can be profitable if activities are carefully targeted.

Notwithstanding the risk mitigation strategies that were developed, attempting to introduce an innovative FSM service delivery model requires a step into the unknown. The commercial manager of DWASA was an enthusiastic advocate of the new SWEEP model.

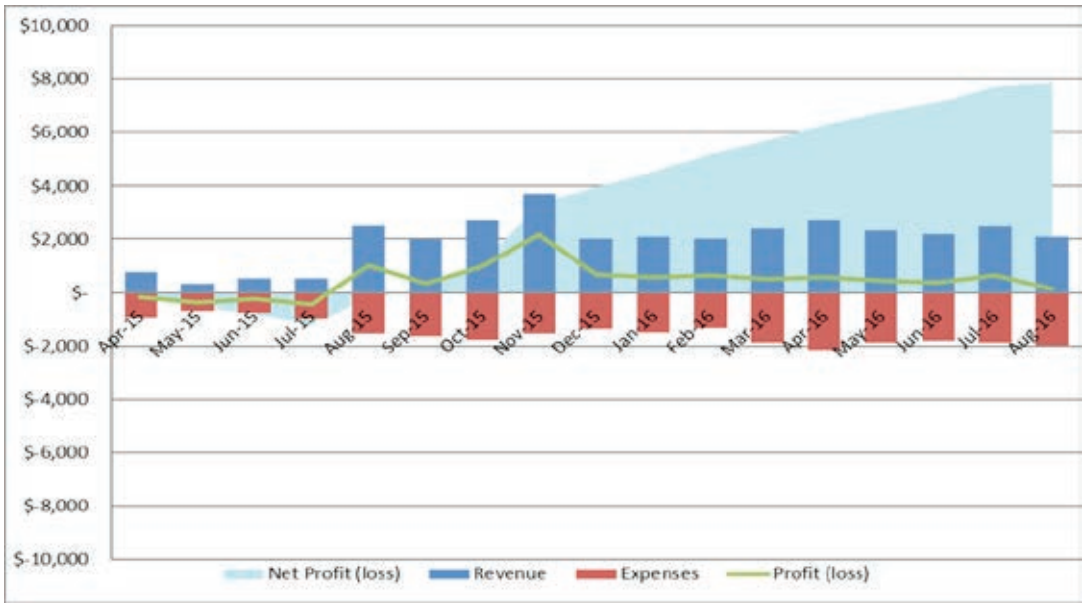



*Figure 6: Overview of SWEEP's performance, April 2015–August 2016 (USD).*[2]

This willingness to take risks and consider alternative options in order to make substantive city-level change is critical when designing and implementing new models. In addition, both the utility and the donor (UNICEF) held a clear vision of what needed to change in order to make substantial improvements for the population of Dhaka. Donors especially must be willing to push for innovation in urban sanitation programmes for new models to gain traction.

## LESSONS LEARNED

**Mechanical FSM services that serve the poor can be viable in Bangladeshi cities:** SWEEP's experience demonstrates that it is possible for mechanical FSM services to make a profit in a large Bangladesh cities such as Dhaka, provided institutional support, appropriate pricing and cross-subsidy are established; and that lower-income customers can be served without jeopardising a company's bottom line. A contractual partnership with the public sector further strengthens this positive outcome; it is intended that serving a minimum percentage of low-income communities be made a contractual requirement of serving under the SWEEP brand. To ensure this is fair for the SME and its customers, data from the current operator is being processed to better understand necessary price points for higher and lower-income customers that would allow for cross-subsidies so that the target percentage of low-income consumers is viable. From initial results it appears possible (and affordable for wealthier customers) for the entrepreneur to use cross-subsidies in order to target households in low-income areas (currently around 30 percent of the total customer base) while maintaining a healthy bottom line for the business.

WSUP is conducting studies to analyse how to increase the incentives to service customers from low-income communities (which could include providing business planning/marketing support to SMEs that meet pro-poor targets), and the level of cross-subsidy required from higher-income customers. In a simplified model, retaining the price for lower-income customers and raising the costs for higher-income customers (by 23 percent, for which there is still a willingness to pay) increases the percentage of customers from low-income communities from 16 percent to 30 percent, and achieves a comparable net profit margin for the SME. There are several other factors to be considered, but this analysis clarifies that increasing the service to low-income communities is feasible (Walcott 2016b).

**PPPs offer a strong framework within which multiple stakeholders with a diversity of strengths can operate**: The lease agreement signed between DWASA and the SME has advantages for both parties: the SME has benefited from reduced risk to market entry through lower start-up costs, greater flexibility and a faster return on investment; and DWASA is able to service customers in a scalable manner across the city, while remaining flexible and maintaining ownership of its assets.

**Detailed understanding of customers and pricing is critical**: The price analysis of SWEEP showed that it was the size of the customer's septic tank that indicated profitability and helped determine pricing (Walcott, 2016a). Although this was related to customer income – in that higher-income households and institutions tended to own larger tanks, had more litres emptied and so paid more overall – on average customers with smaller tanks paid more per litre than mid-sized customers. How best to balance this with a company's utilisation rates – SWEEP operators are currently operating only about 50 percent of their potential working day, partly because smaller septic tanks do not take as much time to empty as larger ones, which require multiple trips to dumping points – must now be analysed in more detail.

**Disposal points are essential in promoting operational efficiency:** SWEEP's experience has affirmed WSUP findings from elsewhere that the provision of disposal points is vital to supporting the viability of emptying businesses, as they keep transport distances low and increase profitability. However, not all of the eight official disposal points provided by DWASA are currently operational.

**A city-wide vision is required to achieve impact at scale:** When engaging with potential public and private partners, implementers must design a strategy for the city as a whole. This means innovating at a micro-level, but maintaining a focus beyond the core business being promoted: it is vital to consider how the model will impact the urban sanitation sector at large, and to support sector-wide efforts to strengthen the enabling environment for sanitation.

## OUTSTANDING CHALLENGES, NEXT STEPS AND PLANS FOR GOING TO SCALE

**Increasing access of low-income customers to their services**: WSUP are currently assessing how best to encourage private sanitation entrepreneurs to increase low-income customers' access to their services. This could mean incentivizing companies by providing business planning/marketing support to those that achieve pro-poor targets, or ensuring that future contracts include a clause that mandates operators to meet a target of low-income households.

**Creating demand**: a significant number of Dhaka households have toilets connected to surface drains and no need for the service, or are happy to continue to pay manual emptiers. During SWEEP's start-up phase, the team found that many people did not know that a mechanical emptying service was available, even though most of Dhaka's population would benefit from such an enterprise.

**Optimising marketing and sales to identify and close transactions more efficiently:** WSUP will continue its support to SWEEP scale-up in Dhaka in 2017, with funding from the Bill & Melinda Gates Foundation. This will include further optimising marketing and sales to identify and close transactions more efficiently, with more repeat and satisfied customers; and ensuring safer, more hygienic disposal of waste.

*Figure 7: Drying bed used by SWEEP*

If demand creation steadily increases, and if the various interests within DWASA continue to support the model and allow for disposal within the sewerage network, more vacuum tankers could be leased under the SWEEP brand.

**Ensuring long-term sustainability in Dhaka:** After 2017, the current contract with the sole SME will be revised to reflect learning from the programme. To scale up, additional support would be required for DWASA to increase its fleet of vehicles, which can again be sub-contracted to the private sector under the same contractual framework. There are positive moves toward this; national policy is being further clarified, placing responsibility for FSM with DWASA, and there are ongoing discussions between DWASA and the World Bank for further sanitation investment which could include emptying equipment leased to the private sector. The business community is recognising that this service can be profitable, particularly if support for capital investment is available. The existing SME owner is considering expanding the service using his own resources, and entrepreneurs in Chittagong, where a replica of this model is being trialled, have expressed interest.

**Learning from SWEEP's experience in Dhaka will inform scale-up and expansion elsewhere:** Supported by the Bill & Melinda Gates Foundation, work to roll out the SWEEP model in Chittagong is already underway: WSUP and the Chittagong city corporation have entered into an agreement to develop a new FSM service under a PPP arrangement similar to that in Dhaka. The policy environment and willingness to engage is even more apparent in Chittagong; WSUP is therefore hopeful that the PPP will come into operation in early 2017, with WSUP providing capacity building support to SMEs. Diagnostic studies on the business model, business management and customers of Dhaka will provide invaluable data supporting SWEEP's expansion in other cities.

**Improving Bangladesh's enabling environment for sanitation is key to SWEEP's long-term success:** The sanitation sector is under-regulated and there is little legislation clearly allocating mandates, or policies and guidelines for stakeholders in urban areas. This is now recognised at the national and municipal level, and efforts to address this are underway, although it is likely that any resulting wide-scale changes will take a number of years to achieve.

## NOTES

[1] BARC, Bangladesh Agricultural Research Council; BARI, Bangladesh Agricultural Research Institute; DAE, Department of Agricultural Extension, ICDDRB, International Centre for Diarrhoeal Disease Research, Bangladesh, IEDCR, Institute of Epidemiology Disease Control & Research

[2] Net Income (Loss) represents total revenue plus total expenditure since inception of the service; Income (loss) represents monthly revenue plus monthly expenses.

## REFERENCES


Ahmed I (2014) 'Factors in building resilience in urban slums of Dhaka, Bangladesh'. *Procedia Economics and Finance* 18

Policy Support Unit, Local Government Division (2014) National Strategy for Water Supply and Sanitation. Ministry of Local Government, Rural Development & Cooperatives. Bangladesh

Riaz A & Rahman MS (eds.) (2016) Routledge Handbook of Contemporary Bangladesh. Routledge

UN Department of Economic and Social Affairs (2014) World Urbanisation Prospects: The 2014 Revision. UN

Walcott J (2016a) SWEEP Pricing and Financial Analysis. WSUP

Walcott J (2016b) Low-Income Customer Ratios and Analysis. WSUP

SFD Promotion Initiative (2016) Dhaka, Bangladesh. WEDC

World Bank (2015) Urban population growth (annual %). Online

WSP (2015) A review of Fecal Sludge Management in 12 cities. Annexure A.7 Dhaka, Bangladesh. World Bank

WSP (2016) Private sector provision of water and sanitation services in rural areas and small towns: the role of the public sector. World Bank


## ACKNOWLEDGEMENTS


This work is funded by UNICEF, the Bill & Melinda Gates Foundation and UK Aid from the Department for International Development.

# Preliminary Results of the FSM Business Model in Faridpur, Bangladesh: Tackling the Post-ODF Challenge through Public-Private Partnerships

Noemie de La Brosse, Dr. Lucy Stevens and Rafiul Islam

## EXECUTIVE SUMMARY

The rapid expansion of household sanitation facilities in the secondary town of Faridpur in Bangladesh has created the 'second-generation' problem of how to manage fecal sludge. This case study provides preliminary insights from the operation of an innovative business model that creates new relationships between the municipality, informal pit emptiers (organized into cooperatives), and a treatment plant operator (TPO). The business model means pit emptiers are paid by their clients for emptying services, and also by the TPO when they deliver sludge to the newly constructed treatment and composting plant. Viability of the TPO is supported by cross-subsidies from the municipality, using income from the lease of machinery to the pit emptiers. An early insight is the importance of demand creation activities to help kick-start the new FSM system, with early indications that pit emptiers are seeing an increase in demand for more flexible and responsive services, and are regularly disposing of fecal waste safely at the treatment plant. The long-term potential of the compost business will take longer to establish.

## BACKGROUND AND CONTEXT: BANGLADESH AND FARIDPUR

Bangladesh has made remarkable progress towards achieving the MDG target on access to adequate water and sanitation, with 38 percent of the population gaining access to water and sanitation since 1990.[1] But the country's urban areas face enormous challenges in terms of providing basic infrastructure and services when the urban population (34 percent in 2015) is growing at 3.5 percent a year. Despite overall progress in terms of human development, the absolute number of people living below the poverty line remains a significant issue for the WHO/UNICEF Joint Management Program (JMP) for Water and Sanitation. Although Bangladesh has achieved the South Asia MDG target by providing 61 percent of the population with access to improved sanitation, more than 62.5 million people in Bangladesh still lack access to improved sources of water and sanitation services.[2]

After years of campaigning and sanitation interventions in Bangladesh, open defecation is down from 34 percent in 1990 to one percent in 2015. This was achieved largely by a growth in onsite sanitation systems (OSS), such as septic tanks, and improved or unimproved pit latrines. However, this success has created a new problem of how to safely manage on-site facilities, especially in towns with no sewers and where residents rely entirely on unimproved or poorly designed facilities. Toilets overflow or are manually emptied into nearby drains and water bodies, creating exposure to human waste and the problems associated with open defecation.

Bangladesh is now facing a 'second-generation' or 'post-ODF' challenge: despite the progress made in the provision of improved sanitation, the questions of public health, environmental protection, and social recognition of those providing FSM services have yet to be addressed. In Faridpur, 90 percent of fecal sludge is not safely managed.

A major impediment to improving access to safely managed sanitation in Bangladesh lies in the absence of a national framework for sanitation, with a clear assignment of responsibilities between service providers, city corporations and municipalities. The Dhaka Declaration (SacoSan VI 2016) re-emphasized the need to implement a regulatory framework as an enabler to ensure dignity, health and income of informal sanitation workers in South Asia. Practical Action and its partner the International Training Network Centre of Bangladesh University of Engineering and Technology (ITN-BUET) support the participatory design of an institutional and

regulatory framework that is expected to enable more systematic FSM and clarify roles and responsibilities across the sector.

The progress towards ending open defecation has created a missing strand in the wider sanitation systems around the emptying of the new sanitation facilities. This has contributed to an increase existing unsafe FSM practices e.g. manual scavenging and dumping in the open and illegal connections to sewers.[3] These practices have negative externalities (water-borne diseases and high pollution of surface and underground water) that cannot be addressed by the construction of improved treatment facilities. They also point to a need for service operation models that create incentives for the marginalized fecal sludge emptiers to contribute to a more sustainable FSM system. Market-based solutions were proposed in Faridpur to create opportunities to increase the revenue and recognition of these workers.

## EXISTING FSM SERVICES IN FARIDPUR

In Faridpur (130,000 people), the Public Private Partnerships for Sustainable Sludge Management Services in Faridpur, Bangladesh project is being jointly carried out by Practical Action and the municipality, building on a decade-long partnership.[4] The initial situation analysis identified four key problems that are at the heart of why the sludge management system was neither effective nor sustainable:

**Unsafe containment**

Despite a slum-dweller population of around 10,600, 94 percent of residents had access to toilets. There is no piped sewerage network, and before this intervention, no treatment facility. Most toilets were either single pit latrines (61 percent) or connected to a septic tank (32 percent). Seven percent used double pits. The municipality estimated that a quarter of all septic tanks have no soak pit to manage the effluents. Effluent and some fecal sludge discharged directly to open drains. Since containment storage capacity was limited and without consistent and affordable emptying services, the pits and tanks often overflowed into the surrounding environment. Households also connected their toilets directly to drains or water bodies. In 2014 in total, 66 percent of the sludge in Faridpur was found to overflow or be abandoned.

**Lack of capacity in collection and transportation**

Given the common practices of by-passing containment and households emptying their own pits, manual pit emptying services in Faridpur were used by only 55 percent of individuals and 81 percent of institutions. The municipality's conservancy department and two informal sweeper groups performing manual scavenging emptied just 30 percent of pits[5]. Therefore, the capacity of these two services was substantially below that necessary for an effective city-wide system. Manual emptying provided by the municipality was seen by customers as slow, unreliable and costly. Highly centralized and heavily subsidized (at 25 percent), the service was used almost exclusively by influential groups and institutions and struggled to meet demand from households.

Historically, informal manual pit emptiers have provided sanitation services in South Asia, but they are highly vulnerable to poor health and social stigma. In Faridpur, they filled the gap in service provision in an unregulated manner, causing considerable negative externalities. Some were in fact also casual laborers of the Conservancy Department. Of those who use an emptying service, 72 percent of households and 52 percent of institutions preferred to use informal services, which were seen as better value for money. Their charges used to range between USD 6.00 and USD 10.00 to empty a tank or pit. The service fee applied by the municipality was estimated at USD 8.25 for a pit latrine and between USD10 and USD20 for a septic tank. The final price depends on the volume of sludge, distance to a disposal site, ease-to-access, condition of the containment facility and the sludge, and the socio-economic status of the customer.[6] The service fees charged by the municipality varied, from USD 9.00 per emptying in underprivileged areas, to USD 22.00 in formal housing areas and non-profit institutions, and USD 28.50 for profitable institutions.

**Unsafe disposal**

With limited transportation equipment and no incentive to safely dispose of sludge, the workers typically looked for the fastest disposal route. 66 percent of the sludge contained in OSS was left to overflow. Of the sludge that was emptied, the four percent collected by the municipality and 14 percent collected by the informal sweeper groups, was illegally dumped in the environment. Overall, the most optimistic estimate is that 10 percent of sludge is safely buried, but without any consideration for the health & safety of the pit emptiers.

**Gaps in national regulation and co-ordination of responsibilities**

The national water supply and sanitation strategy pays scant attention to FSM, and this is focused on big cities. As a result, local municipalities receive little guidance on establishing new systems; nor is there any strategy for significant investment in non-sewer systems. The Ministry of Local Government, Rural Development and Cooperatives (LGR&C),

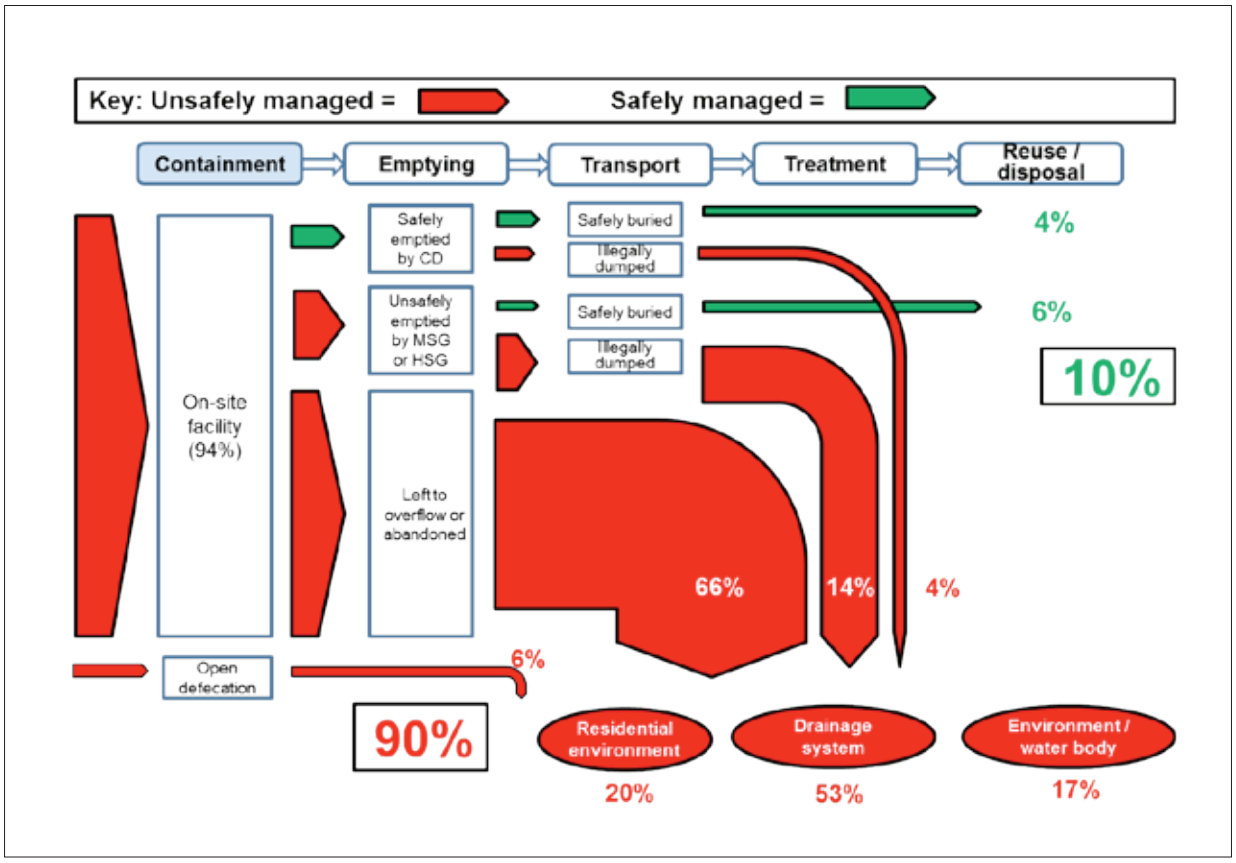



*Figure 1: Faecal waste diagram, Faridpur, 2014*

which is currently responsible for overseeing access to basic services, and the local governments (and municipalities) share the responsibility of funding and implementing the infrastructure. In practice however, the decentralized system makes it difficult for local governments to provide adequate sanitation. OSS systems are considered temporary solutions until sewers can be put in place. Yet in reality, OSS systems are here to stay, either as an intermediate or permanent standalone solution.

## SUMMARY OF FSM INTERVENTIONS AND SYSTEMIC CHANGES

Following a market analysis looking at the (conflicting) incentives of all actors and the business environment, a proposed public-private partnership (PPP) was structured to build on the strengths in the system. A business model was developed, using cost and revenue calculation tools to come up with three different scenarios. Finally, a flexible and adaptive scenario, modelling a progressive operation of the service within the first year was designed to guide the implementation of the service-based agreements. The pilot project was initiated in two wards of the city (26,000 people) with the intention of a city-wide rollout. The project is structured around four objectives: i) improving containment standards in the city; ii) facilitating the PPP to provide collection and transportation with existing sweeper groups; iii) developing a sludge treatment plant; and iv) facilitating the creation of regulation committees to attract private businesses to supply FSM services.

**Preliminary operationalization of the business model and performance-based contracts**

The solution that was built in collaboration with all stakeholders was to replace the inefficient dual system of services provided by the municipality and sweeper groups. To reach the largest number of customers at an affordable price, a business-oriented approach was adopted, forming a PPP between the municipality, the sweepers and a treatment plant operator (TPO), which laid out service-level agreements for pit emptying and for the operation of a new treatment plant. Under the agreement, the two existing sweeper groups provide the pit emptying services, while the municipality monitors progress through quarterly targets to ensure a better quality service and safe disposal of the sludge. A multi-stakeholder steering committee (MSSC) at the municipality oversees the service level agreements and incentives, through a set of key performance indicators that ensure the responsiveness of the system.

A performance-based contract including equipment leasing was signed in December 2015 between the municipality and the Muslim sweepers formalized

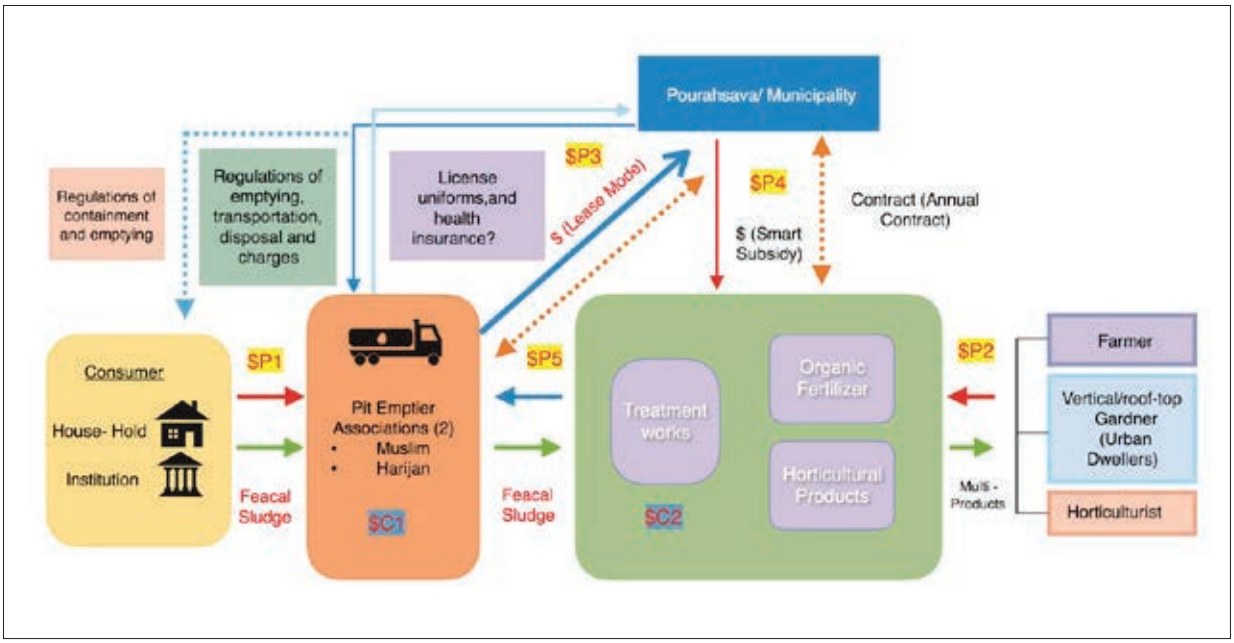



*Figure 2: Institutional arrangement and performance-based contracts for FSM*

as the Khutibari Cleaners Cooperative, who received training in business management and an online emptying demand system. The municipality has recently appointed a TPO. The pilot operation of the plant began in August 2016 and it can currently treat 18m$^3$ of sludge per day (its design capacity is 24m$^3$ per day).

Ongoing service demand generation and awareness raising campaigns are central drivers of a progressive increase in revenue from emptying. The campaigns, which include street drama, cycling events, cleanliness drives, quiz contests and cycle rallies, aim to stop illegal connections to drains. Engagement with local media is also generating a local awareness of the importance of proper FSM to avoid environmental and public health hazards. Increased demand for a trustworthy service demonstrates good potential for uptake of the model.

**Creation of a national institutional and regulatory framework for FSM**

Another strategic pillar of the project lies in the creation of a national institutional framework and a FSM sector coordination network to build a solid enabling environment for scaling up FSM. The FSM business model has been presented at the National Forum for Water Supply and Sanitation, and is now incorporated into the framework for the approval by the Ministry of LGRD&C.

The municipal or *paurashava* framework describes effective roles in the overall planning, implementation, and monitoring and evaluation of FSM. The ministry will endorse this framework, secure funding and initiate inclusive planning and execution of FSM. With the support of the government, the local authorities will be responsible for implementing the entire FSM system. The framework also includes a strong capacity building component. Technical assistance and research will be provided by ministries, research organizations, I/NGOs and the private sector. These will also ensure an awareness building component that includes campaigning, promoting private sector participation, demonstrating FSM business models, performance monitoring, and R&D support and funding.

## FINANCIAL AND ECONOMIC ASPECTS OF THE BUSINESS MODEL

In this model, piloting the business model with one cooperative, the cumulative quantity of sludge emptied by the end of the first year was 324m$^3$. Calculations now show that it is realistic to expect an annual total of 3,360m$^3$ delivered to the TPO each year from the second year. A challenging exercise was to estimate the revenues from emptying services and compost sales.

**The modelled revenues from emptying services (\$P1** in Figure 2) varied considerably between the most favorable to the least favorable scenarios. Revenues in the first year for the Khutibari Cleaners Cooperative were an estimated USD 4,120 from emptying services (\$P1) and USD 210 from disposing sludge at the treatment plant (\$P5). The cooperative currently charges USD 22.00 per emptying. The experimental disposal of the collected sludge at the treatment plant began when the cooperative received equipment (Vacutug and protective equipment) in August 2016. They earned USD 3,087 in emptying fees, for a total of 149 trips to the treatment plant between August and

November 2016. In the early months of the pilot the cleaners earned USD 70.00/person/month, compared with around USD 50.00/person/month before this model was in place. To kick-start the businesses, the cooperative was given a six-month exemption on payments for leasing mechanical and transportation equipment from the municipality ($P3). From March 2017, the Khutibari cooperative will pay a monthly leasing fee of USD 210.00. Total revenue is expected to increase to USD 38,450 from emptying services ($P1) and USD 2,150 from disposing sludge at the treatment plant ($P5) from the second year of operation, when the Harijan pit-emptying group will register as the Bandhaob Palli Cooperative and sign a performance-based contract.

**The "safe transfer incentive" ($P5)** is a payment made to the cooperatives each time they dispose safely of the sludge, which helps making the cooperatives' business model profitable. This payment is made to the registered cooperatives at the treatment plant as soon as the agreement with the selected TPO is signed off.

*Figure 3: Pilot operationalization of the FSM model, 2016*

**Revenue from sale of compost produced at the plant from dried sludge ($P2)** is expected to be low in the first year (USD 1,600) because only one group is currently contracted, and because of challenges in the marketing, certification and cultural acceptance of human waste as a fertilizer. This is why the business model relies on a "cross-subsidy" system, whereby the revenue for the cooperative from emptying services ($P1, expected to be USD 4,100 in the first year of service) subsidizes the low revenue expected from compost sales for the TPO ($P2, expected to be USD 1,603). The low revenue will be compensated by a subsidy to the TPO ($P4) from the municipality, covered by revenue from the leasing contract ($P5). This cross-subsidy will be in place once the FSM system is operational to help cover the plant's operating costs ($C2), which will be an estimated USD 15,000 per year until 2018. It is in the interest of the municipality to reduce this subsidy over time, to incentivize the TPO to maximize its revenue from compost sales to cover these costs. Initially a large subsidy will be needed to cover the shortfall in the TPO budget (USD 8,950 in 2016, covered by a cross-subsidy from the project budget). From the third year of operation, the TPO is expected to be more profitable and have a net cashflow of more than USD 50,000. This business model is transforming informal emptiers into formal businesses and improving their health and livelihoods.

## DRIVERS OF CHANGE

One of the key drivers triggering systemic change was the **municipality's strong commitment to facilitating delivery of city-wide FSM** as part of a long relationship with Practical Action. The introduction of an improved FSM service in the 30-year City Master Plan, and the allocation of a large, three-acre plot of municipality-owned land for a treatment plant illustrate this commitment. Its experience of working with informal solid waste pickers allowed the municipality to see the value in working with existing (albeit informal) service providers.

The **national FSM institutional and regulatory framework** will provide uniform regulation for all municipalities to ensure the proper design and construction of sanitation facilities and disposal of fecal sludge and solid waste. It provides guidance on (i) social sustainability (i.e. social discrimination, rights and safety of pit emptiers), (ii) environmental sustainability, and (iii) economic sustainability (i.e. sustainable business models, including cross-subsidies for pro-poor customers, and "safe sludge


*Figure 4. Signing of the PBC with the Khutibari Cleaners Cooperative*

transfer" incentives). The creation of this national framework provides a very strong enabler that was previously missing. The value of the partnership with recognized knowledge and training center ITN BUET to develop this framework was significant.

**The political unrest in 2015** delayed the initial implementation of the model. The application of the performance-based contract was intrinsically linked to the construction of the treatment plant, which was also delayed until 2016 due to heavy rainfalls, floods and excessive heat. The remaining works necessary for full operation are expected to be completed by April 2017.

The most difficult part of the design of the business model was to **estimate the revenues of the existing service providers**. The absence of a formal service structure or any track record of income generation was a challenge. Using a series of comprehensive emptying, transportation and disposal-treatment costing tools developed by the University of Leeds enabled the team to obtain transparent baseline information to design the business model.

Finally, **challenges engaging with the private sector** in the first year were overcome. A different level of buy-in was observed between the Muslim and Harijan sweeper groups, but the registration of the latter as a formal cooperative is about to be finalized. Despite difficulties finding a viable company to run the treatment plant due to lack of interest in and awareness of FSM locally, an operator was eventually selected after a competitive process.

## LESSONS LEARNED

Bringing informal pit emptying into a more regularized arrangement with the municipality through a binding agreement, and creating cooperatives among the sweepers required time and patience. Trust is hard-won but there is evidence the investment of time and resources is worthwhile. Ensuring buy-in and ownership of the cooperatives has delayed the full operation of the business model, but this is certainly what will ensure its sustainability beyond the end of the project, thanks to their flexibility and understanding of customers' needs. The main lessons we learnt are:

**Awareness raising and demand generation campaigns are stronger driver of FSM business models than expected**. The evidence of their impact on service demand led us to prioritize and accelerate these activities. Residents also need to be made aware of the changes to how they can access these services.

**Facilitation is at the heart of this initiative's success**. The creation of a steering committee as a permanent actor in the municipality to pro-actively regulate the system transparently is a strategic asset. Pro-active

facilitation of the PPP and business model by the MSSC and simultaneous demand generation activities are vital to increase demand for sludge emptying.

**A cross-subsidized tariff structure is required to attain a responsive service in the city**. Yet, this is a complex and new concept for the FSM sector in Bangladesh. Awareness raising among decision makers and the private sector was needed to design the model in a participatory way.

**Engaging the private sector in human waste treatment and compost marketing** is new in Bangladesh and has been difficult. An assessment of the compost market indicated strong cultural barriers, which need to be overcome. The influencing and advocacy role of the national FSM network will support this nexus initiative between farming and urban sanitation, helping to alleviate fears about the safety of using fecal compost in agriculture.

## OUTSTANDING CHALLENGES, AND ACTION PLANS TO SCALE UP THE MODEL

The treatment facility is one of low-cost systems of planted and unplanted bed drying beds with a total capacity of 24m$^3$. This can be adapted for upscaling of the service beyond the initial pilot in two wards of the city (13 percent of households). This model is being tested for a year, and may take up to three years to break even and bring worthwhile lessons for an appropriate city-wide scale-up and profitable uptake.

The cost-revenue modelling results will be regularly updated to orientate the review of the PPP towards more optimal cross-subsidies. Scaling up the model currently developed would require a deeper analysis of containment conditions, using existing costing tools. Setting up the TPO as a viable business appears to be the keystone for sustainability. The marketing potential of safe, dried sludge co-composted with kitchen waste lies in the simplification of its certification process and in generating greater interest from farmers.

The creation of a national FSM network as a platform for innovation, knowledge and policy influencing will be strategic to overcome this. The network of 60 stakeholders from national and local level government agencies, development partners, academia, I/NGO, and private companies will be engaged in regional and international programs. Its first multi-stakeholder convention involved sweepers participating in workshops on rights and dignity for septic tank emptiers, indicating a strong momentum emerging around not only the business potential of FSM, but also the rights of both service users and providers to healthier lives. Discussions to extend funding to support the sustainability of the partnerships and services are taking place.

---

### NOTES

[1] WHO/UNICEF, JMP 2015

[2] World Bank (2015), WHO/UNICEF, JMP 2015

[3] This is despite the 2010 UN General Assembly recognition of the human right to safe drinking water and sanitation and its advice that the manual emptying of pit latrines is "unacceptable from a human rights perspective" (De Albuquerque 2014).

[4] Funded by the Bill & Melinda Gates and the UK Department for International Development (DFID), 2014–2017, USD1.6million

[5] Practical Action Bangladesh 2014

[6] Exchange rate: USD 1 = BDT 78.8

### REFERENCES


Morcrette, Alexis, de La Brosse, Noemie. (2016) *Draft FSM Business Modelling Report*, Practical Action.

L. Stevens., et al. (2015) *Faecal sludge management in Faridpur, Bangladesh: scaling up through service level agreements*, presented at the 38th WEDC International Conference, Loughborough University, UK, 2015

WHO/UNICEF. (2015) *Progress on Sanitation and Drinking Water*, 2015 update and MDG assessment, WHO, Geneva

Practical Action. (2014) *Situational Report on Faecal Sludge Management in Faridpur Municipality*, Practical Action, Bangladesh.

DeFrancis, Marc P., (2012) *Economic Impacts of Inadequate Sanitation in Bangladesh*, Water and Sanitation Program, World Bank, Washington, DC


### ACKNOWLEDGEMENTS


The authors would particularly like to thank Rafiul Islam, Uttam Kumar Saha, and Md. Nazmul Huda who form the core business modelling team in Practical Action Bangladesh. We would also like to thank the UK Policy & Practice team and consultants

Prof. Dr. Barbara Evans and Andy Peal, who helped designing the business modelling and the performance-based contract. We would like to thank the Municipality of Faridpur, the sweeper associations and our partner ITN-BUET for their role in creating this model and the national FSM framework. Finally, we would also like to thank the Bill and Melinda Gates Foundation and the United Kingdom Department for International Development (DFID) for their support and guidance on extracting evidence and learning from this innovative piece of work.

# Co-Composting of Faecal Sludge and Municipal Organic Waste in Sakhipur Municipality, Bangladesh

Suman Kanti Nath, Abdullah Al-Muyeed and Palash Ranjan Sanyal

## EXECUTIVE SUMMARY

Bangladesh has achieved remarkable success in reducing the open defecation rate from 34 percent in 1990 to one percent in 2015. This achievement in sanitation coverage has given rise to the second generation problem of faecal sludge management (FSM). Triggered by the significant volume of the faecal sludge and solid waste generated in the urban areas, the option of combining composting of faecal sludge and organic solid waste was considered by municipal authority of the small town of Sakhipur in Bangladesh. WaterAid Bangladesh provided technical and financial support to establish the co-composting plant. Shit flow diagrams (SFD) were developed to quantify the pre and post condition of the municipality. The introduction of the co-composting plant is expected to increase the proportion of safely disposed sludge from 21 percent to 58 percent in just over two years. Lab tests show that pathogen reduction is significant and the compost has a carbon to nitrogen ratio in the range of 16 to 20 and the average moisture content is around 16 percent. Approximately 24 metric tonnes of compost is produced yearly. Demand for the compost is in and around the town, and local Department of Agriculture officials advise farmers to use this compost. The municipal authority sells the compost directly to local farmers for BDT 15.00 (USD 0.20)/kg, and the farmers use this compost to produce different vegetables. This co-composting plant has created opportunities for capturing information, learning and experience, and offers a unique example of covering the whole cycle of sanitation value chain.

## CONTEXT AND BACKGROUND

One of the world's largest developing countries, Bangladesh has a population of 160 million, and has had consistent growth in GDP of six percent for more than a decade. A development model for many countries, Bangladesh has achieved remarkable success in reducing the open defecation rate to one percent (JMP, 2015), from 34 percent in 1990. The 2013 national sanitation survey found that only 58 percent of households had some sort of latrine; but by 2015, 58 percent had improved sanitation.

A community-led total sanitation (CLTS) approach – a coordinated effort led by the government and supported by NGOs and other development partners – contributed to this reduction in open defecation. Also, the government along with the stakeholders in the WASH sector have developed water supply and sanitation policies, strategies and guidelines that also contributed to this success. Efforts to address marginalised communities, including women, children, differently-abled people, indigenous communities, and poor and floating populations, have been mainstreamed in the policy documents. The 2005 National Sanitation Strategy was the first comprehensive outcome of the combined effort of the engaged parties, and was later supported by a dozen more strategic sanitation policy documents between 2004 and 2015.[1] In 2015, the Bangladesh government finalised the draft version of the country's first and only regulatory framework – the Institutional and Regulatory Framework for Faecal Sludge Management (FSM). These documents demonstrate the government's commitment to addressing sanitation and hygiene at the highest level.

In 2011, an estimated 28 percent of the population lived in urban areas (2011 census). The number of urban dwellers rose from 31 million to 42 million, an increase of 35 percent from 2001. If this growth is sustained, the country's urban population will rise to nearly 110 million by 2035, representing over 50 percent of the total population. Rapid urbanisation is placing severe strains on WASH services. The vast majority (~94%) of the population is served by on-site sanitation technologies, mostly septic tanks and pit latrines, which has significantly increased the volume of faecal sludge over the last decade. Failure to provide long-term household sanitation and FSM solutions

has created a public health risk that will undermine the significant progress made through increased toilet use. The scenario is no better for solid waste disposal: unsafe disposal of municipal solid waste causes severe environmental hazards, particularly in Bangladesh's rapidly expanding cities.

## FSM SERVICES IN BANGLADESH

FSM is now a pressing matter in rural and urban areas of Bangladesh. People are using improved sanitation systems, but sludge and waste from those latrines are polluting the environment. There are no sewerage systems in the towns and municipalities other than in the capital of Dhaka. There is also a lack of faecal sludge treatment facilities, and most on-site sanitation systems, both septic tanks and pits, are emptied manually. Manual emptying is done using buckets, and the faecal waste is transported by vans and carts for discharge in the open spaces or canals. While some municipalities use Vacutags or vacuum trucks, there are not enough to meet demand, and ultimately, the waste is released into the environment untreated. In many areas, especially in cities, most septic tanks and pits are connected directly to the storm drainage system, which is linked to open water bodies within or outside the cities.

According to the regulatory guidance, the Water and Sewerage Authorities (WASA) are responsible for water, sewerage and storm-water drainage in the city corporations where such institutions exist. Currently, only four cities (Dhaka, Chittagong, Rajshahi and Khulna) have WASA. In the cities and towns where WASA are yet to be established, the respective water supply and sewerage departments of the city corporations or municipalities are responsible for water and sanitation services. Under the Local Government Act (2009) municipalities are mandated the management of all types of waste, solid waste, liquid and industrial wastes. The Act also establishes the responsibility of municipalities to identify and provide places for dumping wastes, and instructs city dwellers to follow guidelines on how to dispose of their waste. The Act does not specifically mention faecal sludge, as this requires a different service approach to most other types of waste. The Municipality Act 2009 defines sewerage as drainage, polluted water, rainwater carried by drains and any type of polluted and dirty material carried by canals, again missing out faecal sludge completely.

This gap in the sanitation sector in terms of policy instruments is one of several challenges that the sanitation sector now faces. These include:

- Ongoing use of unhygienic manual emptying
- Lack of well-known and affordable options for transporting faecal waste
- Few options for sludge disposal or productive use of faecal sludge
- The small percentage of sludge treated due to the lack of sludge treatment facilities
- Lack of appropriate sludge treatment plants to ensure a complete and effective sanitation value chain
- Few examples of successful sludge treatment models that can work at scale, and
- Little interest from the private sector due to an absence of profitable business models.

WaterAid Bangladesh now wants to switch focus to concentrate on these on second generation sanitation challenges.

## SANITATION AND FSM IN SAKHIPUR

Sakhipur municipality is about 96 kilometres from Dhaka, the capital of Bangladesh. Covering an area of around 18 $km^2$, Sakhipur became a municipality in October 2000 and has a population of 32,000 people living in a residential area of around eight $km^2$, which translates as a population density of 2,611 people/$km^2$ (2011). In recent years, Sakhipur has been experiencing rapid increase in population, and this, coupled with insufficient waste management strategies, has led to the accumulation of considerable amount of waste in and around the city.

The town does not have a dedicated sewerage system, and on-site sanitation technologies mainly comprise septic tanks and pit latrines of various types. A baseline study in 2015 found identified 5,138 pit latrines, which included 4,510 water sealed pans and 288 septic tanks. In addition, a small-scale decentralised wastewater treatment system (DWTS) is operated in one slum area.

Mechanised systems are not used to empty either the pit latrines that have direct storage in concrete rings or those connected through a pipe to septic tanks. The most common practice is to close a pit when it is full, and dig a new pit. When a pit or tank needs to be reused, professional sweepers are employed to do the emptying. The sweepers manually evacuate the pits and tanks and take the wastes to the disposal points. Due to lack of proper maintenance, emptying and collection services, accumulated sludge from the on-site sanitation units overflows and discharges in nearby open drains, water bodies and forest. This causes a considerable negative impact on public health and harm to the environment.

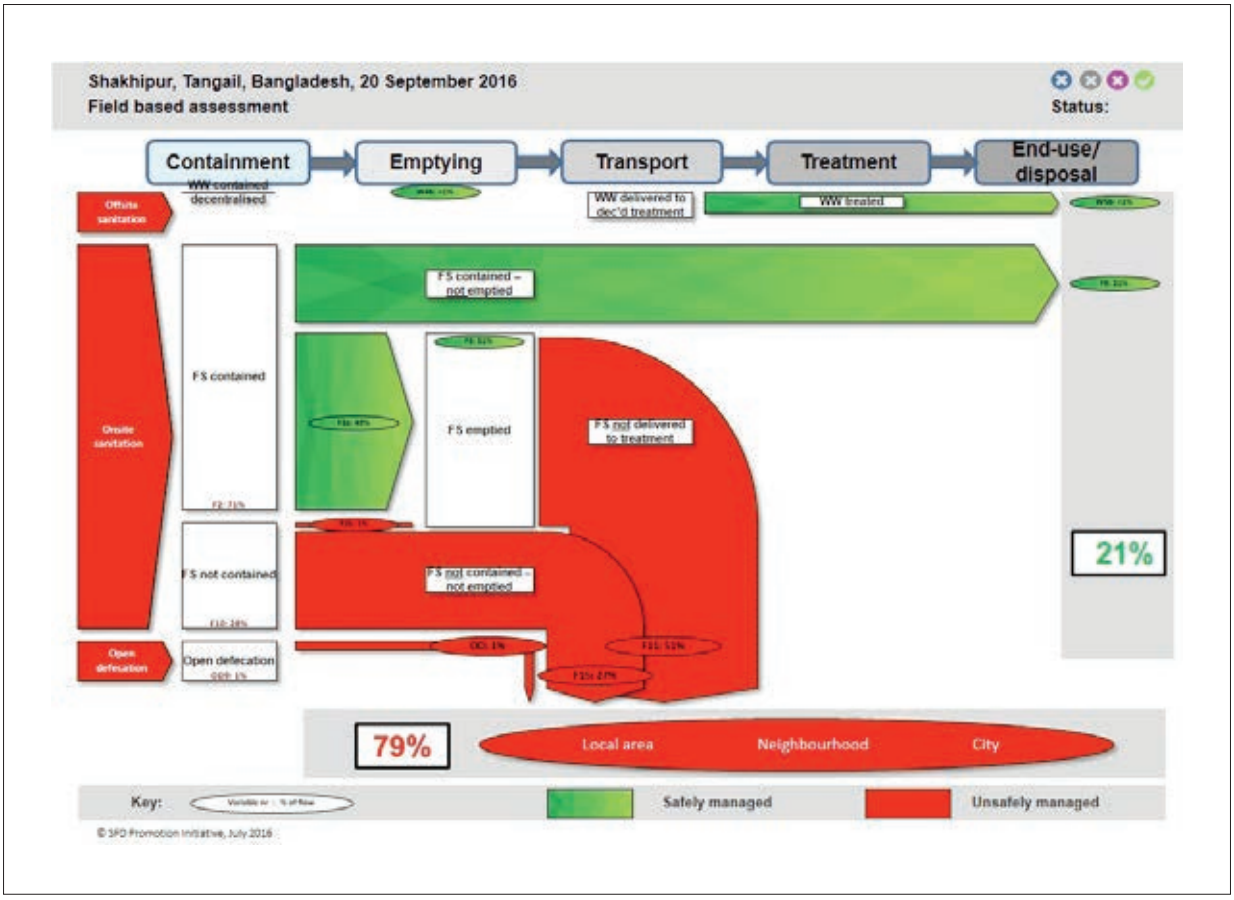



*Figure 1: Fecal Waste Flow Diagram Before Intervention*

Each year, 6,500 metric tons of faecal sludge and 3,500 metric ton of household solid waste is generated. Almost 80 percent of the faecal sludge from the pits or tanks is discharged directly to the environment, either following manual emptying or from overflowing pipes. The Shit Flow Diagram describes the existing situation (Figure 1), where only 21 percent of faecal sludge is disposed safely. It is clear that the absence of a treatment plant has created a gap in the faecal sludge management system.

Solid waste management in the town is also inadequate. There are no dustbins nor any designated waste disposal sites. As a result, city dwellers generally dispose of their household waste in ditches, at the roadside or into drains. The municipality has the capacity to collect about 5.0 tons of municipal solid waste, and disposes of that waste on to land. The municipality has only one truck for solid waste collection and disposal.

Triggered by the significant amount of the solid waste and faecal sludge generated in the municipality, the possibility of combined composting of faecal sludge and organic solid waste was considered by municipal authority, WaterAid Bangladesh and Bangladesh Association of Social Advancement (BASA) during design of the co-composting plant in Sakhipur.

Co-composting means composting of two inputs: organic solid waste and faecal sludge. The newly introduced Vacutug collection and transportation service and co-composting plant launched by the municipality together with BASA and Water Aid Bangladesh are the first initiatives towards modernising transportation and recycling of faecal sludge in Sakhipur.

## SUMMARY OF FSM INTERVENTIONS AND CHANGES

The purpose of the faecal sludge management plant is to contribute to improving faecal sludge and solid waste management, and hence public health. The co-composting plant also created an opportunity to inform scientific and practical knowledge on the technical and operational aspects of co-composting faecal sludge and solid waste in towns in Bangladesh. Analysis of the socio-economic aspects of co-composting, identification of the impacts of using the compost on crops and soil, and raising awareness and knowledge about co-composting as a waste recycling option requires a full-scale plant like the one in Sakhipur. The plant will also train people to operate co-composting plants (capacity development), and inform the occupational safety know-how and practices of


*Figure 2: Schematic of the treatment plant*

pit emptiers, plant operators and others involved in sewerage and waste collection process.

The municipal authority took the lead in meeting the need for faecal sludge management, working closely with WaterAid Bangladesh and its partner, BASA. Representatives of the municipal authority and its elected bodies visited parts of Bangladesh to inspect the severity of the faecal sludge management problem and existing hands-on solutions, in an effort to find appropriate solutions and options for Sakhipur. The municipality leased a 0.3-acre plot of land outside the city centre for the co-composting plant. WaterAid provided technical and financial support and BASA worked as the implementation partner.

Construction work started in 2015, and the plant became fully operational in January 2016. It is already providing useful information for future initiatives.

The technology chosen for the co-composting plant is a three-step process:

- Faecal sludge drying on unplanted drying beds
- Wastewater treatment through a constructed wetland, and
- Aerobic decomposition (composting) of dried faecal sludge and organic solid waste

Transportation is a crucial part of a sanitation system in order to reduce the risk of contamination and ensure proper recycling of sludge. Liquid faecal sludge is collected from septic tanks and pit latrines using a 1,000-litre capacity Vacutug owned by the municipality. The faecal sludge is collected from within Sakhipur municipality and transported to the co-composting plant. The charge for use of the Vacutug is USD 6.50 per trip, for both pits and septic tanks. Depending on size of the pit or tank, several trips may be necessary. The return trip typically takes 45 minutes to an hour on average. The Vacutug is currently operating four days

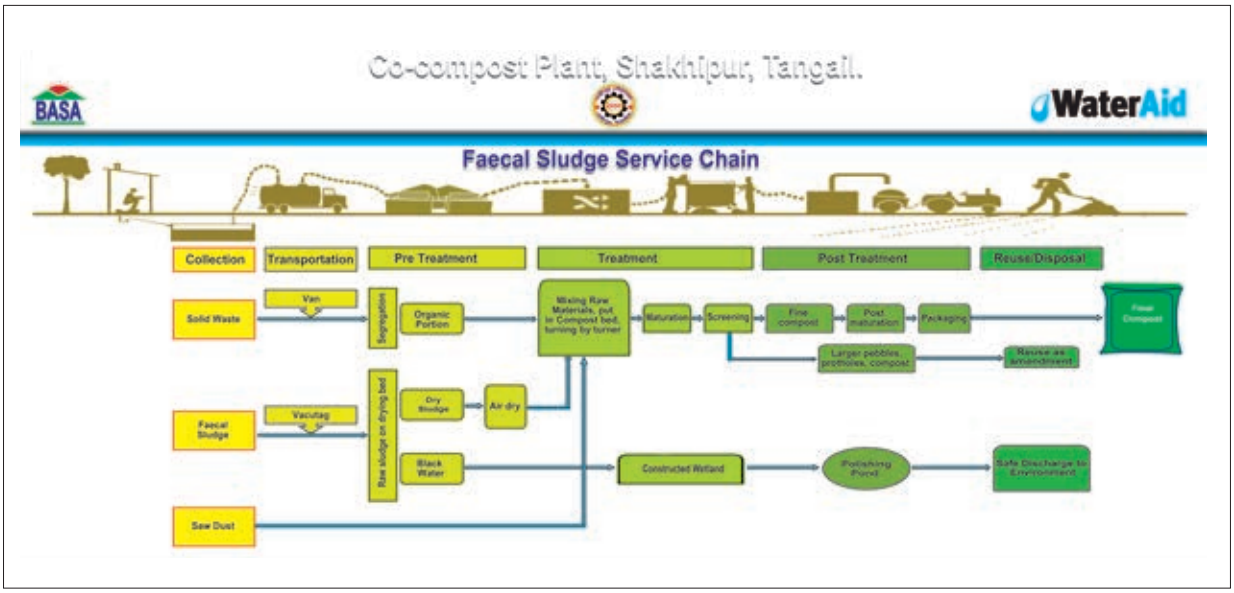



*Figure 3: Faecal sludge service chain in Sakhipur municipality*

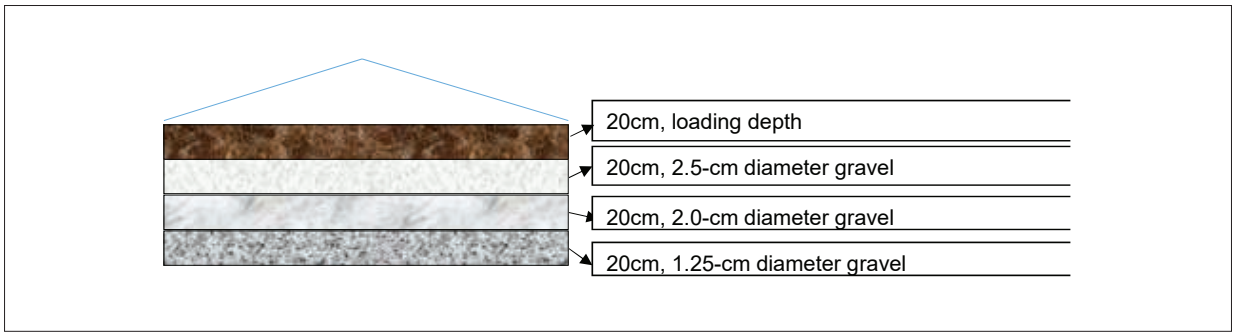



*Figure 4: bed configuration*

a week, and an estimated 16,000l–20,000l of faecal sludge is collected weekly from around sixteen to twenty tanker. In the past year, 800 trips were made to collect faecal waste using the Vacutug. It takes three to five trips to fill one bed, where faecal sludge is kept for 14 days and refilled in cycles.

The plant has ten 9$m^2$-beds, with a loading capacity of 3,000 litres–5,000 litres of sludge each at a loading depth of about 20 cm depending on the concentration of the liquid sludge. The base of the bed is lined with three layers of a gravel-sand filter material of different thicknesses and particle sizes (Figure 4).

The benefits of these beds include needing no electrical power and being built with minimal construction skills and from local materials. The drying process is enhanced by evaporation and gravity percolation. All ten drying beds are protected with a heavy celluloid sheet roof to trap the heat and aid the drying process, and provide cover from the rain. During the drying process, the temperature within the bed is kept at around 50ºC–55ºC during the day in order to killing pathogens and dry the sludge. It takes about two weeks to separate the liquid and solid parts of the raw sludge and achieve significant reductions in pathogens. The dried sludge is then removed from the bed and left in a maturation bed for one week. The liquid part of the raw faecal sludge is dewatered on drying beds and the leachate is further treated in a 12-metre long planted constructed wetland and a polishing pond. The effluent, which complies with Bangladeshi effluent discharge standards, is then discharged into the environment. *Canna indica (Picture 1)*, a perennial plant that grows to height of 0.5m–2.5m high, depending on the variety, is planted out in the constructed wetland to aid evapo-transpiration. Also, hybrid flow (vertical flow + horizontal flow) is maintained throughout the wetland.

The solid waste fed into the plant is collected by the municipality from households for a monthly fee of BDT 40 (USD 0.40) a month. The co-composting plant handles 125 metric tons of solid waste a year, and organic components are screened during the separation process, and the inorganic part is recycled and used by industry. Every week, one composting process is initiated in the plant. The organic solid waste, dried faecal sludge and sawdust are mixed at

*Picture 1: Constructed Wetlands*

*Picture 2: Dry sludge being removing from the drying bed by operators*

a volume ratio of 3:1:1. Sawdust, purchased cheaply from nearby sawmills, is added to increase the solids content and balance the carbon to nitrogen (C:N) ratio. If the C:N ratio is high, decomposition slows down; if it is too low, the compost may become too hot, killing the compost microorganisms.

The mixture is then composted aerobically for eight weeks. Turning, watering, temperature measurement, weighing, sampling and laboratory analysis are carried out during the composting cycle. A customised, locally-made mechanical turner is used to ensure uniform turning of the mixture regularly at three-day intervals. This provides sufficient aeration and increases the nutrient value. If the temperature of compost exceeds 60°C, water is added. Temperatures are recorded three times a day. Thermophilic composting occurs and after eight weeks the compost is removed. The compost is then kept in a post maturation chamber for one week where it undergoes hot air treatment in a hot chamber for 3–5 days to kill pathogens before packaging for agricultural use.

During the composting, a temperature of 50°C–60°C is maintained. The process of turning reduces the temperature. During the eight weeks of composting, the moisture content reduces from 55–60 percent to 25–30 percent, and drops to 20–25 percent during the maturation process. The moisture content settles at between 16 percent and 20 percent after hot air treatment. A screener is used to produce the desired final size of compost.

Laboratory tests at the Soil Resource Development Institute showed that the compost has a C:N ratio in the range 16 to 20, and the average moisture content is around 16 percent. Approximately 24 metric tonnes of compost is produced per year. The municipal authority sells the compost directly to local farmers for BDT 15.00 (USD 0.20)/kg, and the farmers use the compost to produce a variety of vegetables. The

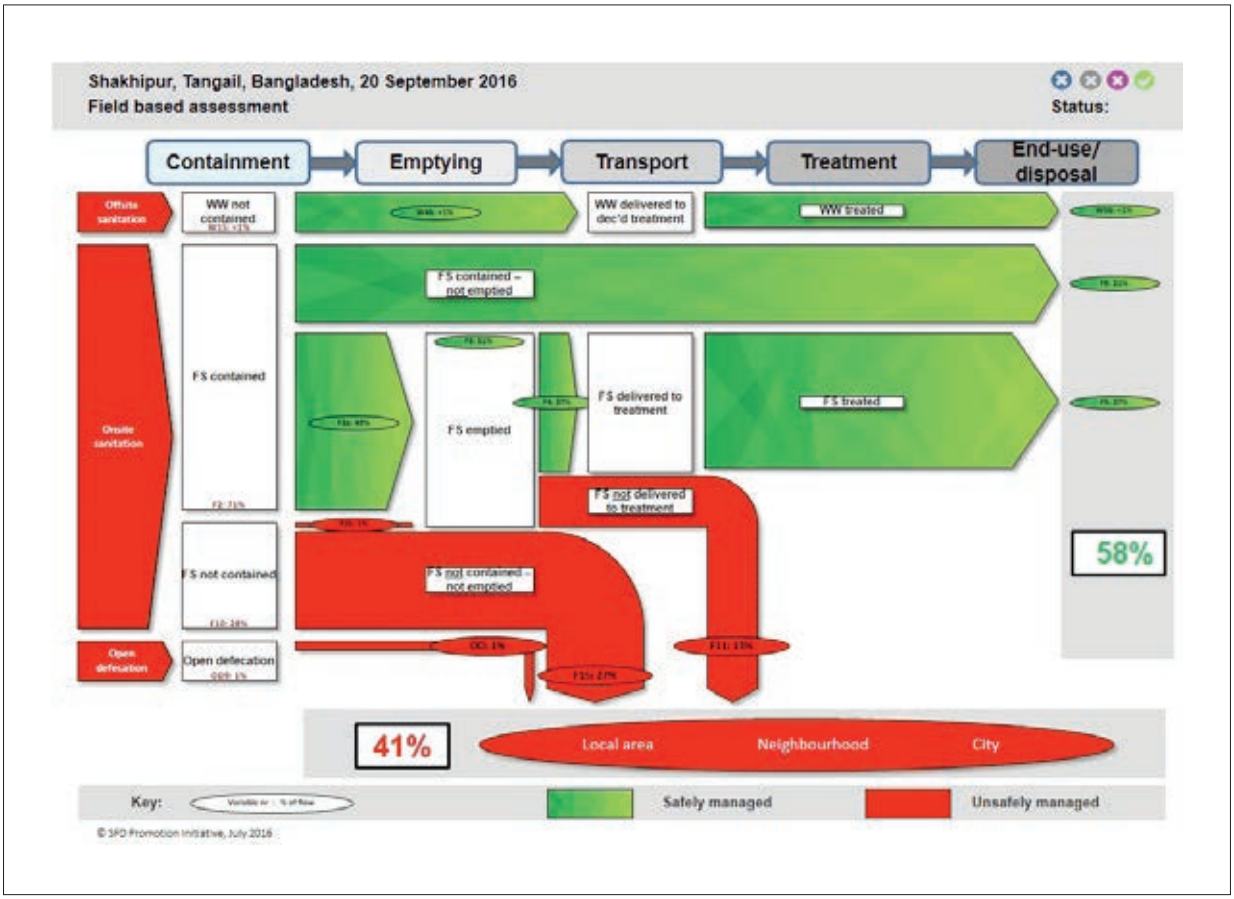



*Figure 5: Fecal Waste Flow Diagram After Intervention*

compost is available in five package sizes: 1 kg, 3 kg, 5 kg and 50 kg. The farmers use the compost as soil conditioner locally and the feedback from the farmers is encouraging, and demand for the compost is high in and around the town. The farmers have used the compost to grow papaya, snake gourd, dhundala, jhinga, pepper, spinach, pumpkin, bottle gourd and bitter gourd in Sakhipur. Recently, the compost has been used to grow 60,000 papaya seeds.

Shit flow diagrams (SFD) developed to quantify the pre- and post- condition of FSM in the municipality revealed that the introduction of the co-composting plant is expected to increase the volume of sludge treated from 21 percent to 58 percent [Figure 5] over two years in the city.

## FINANCIAL AND ECONOMIC ASPECTS

The fee for faecal sludge collection and transportation is BDT 500 (USD 6.50) per trip within the municipality; while clients outside the municipality pay more for the extra fuel. An estimated USD 7,000 is collected annually in fees for these services. An additional USD 6,000 per year has been raised from sales of compost. Operation of the co-composting plant is labour intensive, with a plant supervisor, two solid waste segregators and three personnel working with the Vacutug. Solid waste sorting is the costliest activity, accounting for around 30 percent of the total operation and maintenance cost.

## LESSONS LEARNED

The co-composting plant has experienced few operational problems, including

- **High moisture and pathogen content of the compost produced.** This was solved by introducing a solar-powered hot air blower after eight weeks of composting to reduce bacteria reduction. This is an effective way to get a safer and more stable compost product, as it reduces the moisture content to less than 16 percent, and kills or inactivates most pathogens inside the chamber.
- **In the wet season more liquid sludge is collected**. Demand for collection and transport services is highest during the rainy season, as heavy rainfalls result in overflowing and flooding of on-site systems. Consequently, the volume of dry sludge is reduced which has implications for the composting operation. To keep the dry sludge volume up, the beds are filled up to capacity if necessary.

## CHALLENGES, NEXT STEPS AND PLANS FOR GOING TO SCALE UP

As a new approach for Bangladesh, the challenge is to change the perception of people about the compost. The stigma around faeces and its reuse needs to be addressed. Human waste can be turned into new resources, and Sakhipur provides the evidence in the context of Bangladesh. The compost produced at Sakhipur improves soil fertility, which leads to more satisfactory yields for farmers.

The co-composting plant exemplifies how to effectively deal with solid waste and faecal sludge induced environmental pollution through FSM practice. However, a full-life cycle cost analysis for needs to be carried out to ensure sustainability.

There is a need of advocacy and policy to influence the start up and scale up of such initiatives. The government of Bangladesh has taken steps to develop an institutional and regulatory framework. As for implementing this framework, the policy journey has just begun.

| Annual Cost | | Annual Income | |
|---|---|---|---|
| | Total (USD) | | Total (USD) |
| Personnel: faecal sludge and solid waste collectors | 8,307 | Total revenue from faecal sludge collection and transportation | 5,128 |
| Personnel: plant operators | 5,307 | Total revenue from solid waste collection and transportation | 2,153 |
| Fuel | 4,307 | Total revenue from selling compost | 5,770 |
| Maintenance and others | 2,700 | | |
| Total | 20,621 | | 13,051 |

*Figure 6: Annual Cost and Income*

## NOTES

[1] Sixth South Asian Conference on Sanitation (SACOSAN-VI), Bangladesh Country Paper 2016

## REFERENCES

JMP (2015), Joint Monitoring Program for Water Supply and Sanitation, 2015v Report, accounted at www.wssinfo.org

Cofie, O. and Koné, D. (2009) Co-composting of faecal sludge & organic solid waste

Cofie, O.O., Agbottah, S., Strauss, M., Esseku, H., Montangero, A., Awuah, E. and Kone, D. (2006) Solid-liquid separation of faecal sludge using drying beds in Ghana: Implications for nutrient recycling in urban agriculture. Water Research 40(1), 75-82.

Population and Housing Census 2011 – Bangladesh Bureau of Statistics

Sixth South Asian Conference on Sanitation (SACOSAN-VI) 2016, Bangladesh Country Paper

# Implementing FSM Regulations at City Level: A Case Study of Warangal, India

V. S. Chary, Y. M. Reddy and S. Ahmad

## EXECUTIVE SUMMARY

Warangal is the first city in India to introduce and implement faecal sludge management (FSM) regulations. Evidence-based advocacy, leadership at city level, citizen awareness campaigns, capacity building of stakeholders (particularly mechanised desludging operators) and extensive use of information and communication technology (ICT) tools for monitoring have played an important role in implementing the regulations. In the last year, the city government, through FSM regulation, has successfully introduced: a) licensing and training of masons (as toilet builders) to ensure toilets are built to design specifications, b) site inspection by the sanitation team prior to issuance of building plan approval, c) licences to operate mechanised desludging and service level agreements with private operators, d) use of personal protective equipment by the operators e) a mobile app in vernacular language for record-keeping on desludging, f) a dedicated helpline for citizens seeking support with FSM operations and, g) awareness campaigns on safe FSM and scheduled desludging. A comprehensive property database is being developed to schedule desludging of septage. The city government has also earmarked land and financial resources for a faecal sludge treatment plant (FSTP), demonstrating its commitment to safe FSM. Lessons from Warangal are being scaled up through the introduction of state-level FSM regulations and operational guidelines.

## CONTEXT AND BACKGROUND

In the near absence of a regulated system to manage sanitation across the value chain, over 65 percent of urban India relies on onsite sanitation (septic tanks and pits), resulting in unmanaged faecal sludge. Existing standards on the design of septic tanks and the requirement for periodic desludging are not followed. Emptying and transportation of septage is not based on scientific principles, and most cities have no septage treatment facilities. Indiscriminate disposal of septage has significant health and environmental implications. The Ministry of Urban Development brought out an advisory note and primer on FSM and septage management in urban India in 2013 and in 2016, and encouraged urban local bodies to formulate their own by-laws and rules for management of septage in the city. Recognising the importance of safe FSM, the Greater Warangal municipal corporation (GWMC) took a lead in developing a regulatory framework covering the entire sanitation value chain.

## FSM SERVICES IN WARANGAL

With a population of 610,000 (2011), Warangal is the second largest city in the newly formed state of Telangana, India. The Administrative Staff College of India (ASCI) conducted a detailed diagnostic study in 2015 to understand the condition of FSM in Warangal. It furthered this understanding with continuous interactions and in-depth interviews with FSM operators and functionaries of the GWMC, field visits and focus group discussions with other stakeholders in 2015–16.

In 2015, about 77 percent of households had access to onsite sanitation (59 percent had septic tanks, 18 percent had pit toilets). The design and construction of toilets has not been regulated, and there was a prevalence of insanitary toilets. These pit toilets typically comprise of single or twin pits, and in many cases septic tanks do not have soak pits and have an outlet directly connected to open drains. The existing process of building approval required citizens to submit house construction plans along with the design of the septic tank compliant with standards for construction of septic tanks (National Building Code in compliance with Government Order Ms. No. 168 dated 07-04-2012). However, in practice, this was not done. Further, no field inspections were conducted by GWMC staff to ensure compliance. Field visits undertaken by the ASCI team to three slums (Ambedkar Nagar, BR Nagar and OS Nagar) revealed non-compliance with toilet construction standards, even for toilets newly constructed as part of the Swachh Bharat Mission.

*Toilet directly connected to open drain*

*Dysfunctional pit latrine*

*Figure 1. Insanitary toilets*

Desludging was not periodic, and customers and desludging operators had limited appreciation of the reasons for, and the requirements, standards and operating procedures related to, periodic desludging. The private operators are unregulated by the city government, and GWMC did not offer a desludging service**.** Desludging was being carried out only when the septic tanks were full and the household noticed a backflow. The operators were found to be unaware of and non-compliant with regulations and procedures related to transportation (closing valves, fixing routes, spillages, traffic conditions, etc.). The private operators and their workers, as well as GWMC officials, had no formal training in FSM procedures. Nor was there a process for the formal licensing of operators.

The transportation of faecal sludge collected from septic tanks did not comply with Central Public Health and Environmental Engineering Organisation (CPHEEO)[1] guidelines. The desludging operators/ workers were not equipped with protective gear such as gloves and masks. The trucks were not equipped with any safety kit. Also, manual scavenging using buckets was practised in areas where desludging vacuum trucks could not reach or where the sludge was too thick or solid for the pump to work effectively.

Although the vehicles being used by the private desludging operators were found to be in compliance with design requirements, the operators and workers and had not undergone formal training on the transportation of sludge and associated aspects as required by regulations and procedures. There was no procedure in place for the documentation of the volume of faecal sludge generated, treated and disposed.

The faecal sludge generated in the city was not scientifically treated and disposed. Because there was no sludge treatment plant, the sludge collected from households was being disposed on agricultural land, drains, low lying areas and water bodies around the city. There was no effective process for FSM monitoring by municipal officials due to a lack of operating regulations and supporting guidelines. Hence, there was a need to develop comprehensive faecal sludge management guidelines.

GWMC addressed this multi-faceted FSM challenge by introducing FSM regulations and septage management guidelines in compliance with, and drawing upon, provisions and specifications related to septage management in various national level guidelines and regulations (National Building Code, 2005, revised CPHEEO Manual on Sewage and Sewerage Treatment 2012, Advisory Note on Septage Management in Urban India, 2013 and National Urban Sanitation Policy 2008). The objective of the regulations and guidelines was to promote a comprehensive and integrated approach to FSM and septage management covering collection, storage, desludging, transportation, treatment, disposal and reuse. GWMC formalised the FSM regulations and supporting operating guidelines by issuing a council resolution on 25 March 2016, making Warangal the first city in India to introduce a comprehensive FSM regulatory framework.

The guidelines cover the following key elements of septage management:

- Design and construction of septic tanks
- Conversion of insanitary latrines into sanitary latrines
- Septic tank pumping and desludging
- Septage transportation
- Treatment, disposal and reuse of septage
- Information, education and communication
- Training programs
- Record keeping and reporting (MIS)
- Helpline for septage management (S-Line)

## IMPLEMENTING REGULATIONS – FSM INTERVENTIONS AND CHANGES

The city has developed an institutional framework defining the roles and responsibilities of stakeholders, and enforcement and monitoring strategies for successful implementation of FSM systems. During the last year, the city government has taken several initiatives:

**Improving design and construction of septic tanks:** Adoption of improved designs of septic tank for households. Also the use of advanced three-chamber septic tanks and decentralised waste water treatment systems (DEWATS) by institutional and bulk consumers such as hotels, colleges and apartments etc. This is being achieved by adopting regulations on septic tank designs and construction methods as part of building plan regulations. As a first step, the building plan approval process has been reengineered so that the town planning department and/or sanitation department of the municipal corporation approves the design at the time of approval of building plan, and also inspects the septic tanks during their construction to ensure that there are no deviations from the approved design.

**Conversion of insanitary latrines into sanitary latrines:** The corporation's public health department has completed a survey of all households to identify insanitary latrines and improperly constructed septic tanks. This information will be used to educate households with insanitary toilets, and give them notice to refit their toilets to comply with approved designs. Funding support of USD 90.00 is being made available to households for the conversion.

**Septic tank pumping and desludging:** GWMC has established a formal process for licensing of desludging operators and has issued licences for collection and transportation operations since 26 October 2016. The licence is valid for five years and needs to be renewed every year. While the GHMC reserves the right to regulate and fix the user charges, it has decided to let the process be market determined. Currently an operator charges anywhere between INR 2,000 and INR 3,000 (USD 29.00 to USD 44.00) per visit. Households are encouraged to engage operators that are licensed for collection and transportation to desludge. The GHMC has written to the police commissioner requesting that unlicensed operators be arrested and their desludging

*Desludging operators have no safety equipment for desludging septic tanks*

*Disposal of faecal sludge*

*Figure 2. Faecal sludge transportation and disposal processes in Warangal*

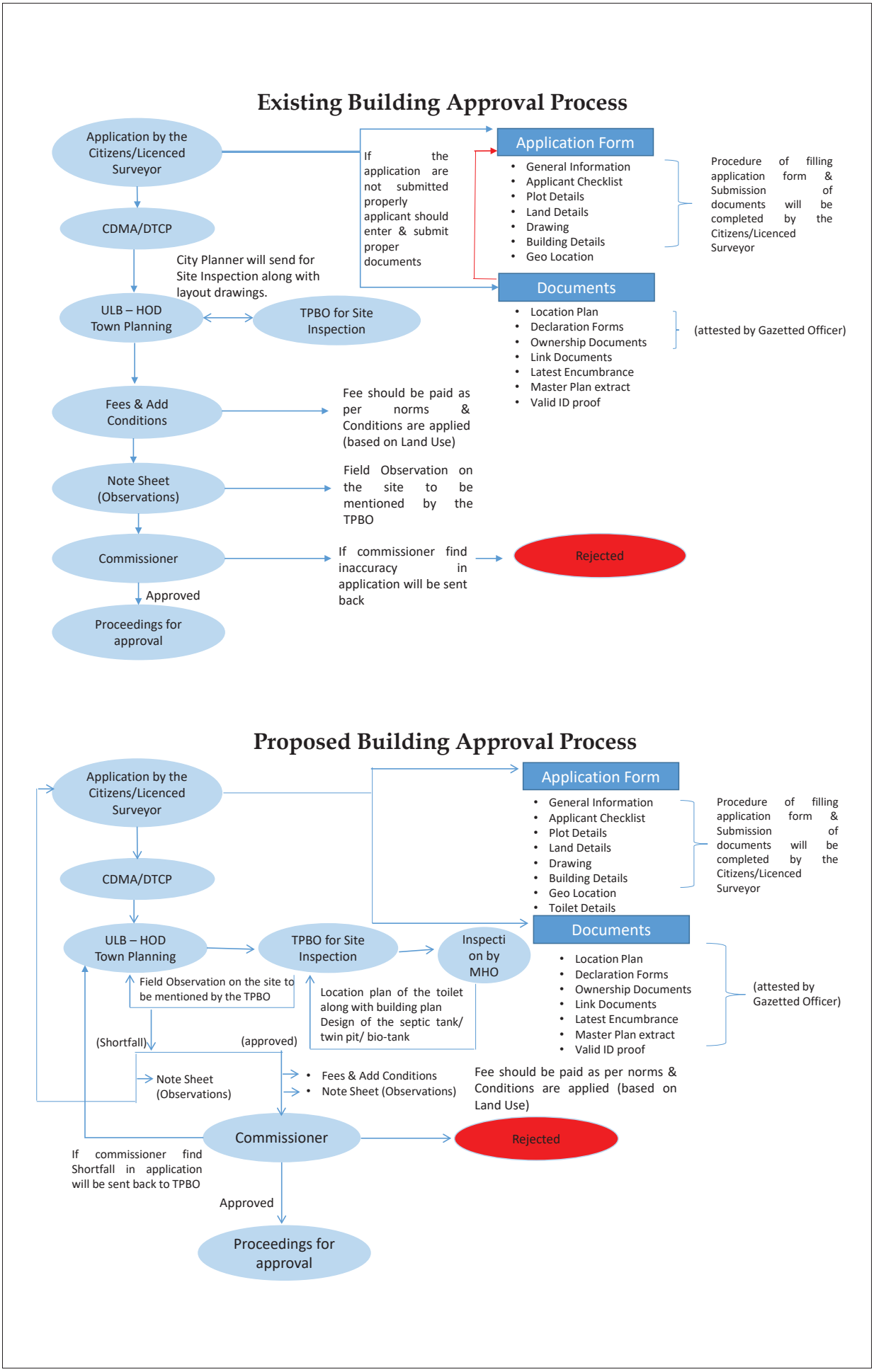



*Figure 3. The former and revised for building plan approval processes*

vehicles confiscated. Multiple rounds of training and demonstrations have been organised to explain the approved standards and procedures for pumping and desludging and the use of personal protective equipment (PPE). A supplier of PPE for the operators has been identified.

**Septage transportation:** The licensed desludging operators have vehicles that meet the approved standards for desludging and transportation. The vehicles are fitted with GPS, which GWMC uses to track and monitor vehicles. The trucks have trained workers equipped with uniforms, safety gear, tools and vacuum trucks.

**Treatment, disposal and reuse of septage:** A series of interactions with technology vendors has identified suitable technology that is legally compliant. GWMC has identified blocks of land that meet environmental requirements and standards for construction of the septage treatment plant. An appropriate financing model involving PPP for construction and operations and maintenance of septage treatment and disposal facilities is being finalised. Sludge is treated by anaerobic stabilisation, and then dried on unplanted drying beds. The liquid fraction is treated by DEWATS, using settler, anaerobic filters and constructed wetlands. The by-products such as bio-solids can be

File No.HLTH-GEN/20/2016-SR AST1 HLT HOF

PROCEEDINGS OF THE COMMISSIONER (FAC) :: GREATER WARANGAL MUNICIPAL CORPORATION

Present: Sri Shahid Masood, B.Com,

Rec.No.HLTH-GEN/20/2016/Permit-01/2016 Dated:27-10-2016.

Sub: Greater Warangal Municipal Corporation – Public Health Branch – License for collection, Transportation and disposal of septage - Orders – Issued.

Ref: Your application dated 02/09/2016

ORDER:

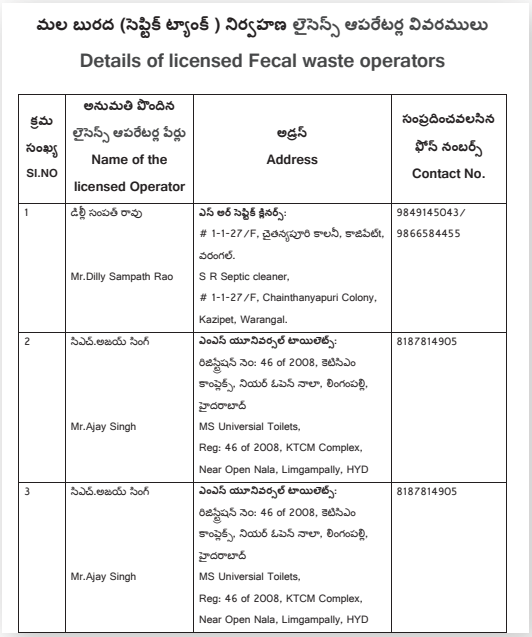
In accordance with all the terms and conditions of the By-laws / Regulations, Municipal Corporation Act/Rules, the special license conditions accompanying this license and applicable rules and laws of Government of Telangana, permission is hereby granted to

Shri. Ch.Ajay Singh S/o. Sarwan Singh is hereby authorized to undertake desludging of the septic tanks and pits from the individual households, institutions, commercials entities and to transport for disposal at a designated site as certified by GWMC duly following the "Operative Guidelines on Septage Management (Collection, Transportation Treatment and Disposal) in Greater Warangal Municipal Corporation (GWMC) - 2016".

Municipal Health Officer
Greater Warangal Municipal Corporation

To
Copy to the Deputy Commissioner-II (Sanitation), GWMC
Copy submitted to the Commissioner, GWMC for favour of kind information.
Copy submitted to the Hon'ble Mayor, GWMC for favour of kind information.

Signature valid



**మల బురద (సెప్టిక్ ట్యాంక్ ) నిర్వహణ లైసెన్స్ ఆపరేటర్ల వివరములు**

**Details of licensed Fecal waste operators**

| క్రమ సంఖ్య SI.NO | అనుమతి పొందిన లైసెన్స్ ఆపరేటర్ల పేర్లు Name of the licensed Operator | అడ్రస్ Address | సంప్రదించవలసిన ఫోన్ నంబర్స్ Contact No. |
|---|---|---|---|
| 1 | దిల్లి సంపత్ రావు<br>Mr.Dilly Sampath Rao | ఎస్ ఆర్ సెప్టిక్ క్లీనర్స్:<br># 1-1-27/F, చైతన్యపురి కాలనీ, కాజీపేట్, వరంగల్.<br>S R Septic cleaner,<br># 1-1-27/F, Chainthanyapuri Colony, Kazipet, Warangal. | 9849145043/ 9866584455 |
| 2 | సిహెచ్.అజయ్ సింగ్<br>Mr.Ajay Singh | ఎంఎస్ యూనివర్సల్ టాయిలెట్స్:<br>రిజిస్ట్రేషన్ నెం: 46 of 2008, కెటిసిఎం కాంప్లెక్స్, నియర్ ఓపెన్ నాలా, లింగంపల్లి, హైదరాబాద్<br>MS Universial Toilets,<br>Reg: 46 of 2008, KTCM Complex, Near Open Nala, Limgampally, HYD | 8187814905 |
| 3 | సిహెచ్.అజయ్ సింగ్<br>Mr.Ajay Singh | ఎంఎస్ యూనివర్సల్ టాయిలెట్స్:<br>రిజిస్ట్రేషన్ నెం: 46 of 2008, కెటిసిఎం కాంప్లెక్స్, నియర్ ఓపెన్ నాలా, లింగంపల్లి, హైదరాబాద్<br>MS Universial Toilets,<br>Reg: 46 of 2008, KTCM Complex, Near Open Nala, Limgampally, HYD | 8187814905 |


*Figure 4. Licensing documentation for desludging operators*

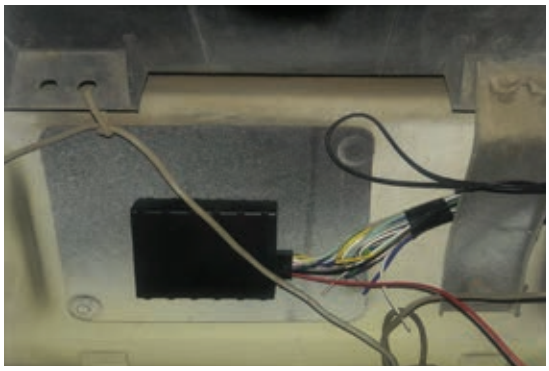
reused in agriculture as soil conditioners, and treated water can be used for irrigation or safely disposed into nearby water bodies. Co-treatment with municipal solid waste (biomethanation) is also being considered.

A detailed project report on the development of a treatment plant with a daily capacity 16 kilolitres has been prepared by the DEWATS Dissemination Society (CDD) consortium in association with ASCI, and was presented to GWMC in early January 2017. The estimated capital expenditure for this project is USD 300,000, and the annual operation and maintenance expenditure is an estimated USD 17,000. Development of the treatment plant will require a 4,600 $m^2$ plot of land.

**Information, education and communication:** GWMC has held awareness generation camps in slums and non-slum areas, and established sanitation resource centres in some slums, to promote adoption of proper toilet designs, construction methods, periodic desludging and safe sanitation practices. Workshops have been held with masons, builders and desludging operators to expose them to better designs and better methods of construction. Posters have been displayed at public toilets and on septic tanks to raise awareness and provide a channel for citizens to seek information. School children have been involved in information, education and communication (IEC) campaigns. Resident welfare associations are engaged to promote safe FSM practices.

**Training programs:** GWMC is supporting capacity building of stakeholders, including its own staff, through appropriate institutions of repute, such as the Kakatiya Institute of Technology and Science Warangal, ASCI and CDD. An organisational strengthening and training needs assessment has been commissioned with KITS to identify the training and capacity building requirements of different stakeholders. To influence the quality of toilet construction, CDD has been engaged to design and deliver a 'toilet builder' training programme leading to certification and licensing of masons. More than 70 masons have been licensed so far and their details are shared with citizens.

**Record keeping and reporting (MIS):** GWMC is building a data and information base of septage generation from households and commercial establishments, insanitary latrines, location of septic tanks, details of operators responsible for collection of desludge, and details of the septage treatment plant. Septage



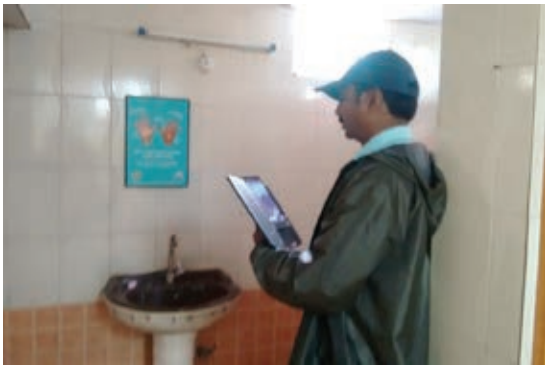
*GPS tracker inside a vehicle*

*FSM vehicle location: red arrows show locations of vehicles*


*Vehicle route map: Route is marked in red, blue arrows indicates the direction in which vehicle travelled*

*Figure 5. GPS tracking of septage vehicles*

*Mason training programmes*

*Sanitation improvement workshop for sanitation inspectors*

*Desludger operator training in PPE and use of the FMS tracker mobile app*


*S-Line campaigns*

*Figure 6. IEC initiatives and training programmes*

*Involving the community*

*Figure 6. IEC initiatives and training programmes*

vehicles are being fitted with GPS, and the data generated is being used by GWMC for monitoring. An FSM tracker mobile app in vernacular language has been developed to capture information on septage collection in real time and aid effective implementation of the regulations. All licensed operators are required to report information as required by the manifest defined by GWMC. Detailed records of the operations, including households, area and location, type of septic tank, age of septic tank, date of desludging, quantity of septage, user charges collected, accidents and spillages, and the next date of scheduling for desludging are being maintained. A system linking information gathered through the mobile app to the city's property database is being developed to ensure scheduled desludging.

**Septage management helpline:** GWMC has set up sanitation helpline (S-Line), a single point of contact for citizens to reach out for FSM related services. GWMC's existing toll-free phone line has been extended to include: (a) request for new toilets, (b) technical support for construction of toilets (design and building materials), and for trained and licensed masons etc., (c) public services and grievance redressal, including information about accessing desludging services and filing complaints and offering suggestions about the provision of public toilet facilities. The system is now IT-enabled, and S-Line services are institutionalized under the GWMC IT department, which works closely with the city's sanitation and town planning departments.

Launched in May 2016, S-Line has become popular and on an average receives 45 requests every day. In the pilot phase of 4 months, 542 grievances were redressed and technical assistance provided to all the 160 callers. The successful pilot is being scaled up city wide to make Warangal a model sanitation city.

## DRIVERS OF CHANGE

The key triggers that enabled the situation to change in Warangal were:

- **Evidence based advocacy:** Compelling evidence, gathered through a diagnostic study of FSM practices revealing their potential public health and environmental risks and inverse linkage to health, was shared extensively with city stakeholders and state government. Bringing evidence to the public domain was a wake-up call and led to stakeholder consensus for action.
- **City level leadership:** Committed leadership at state and city level that recognised the urgent need to address unregulated septage management practices. Introduction to national and international good practices through exposure visits led to confidence building.
- **Environmental concerns:** Evidence of contamination of drinking water bodies in the pathway of faecal waste disposal areas as reported by local media prompted a public outcry for action.
- **Civil society participation:** Active dialogue with resident welfare associations, city sanitation task

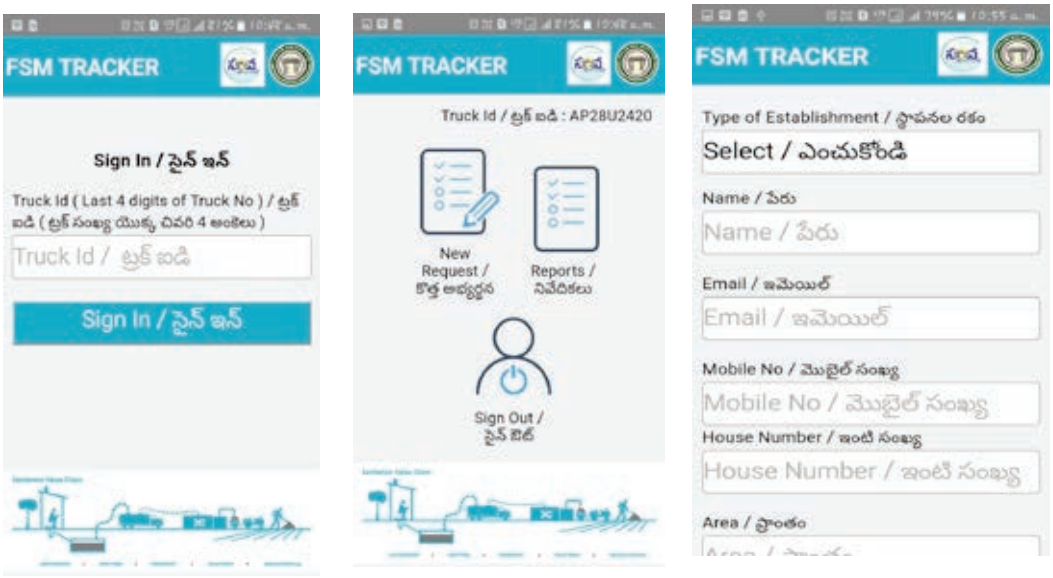
force members, town-level federation members, non-governmental and private sector players led to ownership of FSM initiatives and acceptance of new practices.

- **Active support of desludging operators:** Two major private desludging operators with eight trucks service the city. Operators experienced difficulties disposing the sludge due to growing citizen vigilance. Prior to introduction of regulations, they made a representation to the city government to earmark land for sludge disposal. Operators welcomed regulation and asked the city government to prioritize FSTP. Another reason for their support is the perceived risk to their business from small-time operators (involved in manual/semi manual desludging) and the need to create a level playing field.

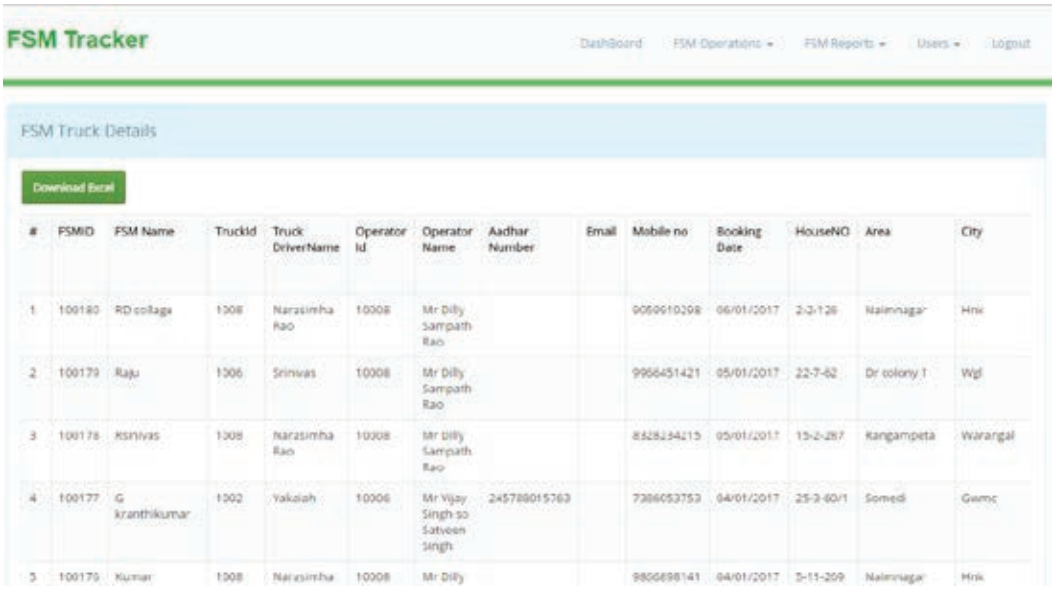
## LESSONS LEARNT

Lesson learnt during the first year of implementing FSM regulations in Warangal are:

- **Urgency to establish faecal sludge treatment plant** Because of delay in establishing the FSTP, operators continue to dispose sludge in an unregulated manner and citizens have not seen significant change.




*FSM Tracker app downloadable from the Google Play store*




*The FSM Dashboard provides real time information for analysis and decision making*

*Figure 7. FSM tracker and dashboard*

Technology selection process, DPR preparation and earmarking of land for a FSTP should begin early on in the project cycle, and the FSTP should be prioritised and implemented concurrently with other components of regulations.

- **Site selection for the FSTP**
  The land parcel identified for FSTP is more than 20 km from the city limits. Selection of suitable land parcel(s) closer to the market, preferably within 10 km, will enhance compliance and improve the financial viability of the initiative.
- **Defining institutional arrangement for FSM**
  There is no clear assignment of roles and responsibilities of stakeholders for safe management of faecal sludge. State government could play an enabling role and define upfront the responsibilities of citizens, GWMC, the Pollution Control Board, civil society groups etc. Further, for FSM activities to be successful, organisational structure and staff responsibilities at the municipal level should be clearly defined.
- **Strengthening data systems at municipal level.**
  The city level data systems with regard to toilet coverage, toilet typology, property numbers are disorganized and hindering effective planning of FSM. It is important to strengthen data systems using Geographic Information System (GIS) tools to enable effective planning and for introducing scheduled desludging of toilets.

## WAY FORWARD

Following the successful enactment of FSM regulations, the city is geared up to address outstanding challenges by undertaking various initiatives along the sanitation value chain:

- **Establishing an FSTP:** A detailed project report for the FSTP has been prepared, land and financial resources have been earmarked, and a technology partner has been identified. The PPP model with an SLA is being considered for the FSTP.
- **Introducing city-wide global information system (GIS) mapping:** International best practices have been identified, consultants and technology have been found, and mapping households and linking the data to desludging schedule has been carried out.
- **Conversion of insanitary to sanitary toilets:**
  The city has appointed nodal officers for each of its 58 election wards for better supervision and coordination of works. S-Line is being scaled up to expedite processing of applications, funds disbursal and toilet construction/repair.
- **Conducting awareness campaigns** involving RWA, bulk generators and municipal functionaries, emphasising the need to convert insanitary to sanitary toilets, periodic desludging practices etc. Monitoring environmental quality around existing disposal areas to sensitise residents is also planned.
- **Monitoring desludging operators** to ensure usage of (PPE) and other commitments outlined in SLAs is a must. The city has appointed a sanitary officer responsible for monitoring desludging operators. Study tours and exposure visits are being planned for the desludging operators.
- **Regulating prices to attract citizens** may be prudent going forward. Currently, the prices charged by the operators is market determined. But as the number of operators grows and periodic desludging is set into motion, regulating prices could be considered.
- **Enforce strict restrictions** on the growing number of non-licensed operators and impose fines for non-compliance with scheduled desludging by households and bulk generators.

Innovative processes and solutions (S-Line, co-treatment of faecal sludge and municipal solid waste, the FSM tracker and GPS systems in desludging trucks to name just a few) are being piloted and scaled up. Concerned evidence based advocacy indicates an encouraging response from stakeholders. The city is poised to address challenges, deepen implementation and earmark financial resources. PPP models are also being considered. Lessons from Warangal are being scaled up across the State of Telangana through the introduction of state-level FSM policy and operational guidelines. Representatives of cities in India and overseas have visited Warangal to witness its success in FSM, and learn lessons for their mutual benefit.

## NOTES

[1] Central Public Health and Environmental Engineering Organisation (CPHEEO) is the technical wing of the Ministry of Urban Development, Government of India

## REFERENCES


Ministry of Urban Development (2013).Septage Management in Urban India: Advisory Note

CPHEEO (May 2012). Manual on Sewerage and Sewage Treatment: Part A: Engineering – Final Draft, Ministry of Urban Development, Government of India in Collaboration with JICA, New Delhi

ASCI (2015). Report on City-Wide Plan and Technical Proposals through PPP for Delivery of Sustainable and Equitable Sanitation Services in Warangal Phase-1

Ministry of Urban Development (2016). Primer on Faecal Sludge and Septage Management


## ACKNOWLEDGEMENTS


Greater Warangal Municipal Corporation, Warangal

Municipal Administration & Urban Development, Government of Telangana

Rotary International

Resident Welfare Associations

Mission for Elimination of Poverty in Municipal Areas

Bill and Melinda Gates Foundation

# Introducing Regular Desludging in Balikpapan, Indonesia

R. F. Siregar and M. Listyasari

## EXECUTIVE SUMMARY

Balikpapan city has been making significant progress in improving septage management in the last three years. This started when the city government appointed the city water utility to take responsibility for off-site and on-site systems.

The main outputs so far are: 1) three approved regulations on domestic wastewater including both off-site and on-site systems, 2) on-site sanitation censuses in selected locations, conducted and funded by the city water utility prior to piloting regular desludging, and development of a database that links to the existing city water customer database, 3) development of a single-billing mechanism for water supply and regular desludging, 4) a new tried-and-tested system that makes use of an ICT application for regular desludging operations. One cycle of desludging promotion has been carried out by the local sanitation promotion team and completed in the pilot area.

The commitment of the city's leaders, strong leadership from the local planning board to develop close and intensive coordination among sanitation agencies and local government offices have played a key role in moving on the septage management programme in Balikpapan.

The city water utility, with support from local planning board and other agencies, will need to continue to trial the implementation of planned regular desludging in the pilot area, and with lessons learned and experience gathered from the first pilot, scale up to wider area with a better plan. It is important that septage management is incorporated into the local government's sanitation strategy and plan, and in the city water utility's business plan, in order to maintain the sustainability of the improved septage management programme.

## BACKGROUND

More than 80 percent of urban Indonesians have access to household sanitation, with 73 percent of facilities classified as improved and 10 percent as shared (UNICEF/WHO, 2012). Almost all are on-site systems, with excreta flushed from a water-seal toilet to a leach pit and separate sullage discharged to a nearby drain. In recent years, the government and other stakeholders have also built numerous small-scale local sewerage schemes connected to decentralized wastewater treatment facilities (DEWATS). In all these systems, faecal sludge accumulates in the pit or tank and must eventually be removed and treated.

Recognizing the need for improved septage treatment, the Directorate General of Human Settlements at the Ministry of Public Works (MoPW) is currently rebuilding or renovating septage treatment facilities in more than 100 cities. Unfortunately, only around 10 percent of the existing 150 sludge treatment facilities constructed in the 1990s were still functional, and less than 4 percent of Indonesia's septage was treated at a treatment plant (AECOM and SANDEC, 2010). In the light of this, the MoPW requested technical assistance from the World Bank and USAID to develop improved septage management systems.

This paper summarizes lessons learnt from Balikpapan, a World Bank assisted city in East Kalimantan. The city has 664,600 inhabitants comprising 132,919 households. Per capital gross regional domestic product in 2015 was IDR 120,320,000 (USD 9,047) (Balikpapan Statistics Office).

## INSTITUTIONAL SET-UP OF THE WASTEWATER SECTOR IN BALIKPAPAN

Prior to 2014, there were no regulations concerning the institutions responsible for domestic sanitation or the authority to manage domestic wastewater in Balikpapan. In practice, however, the municipal agency in charge of cleanliness, parks and cemeteries managed the septage treatment facility, because it was the agency responsible for the solid waste management system, which included leachate treatment. The septage treatment plant was built by the national government in 1995, next to the solid waste leachate treatment plant.

The Balikpapan municipal water utility was appointed in 2001 by the city government to take on the job of managing a small sewerage system designed for 5,000 houses, built by the national government in 2000. Despite a lack of legal support, by 2014, 1,380 houses were connected to the system. Following an audit in 2014, local government was urged to formalise the mandate of the municipal water utility to manage the wastewater system. The Balikpapan local government and city council agreed, and the new local law names the municipal water utility as the institution responsible for managing both the water supply system and the domestic wastewater system.

With this new regulation in place, a multi-departmental city sanitation working group approached city leaders and other main stakeholders advocating that the domestic wastewater system be planned and managed in an integrated and holistic way and include both off-site and on-site systems, and that this would be most efficiently managed by a single institution.

The municipal water utility subsequently agreed to set up an internal ad-hoc team to bridge the process of transferring responsibility for septage management, including the septage treatment facility at the landfill site, to the city water utility.

After around 15 months of discussions among agencies, within the municipal utility, at local government level and later with the city council, an agreement between the parties was finally reached.

## NEW LOCAL LAWS ON DOMESTIC WASTEWATER

Circular letters from the city's mayor in 2015 and 2016 were used as a reference by the municipal water utility, the city planning board and other agencies to discuss the preparatory work and draft the local law and decree of the mayor on domestic wastewater management, including septage management.

Two local regulations have now been issued, one in December 2014 and the other in October 2016, along with implementing regulation concerning domestic wastewater, issued in November 2016. The 2014 local regulation confirmed the municipal water utility as the sole institution responsible for wastewater management in Balikpapan city.

The October 2016 regulation stipulates integration of off-site and on-site systems. Where sewer pipelines have been installed in an area it is mandatory for all premises to connect to the sewer. In areas without sewerage systems, building owners have to build a septic tank that complies with the government technical standards, and desludge it regularly. The sewered areas are defined by local government and the city water utility and will be expanded incrementally based on local government plans. The regulation also requires that a decentralised communal sewerage and wastewater system with 50–100 connections be emptied regularly.

The mayor has most recently implemented a regulation covering the responsibilities of city government, the city water utility, private operators and households. For example, an on-site sanitation system is one of the requirements for issuing building permit; households must provide an access lid and no structure is to be built above the access hole; on-site systems must be desludged every 4 years; and septage must be disposed of in a septage treatment plant owned by the city government and managed by city water utility.

Regular emptying schedules and on-demand tariffs will be established by decree of the city water utility.

## FINANCIAL ASPECTS

**Tariff and payment mechanism**

Calculation of the regular and on-demand desludging tariffs take into account all expenses, including overheads, septage transportation and septage treatment costs. The city water utility will cooperate with private companies interested in supplying regular and on-demand emptying services. One of benefits is that this mechanism reduces capital investment in vehicles.

The desludging tariff is paid monthly over four years, charged in the monthly water bill of the city water utility's customers. This means the tariff for regular desludging depends on the customer's water tariff. The average charge is IDR 9,500 (USD 0.71) per month per household. The fee for on-demand emptying is higher than the total paid over four years for regular desludging to make the latter more attractive to households. Over the four-year period, the total payment for regular desludging is IDR 456,000 (USD 34.00), while the proposed tariff for on-demand emptying is IDR 550,000–IDR 600,000 (USD 41.00–USD 45.00). The city water utility has prepared a draft regulation on monthly fees for regular emptying, which will be finalised in the coming months.

The city water utility has to provide a budget to fund the private operator to provide regular desludging. Because the final payment will not be collected until the end of the fourth year, this money will be used to fund the payment gap. This means that annual projections for regular desludging need to be made, and incorporated into the utility's business plan.

The private operator has been providing on-demand emptying for three years, and the average charge for customers is IDR 500,000–IDR 600,000 (USD 38.00 to USD 45.00) per emptying, depending on the distance from the household to the sludge treatment site. Currently, the local government provides treatment of septage delivered by the private operator free of charge.

However, in the short term, only the utility's customers can benefit from the regular desludging service. The households which are not connected to the piped water system can use the on-demand desludging services provided by the utility in partnership with private operators.

The city water utility is considering options and payment mechanisms that could apply in the future to other customers who want a regular desludging service. Currently, the city water utility has a customer base of 95,249 households, and it covers 76 percent of the service area. This means that there is still a large potential market for the utility for regular desludging services. However, it may be years before this market can be served.

**Private sector engagement**

The private sector will have key role in emptying and transportation for regular desludging and on-demand desludging. The city water utility will work together with selected private operators, and draw up agreements for regular emptying services that would offer a win-win arrangement for both parties. The tanker will empty two septic tanks per trip, before transporting and unloading the septage at local government's septage treatment plant, which is managed by the city water utility. These partnerships will benefit private tanker operators by providing them guaranteed work and more orders than they have at present. For the water utility, the agreements will not only reduce its capital investment in vehicles, but also ensure that private tankers are registered and dispose of their sludge into the treatment plant.

The current arrangements for on-demand emptying will continue, with the private operators conducting business with their own customers. The city water utility is currently developing a mechanism and system to ensure that private operators transported sludge to the septage treatment plant, and for this to happen, the operators must meet certain criteria. as stipulated in the new regulation (PERDA 8/2016), private operators will be charged each time they unload.

**Payment to private desludging operators**

Payment for private sector services will be made weekly or monthly, depending on the agreement between private operator and water utility. The two parties have been negotiating a draft agreement, criteria, fees, and the payment mechanism and period. The private operators will be paid based on the number of work orders executed, which must be verified by the water utility using an ICT application, customer signatures and proof of the number of trips on that day to the treatment facility.

## PLAN FOR PILOTING REGULAR DESLUDGING

**Selected pilot area**

The pilot area selected by the city water utility and the Balikpapan multi-departmental sanitation working group was part of two city sub-districts. The main criterion was that the majority of households were city water utility customers. Other households were excluded from this pilot because further analysis to identify an appropriate payment mechanism is needed, and they will be using on-demand FSM services.

**On-site sanitation census in the pilot area**

The census of 1,100 households made use of an Android app to minimise data entry and provide more accurate in results. This took less time than a manual survey, although the network connection was a challenge in the city. However, the data collectors were able to save the data on their mobile phones and send it when network connection was available.

The system installation and trial of the application was carried out in August 2016 to ensure that the system ran well prior to implementation. The city water utility team were trained as trainers of the data collectors who were recruited from the local university. The trainers were equipped with tutorial materials and manuals on use of the Android app connected to the utility's database system; understanding of the content of the census tools; tips on interviewing respondents; and guidelines for conducting technical surveys, such as taking tank measurements.

The results of the on-site sanitation census can be used not only by the city water utility but also by other agencies for other sanitation programs, such as the national government's output-based aid programme to upgrade existing sub-standard sanitation systems owned by low income-household, and the open-defecation free programme, and as a primary data source for planning communal decentralised wastewater treatment systems (DEWATS).

All of the 1,101 households surveyed owned their toilet, 98.5 percent (1,085) of households were city

water utility customers, and 99 percent (1074) had an on-site system. However, of those with an on-site system, only 30 percent (325) had an access lid for emptying and only 46 percent of those (152) could be opened. On-site systems that had no access lid were typically buried under ceramic floor tiles inside the house. This is generally because an additional room has been constructed over the septic tank and the access hole has cemented in place to prevent smells leaking from gaps in the access cover. There is also a widely-held perception that septic tanks do not need to be emptied or that they take a very long time to fill up.

Only 133 septic tanks of 1074 surveyed (12 percent) had ever been emptied. This figure includes four tanks that are regularly desludged more than once a year, because they are small or because they get full quickly in the rainy season. This low emptying rate is understandable, as the survey results revealed that 67 percent of the systems had an overflow connected to nearby drain, and 87 percent of the systems had never been emptied.

**Planning for piloting regular desludging**

The city water utility will calculate the number of tank emptyings per week or per month, assuming two emptyings per trip for tanks with an access hole. They will work through the private sub-contractors and the contractors then make any further arrangements with the households to confirm the timing of the service.

The operation would be more efficient if the emptying locations are organised to be as close to each other as possible, can be reached by the one truck, and have a total emptying volume of 1.5 $m^3$ per location.

The capacity of the newly built septage treatment is 15 $m^3$/day. On-demand emptying currently accounts for one or two trips or approximately 6 $m^3$/day. The remaining capacity that can be used for regular desludging is no more than 9 $m^3$/day or three trips/day. One tanker can do two trips per day to serve four households, which means that in less than two months, the 152 households can be served for the first batch pilot.

The immediate step required is to promote to households that have a covered access hole or no access hole the need to provide an access hole that can be opened, as this is now mandatory under new regulations (PERWALI 24/2016).

## INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) APPLICATIONS IN SEPTAGE MANAGEMENT

The system is designed to support the operation of services, including the drawing up emptying schedules, tracking and monitoring sludge tanker movements for regular emptying, and ensuring the tankers unload septage in the designated place at the Manggar treatment plant. Actual times will be automatically recorded on the ICT system. On-site sanitation census data and the water utility customer database would be integrated into the system as 99 percent of households in the pilot area are city water utility customers. The city water utility head office and the drivers of privately operated tankers will be the users of the app.

The city water utility schedules the emptying times per area, produces a list of customers and IDs, sets

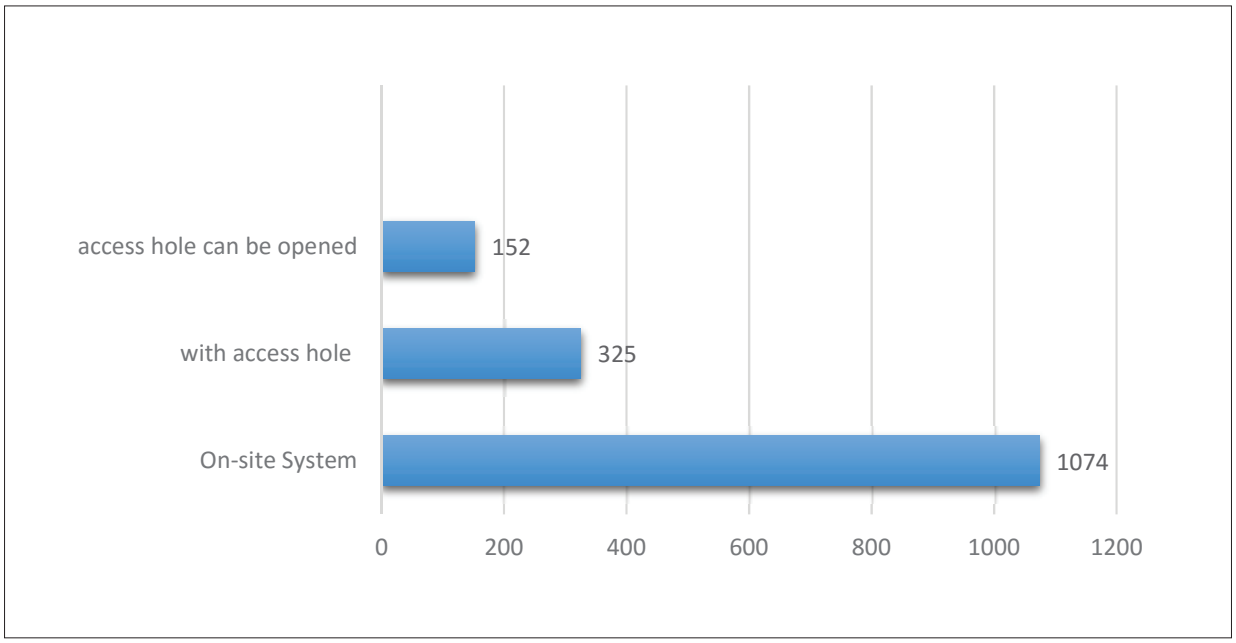



*Table 1: Tank's Access hole*

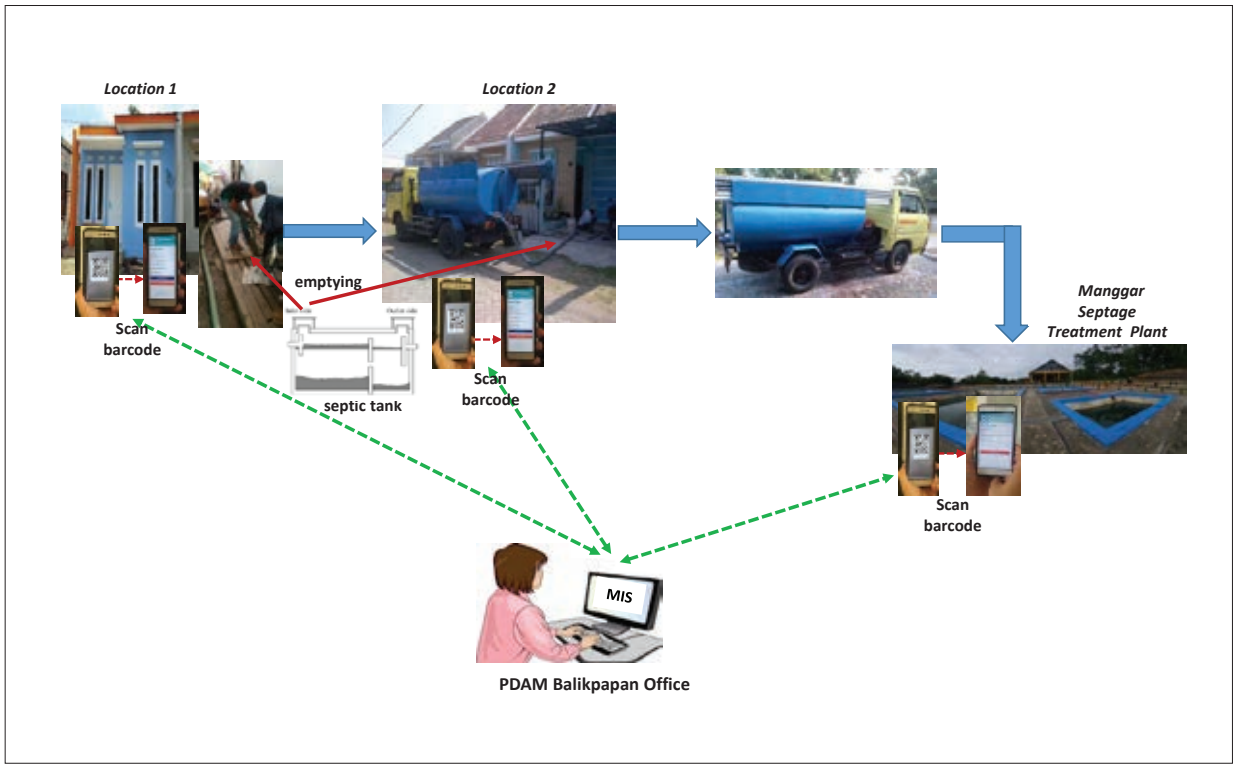



*Figure 1: Mobile and Web-based system*

emptying timeslots for each contractor. The contractor then makes further arrangements with each customer about arrival time. The work order barcode is scanned at each location and at the treatment site and the work order are signed by each household as proof that the work order has been completed. A manual system is also available should internal system or the network fail. The standard operating procedures for this address what should be done if the system is down or is disrupted temporarily. The desktop and mobile apps for regular desludging have been pre-tested and are ready for use.

## REGULAR DESLUDGING PROMOTION

### Setting up the local promotion team

World Bank has helped to facilitate Balikpapan local government to set up a promotion team, consisting of the city water utility and related agencies, local NGOs and city secretary's public relations unit, which is

*Figure 2: Promotion planning process*

also responsible for supporting promotion of public services. Each team member has specific roles and tasks. The team, which is divided into sub-groups, was established in May 2016 under a decree of the head of the city water utility.

**Training cycle and learning-by-doing**

The team has been trained using a ten-step FSM promotion kit developed by USAID that covers social promotion know-how, how to build promotion skills and techniques in practice, understanding the whole promotion process. Each step has clear outputs and clear quantitative and qualitative indicators that are reviewed before moving on to the next level. The first training was followed by another after the local promotion team came up with outputs. The budget for promotion is shared between the city water utility, other local government agencies and the World Bank.

The activity kicked off with an assessment of the existing condition of septage management. Information was then collected from focus group discussions in the pilot location to confirm the main issues. The team then came up with a promotion strategy for the defined target group, a promotion plan and activities, outputs and outcome indicators, monitoring and evaluation plans, and the budget required for all the promotion activities.

The team was also trained in what and how to develop communication materials, and the next step is to define and develop the materials and pre-test them with community groups with guidance from The World Bank promotion team.

**Implementation and monitoring activities**

The implementation of regular desludging promotion in communities involves the heads of the administrative structure, women's groups and heads of sub-districts in the pilot area. The final activity was to monitor the performance and the results of recent promotion activities. This involved completing 112 questionnaires (with a validity rate of 85 percent per 1,000 households) followed by focus group discussions. The results were as follows:

- Understanding of regular desludging: 92 percent
- Willingness to be a customer: 70 percent
- Willingness to pay IDR 9,500 per month: 63 percent (through the city water utility's billing system)

Of the respondents who showed little interest in joining the regular desludging programme, 60 percent did not give any reason, 30 percent cited other reasons such as a septic tank not requiring emptying (12.5 percent), and the remaining ten percent said they were not the house owner (10%).


*Figure 3: A communication product*

*Figure 4 : Evaluation process*

## NEXT STEPS TO SCALING UP THE PILOTS

Balikpapan is moving forward in improving septage management and various follow up actions are required along with commitment from the leaders at the highest level and the city water utility to building on the pilot. Next steps include:

- assigning designated staff to plan the development and management of septage management and outsourcing some work is a possible option. More trained staff to operate the septage treatment facilities that are soon to be transferred from DKPP to the city water utility are also needed;
- coordinating and starting the preparatory work for the transfer of physical assets from DKPP to the city water utility, which will require an audit process with the city government and local agency that manages local government assets before the city water utility can officially operate the facilities and integrate them into its administration system;
- finalising the tariff regulation for regular desludging and on-demand emptying (and publicising the tariff structure;
- initiating discussions with potential private desludging operators about the administrative technical requirements and format and content of agreements. Agreements between the city water utility and selected private operators must be signed prior to implementation;


*Figure 5: The results*

- strengthening the city water utility's internal communication system by integrating domestic wastewater into the customer relations and customer services that are already provided for water;
- implementing the first batch of regular desludging for households in census area;
- analysing the available census database and making further plans for the next step of intervention for households that show willingness to be regular desludging customers but have no tank access. This will need strong support from the city government and local promotion team, and revision of the decree of the head of the city water utility, to ensure continuity of promotion activities and to develop a comprehensive promotion plan and action plan.

Other next steps include:

- Carrying out a customer satisfaction survey in the pilot area and using mass media and social media to develop strategic communication with targeted communities;
- Ensuring budget provision for replication of the on-site sanitation census to a wider area as well as replication of promotion activities;
- Improving septage management as part of the city sanitation strategy, and incorporating this strategy into the local government's medium- and long-term plans.


## ACKNOWLEDGMENTS

Balikpapan City Water Utility team; Chaidir Effendi; Arviansyah; Wiwit Heris: Inni Arsyini: Ritzky Cahyanto; Yulita Setiawati; William Gunawan; Hendra Murtidjaja

# Moving Towards Improved Urban Septage Management at Scale in Indonesia

A. K. Mardikanto, A. Indiyani, M. Listyasari and R. Yuwono

## EXECUTIVE SUMMARY

Indonesia has managed to increase its sanitation access by nearly two percent per year on average in the last ten years, and overall has made good progress towards achieving the MDG target. This achievement, combined with the mandate of the 2005–2025 National Long Term Development Plan has triggered the national government to set universal access targets for sanitation in the 2015–2019 National Medium Term Plan. This includes increasing centralized and decentralized sewerage from the current 2 percent to 12.5 percent, thereby recognizing that on-site sanitation and fecal sludge management (FSM) will continue to be the main approach to improving urban sanitation.

Since 2013, Indonesia has changed its focus on urban septage management from only building septage treatment plants to a more comprehensive approach to ensure that all components in the sanitation service chain are addressed. A 2012 evaluation found that less than ten percent of around 150 existing septage treatment plants are in use and well-operated due to low demand for emptying and low volumes of septage being disposed of at the treatment plants. Thus, to ensure the safe management of fecal waste in urban areas, the national government has piloted the implementation of improved urban septage management in several cities, with support from development agencies. Several initiatives have been implemented to improve FSM, including using information and communication technology (ICT) to support FSM planning and operation.

With successful interventions under its belt, and considering that all cities in Indonesia will rely on on-site sanitation for the near future, the government continues to improve urban septage management nation-wide. Lessons learned have informed government and key stakeholders in scaling up the intervention to all other cities in Indonesia. Improved of septage management is also expected to contribute to the achievement of universal sanitation access in 2019 as well as to the country's commitment to Sustainable Development Goals (SDGs), which consider both the quality and quantity of services.

## CONTEXT AND BACKGROUND

Almost half of Indonesia's 254 million people are currently living in urban areas. It is estimated that two thirds of Indonesia's population will be living in urban areas by 2035. Despite rapid economic growth, infrastructure development in Indonesia, including development of sanitation infrastructure in urban areas, is relatively slow and lags behind neighboring countries.

Indonesia has one of the lowest rates of urban sewerage access in Asia. Less than two percent of the urban population has a sewer connection despite an estimated 82 percent of the urban population having access to improved sanitation. The majority of urban residents use onsite sanitation systems with pour-flush pan toilets provided by the household. Despite being called *tangki septik* (septic tanks), most of them are soak-pits or unsealed tanks. Almost 70 percent of onsite units have never been desludged, and less than 5 percent have been desludged at five-year intervals. Data from 2012 show that around 90 percent of the sludge treatment plants built since the 1990s are either no longer in operation or perform poorly. Overall, less than four percent of septage in Indonesia is treated properly. (Figure 1).

The Government of Indonesia (GoI) has set the targets for sanitation development in its 2015-2019 National Medium-Term Development Plan. In addition to the eradication of open defecation by 2019, it is also targeted that 85 percent of the population have access to a toilet with an effective wastewater management either on-site or offsite. Recognizing affordability constraints, onsite systems will continue to the main wastewater management option in most urban (and rural) areas (see Figure 2). Consequently, improved urban fecal sludge management (FSM) is essential.

Considerable effort, resources and capacity is required to improve current FSM practice, which may involve the following challenges:

- **Containment**: Despite the existence of a national septic tank standard, most onsite units are unsealed single chamber pits, most of which discharge to the ground and 13 percent overflow directly into drains and waterways. The onsite sanitation units usually only receive blackwater (from the toilet) while the majority of greywater is discharged to drains and sometimes a separate soak pit.
- **Emptying and Transport**: Emptying onsite units in urban areas is not common practice. As mentioned earlier, 68 percent of households have never emptied their onsite units, despite using them for an average of 15 years. Emptying with a vacuum pump (or occasionally a modified water pump) attached to a tanker truck is the most common approach. Emptying is carried out by public or private operators on demand, when problems such as overflows, blocked toilets or bad smells occur.
- **Treatment and Reuse**: The emptied sludge is discharged either to septage treatment plants, sewerage systems (Bandung and Medan) or illegally to land, drains and rivers. Some is applied to agricultural areas upon request of farmers. Most septage treatment plants are non-mechanized and are of varying designs, including solid-liquid separation, sludge drying beds and waste stabilization ponds. Most treatment plants are reported to receive volumes of septage much lower than their designed capacity. Financial constraints do not allow the treatment plants to be operated and maintained properly. Consequently, most plants fail to produce effluent that meets the standard.

Under Law No. 23/2014 on local government, the development, operation and improvement of FSM falls under the authority of the local (city and district) government. However, because most local governments lack the technical and financial capacities to discharge the prescribed tasks, the involvement of national government is still required, including in capacity building, planning and provision of the large-scale municipal infrastructures.

## SUMMARY OF FSM INTERVENTIONS

FSM completes the current efforts by government to manage domestic wastewater. It provides an appropriate alternative wastewater management option to complement offsite sewerage systems (see Figure 2), which few cities have. As a system, FSM enhances the government's effort to deal with on-site sanitation, which until recently focused solely

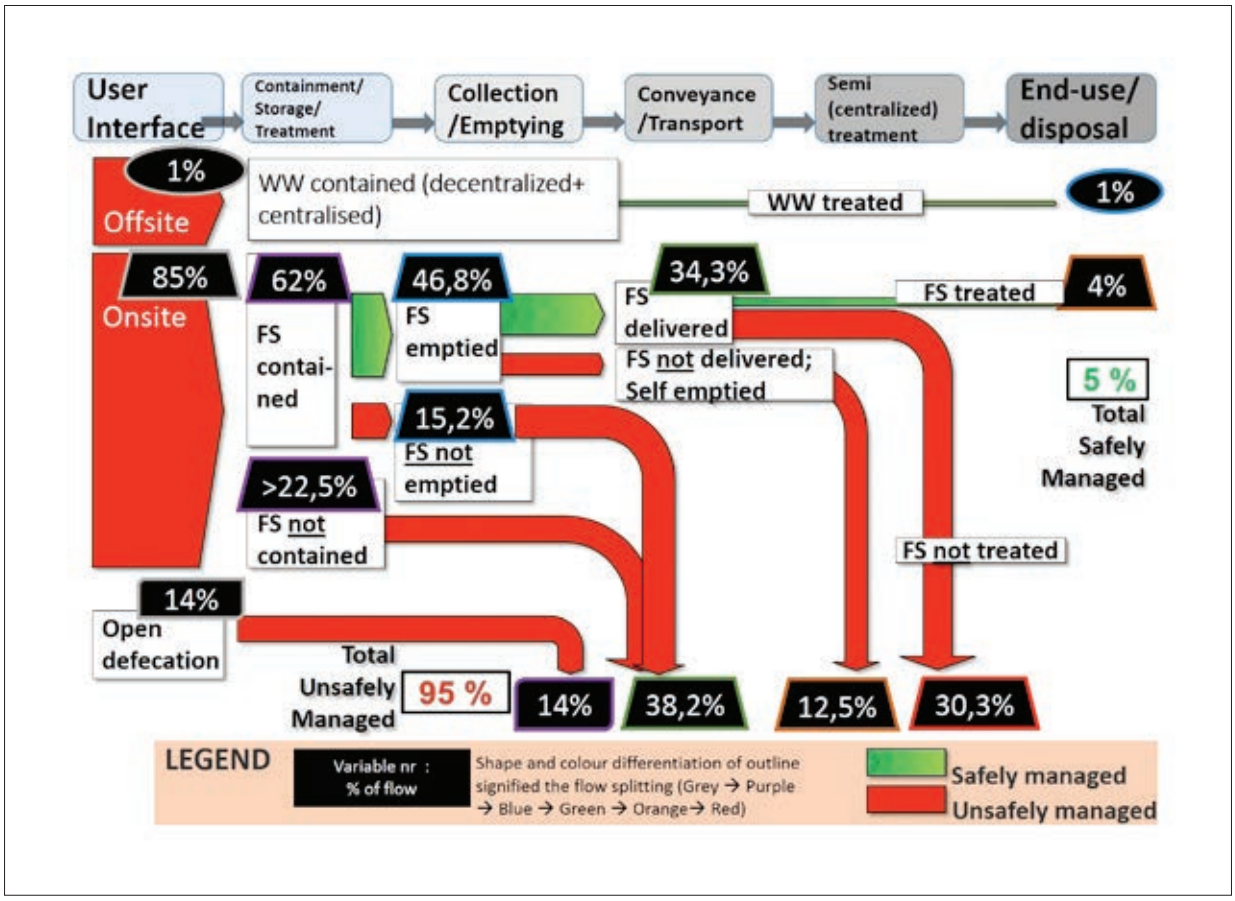



*Figure 1: Fecal Waste Flow Diagram for Urban Sanitation in Indonesia.*

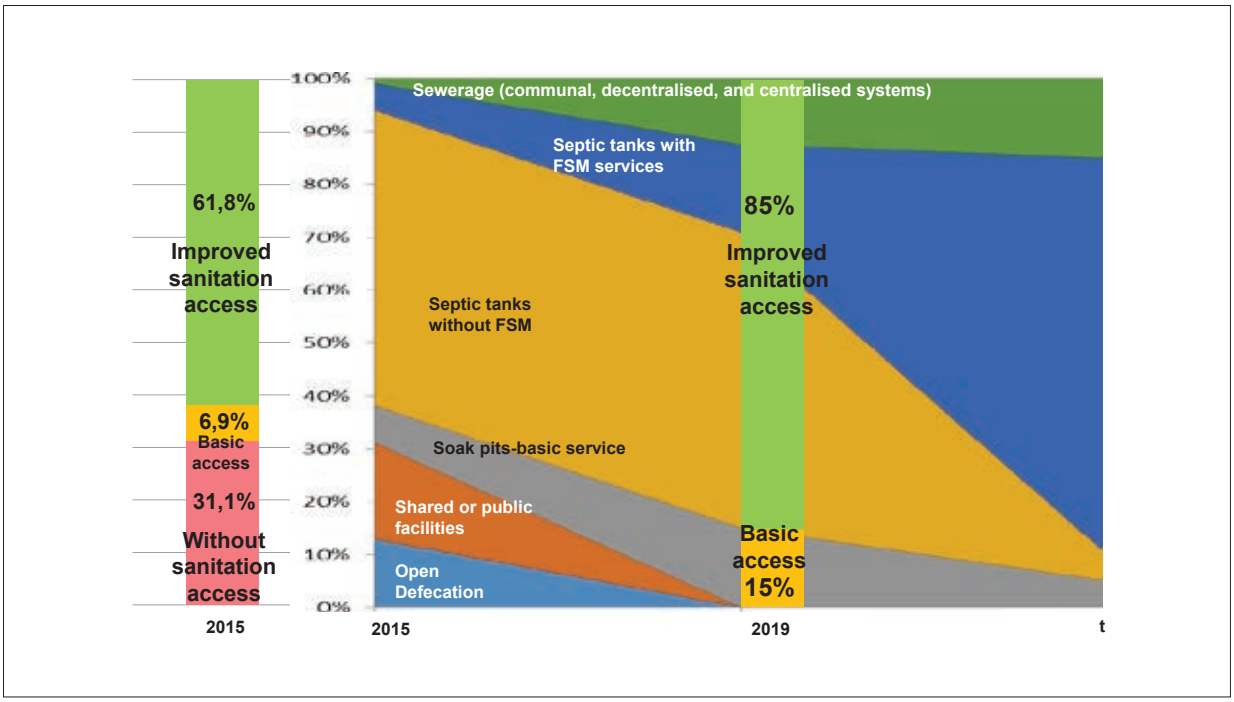



*Figure 2: Schematic Diagram of Indonesia Existing-to-Target Sanitation Access.*

on the construction of sludge treatment plants. FSM in Indonesia aims to improve the institutional, regulation, financial, and operational aspects of the whole sanitation service chain, by improving existing on-demand desludging services and introducing scheduled desludging services.

Together with several sanitation development partners, the GoI has prepared models for a comprehensive approach to ensure that septage is safely and sustainably collected, transported, treated and reused. The national government promotes to local governments the importance of having improved FSM. As the first step on the advocacy agenda, an assessment of sanitation service delivery performance was conducted using a city Fecal Waste Flow Diagram or SFD (as shown in Figure 1). The diagram shows the proportions of fecal waste that are safely managed and discharged unsafely to the environment. It has been used in eight pilot cities and proven to be an effective advocacy tool to highlight real challenges. It has also served as a tool to help local government to prioritize investments to improve the sanitation conditions.

Scheduled desludging has been introduced in the cities of Makassar, Surakarta, Tabanan, Bekasi, Malang, Bogor and Jakarta while simultaneously improving the existing on-demand emptying system. Defined as mandatory regular desludging for all or targeted onsite units, implementation of the scheduled desludging has several prerequisites, including local regulation requiring all onsite units to be emptied regularly. It also needs a well-organized and designated operator. To prepare for effective scheduled desludging, national government expects cities to first improve their on-demand desludging services, which includes preparing for and improving onsite units, septage treatment plants, payment mechanisms, and monitoring and evaluation processes.

The national government requires local governments to prepare plans for improved FSM before they can access support to build septage treatment plants. This includes wastewater institutions and local regulations being ready before support can be provided to the cities. During the initial period in 2015-2016, FSM facilitation from the Ministry of Public Works in 10 of 21 cities facilitated had to be postponed because the cities had not allocated a budget for the pilot areas, including for operations and maintenance, and were reluctant to draft relevant regulations and improve their institutions.

Some specific interventions made to improve FSM practice in cities include:

**Enabling the managing institutions.** One main challenge is the unclear institutional responsibility for sanitation at local level, with various departments involved, and frequent gaps of responsibility in some components in the sanitation service chain. Therefore, one of the main activities is to support the local government to define the assigned institution (whether it is formed as city government department, technical service unit, semi-autonomous local government agency, local government owned-water or wastewater utility) with clear roles and inclusion of FSM in the scope of responsibility. Support has been given to

Makassar and Tabanan to improve their technical service units; to Balikpapan, Malang and Surakarta to improve their water utilities; and to Jakarta to improve its wastewater utility.

**Preparing local regulations**. Because the implementation of improved FSM requires strong regulation, facilitation to prepare local sanitation regulations has been provided. Other forms of regulation have also been developed under the facilitation, such as a regulation of the mayor of Surakarta on septage management, a regulation of the mayor of Balikpapan on wastewater management, and a regulation of the mayor of Bekasi on establishing and operationalizing a special technical unit for domestic wastewater management.

**Developing a census (and e-census) and database of on-site units** to enable local governments to have a complete record of their scheduled or on-demand desludging customers. An Android app has been developed that allows enumerators to input data directly to the gadget and send the data instantly to the central processing computer, where the data will be combined with other data and processed instantly. The tool has been tried out in selected cities, including Surakarta, Balikpapan, Tabanan and Malang. The e-census has reduced the time required to carry out onsite unit censuses. This app also allows operators managing the desludging operation to monitor the transport to, and discharge of septage at, treatment plants (see Figure 3). Cities such as Bekasi, Surakarta, Balikpapan have already introduced the app. Other software been developed to support the payment system.

**Implementing the advocacy and promotion agenda**. Support has been given to cities including Jakarta, Balikpapan, Bekasi, Surakarta, Makassar, Medan and Tabanan to prepare advocacy and promotion plans for improved desludging services. This includes support for the planning, design and production of advocacy and promotion tools, and implementation of promotion events. Promotional videos were made for these cities, and some cities engage staff from the wastewater institutions as the talents. Discussions have also been held with mayors or district heads and with parliament members and media representatives. Television and radio talkshows broadcast in Surakarta to promote the scheduled desludging.

**Improving septage treatment plants.** The government has assessed most septage treatment plants in Indonesian cities, and selected cities have had a more thorough assessment supported by donor programs. Engineering designs, based on the design and operational guidelines for new and improved septage plants, have been made. The government has provided funding to develop the plants in Bekasi, Surakarta and other cities.

**Setting up the tariff for regular and on-demand emptying services**. The mechanism and method for calculating desludging tariffs for cities, factoring in account all capital and operational expenditures and expected incomes, have been developed. The tariffs also take into consideration financial support to be

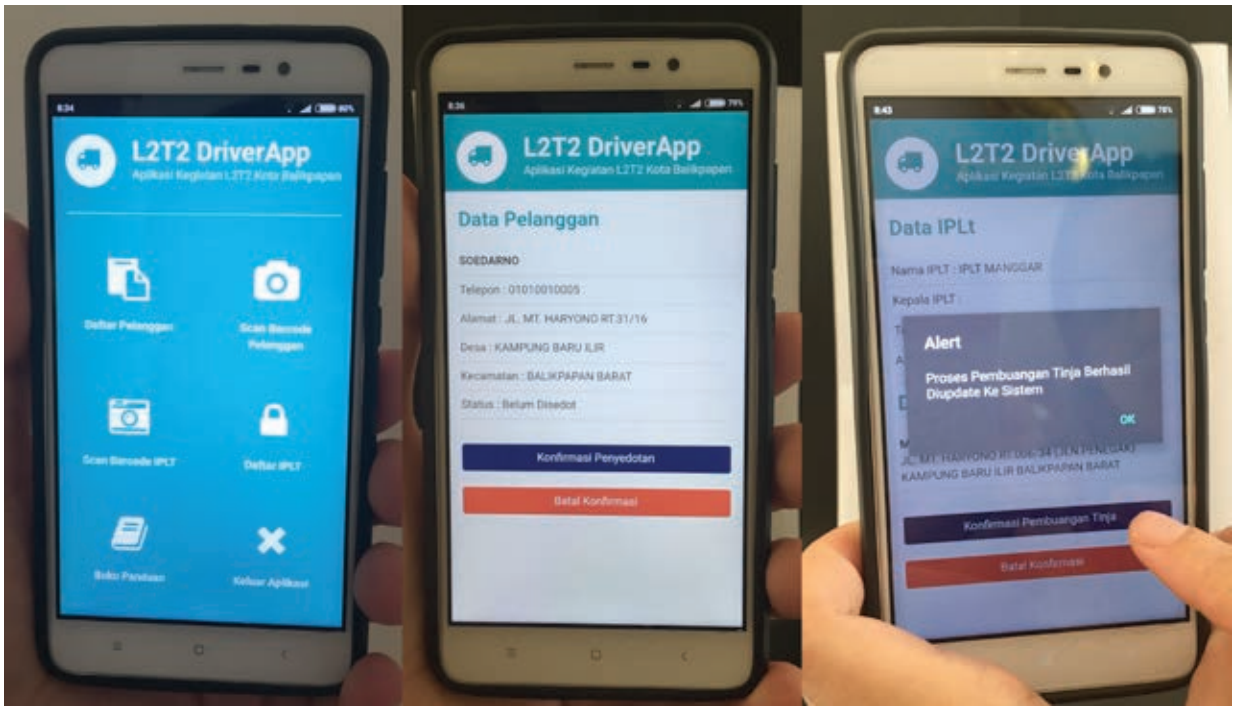



*Figure 3: Android Application for Desludging Operation made for the city of Balikpapan.*

provided by local governments. Advocacy support was provided to the cities of Balikpapan, Tabanan and Surakarta to ensure the tariff is approved by local government and local parliament.

**Preparing the operation design and management system**. Standard procedures for desludging, transportation and treatment operations were developed based on an operational algorithm identified together with local actors. In some cities, like Balikpapan, Tabanan, Jakarta, Surakarta and Bandung, workshops were conducted to introduce, improve and formalize the SOPs.

**Strengthening partnerships with the private sector**, especially for emptying services. In many cities, it was decided that private emptying services will be an important element of the improved FSM. Considering the current condition of most private companies, basic requirements for future private partners must be formulated and agreed. This includes technical and administrative requirements. Memoranda of understanding or contracts governing these public-private partnerships have been signed in Balikpapan and Surakarta.

Sixteen cities have been chosen by the GoI as champion cities to demonstrate effective application of an improved FSM model. These cities are currently in different stages of implementation due to the varying level of commitment from high decision-making stakeholders at city level; development of city regulations; readiness of the local institution designated to be responsible for regular desludging or/and improving the on-demand emptying system, and other reasons.

Considering that one of the main challenges in improving FSM concerns the quality of onsite sanitation. The Ministry of Public Works and Housing has taken the agenda of upgrading the on-site sanitation seriously. A performance-based program for upgrading onsite sanitation was launched in 2015. And, to leverage the outputs, the GoI allows local governments to use special allocation funds to support the grant program for septic tank improvement in urban areas.

## FINANCIAL AND ECONOMICS ASPECTS

Improvement of FSM requires funding from a range of stakeholders. Despite the fact that the main responsibility for FSM lies with local government, currently the main source of funding to develop improved FSM comes from the national government.

| Items | Surakarta | Makassar | Balikpapan | Tabanan | Gresik |
|---|---|---|---|---|---|
| Official launch | October 2015 | August 2015 | February 2017 | April 2017 | April 2017 |
| Operators | Surakarta City Water Utility | Technical Unit for Wastewater Management | Balikpapan City Water Utility | Technical Unit for Solid Waste Management | Technical Unit for Wastewater Management |
| Desludging period | 3 years | 3 years | 4 years | 3 years | 3 years |
| Involving private sector desludging companies | Yes | No | Yes | No | Yes |
| Average monthly service fee for residential | USD 0.65/household | USD 1.00/household | USD 0.73/household | USD 0.65/household | USD 0.74/household |
| Payment | Combined with water bill (utility customers) and door-to-door for other customers | Door to door | Combined with water bill (utility customers) and door-to-door for other customers | Uses local community organization as third party to collect payment | Managed by Public Works Office |

*Table 1: Implementation of Regular Desludging in Cities in Indonesia. Source: IUWASH & WSP-World Bank and Ministry of Public Works and Housing.*

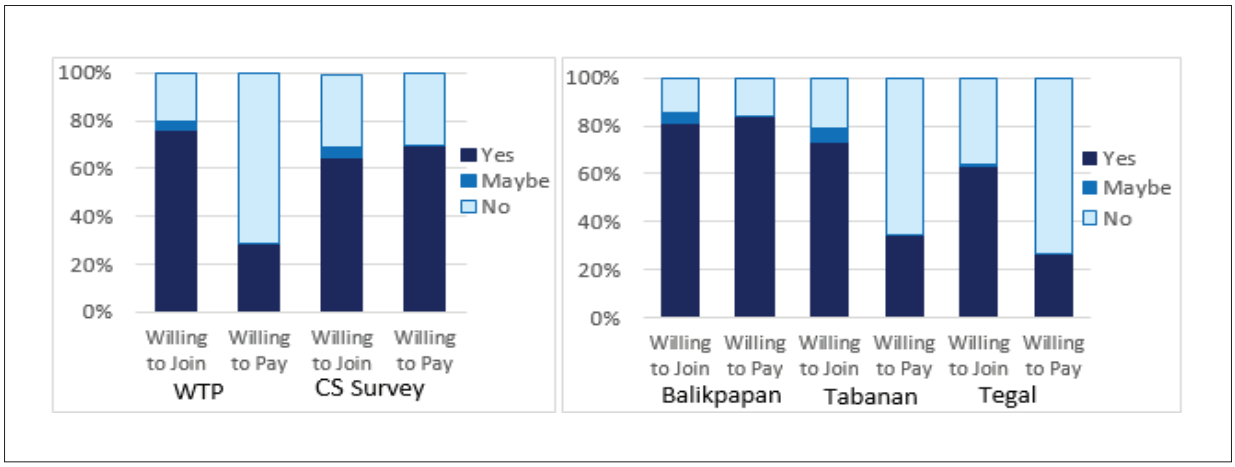



*Figure 4: Willingness to Join and Pay for Regular Desludging (by survey type and city)*

This includes funding for planning and preparation as well as capital investment for major infrastructures. Thus, the Ministry of Public Works and Housing builds the treatment facilities, and these assets are later transferred to local government. Other capital investment, especially in tanker trucks, can come from the private desludging service provider or the local government.

FSM operational costs are funded in part by local government, especially in the initial stage of implementation. The main source of funding for operations is the revenue from the desludging service fees collected from building owners. A World Bank study suggests that the willingness of home owners to pay for the emptying service is relatively high (see Figure 4). In addition, there is also income from trucks discharging septage at septage treatment plant. Local governments typically charge the trucks USD 0.77–1.15 per $m^3$ of septage discharged.

An interesting aspect of the regular desludging scheme, is the expectation that its operations should be financial self-sustaining. A conservative revenue projection for scheduled desludging suggests there would be sufficient income to finance the whole FSM operation, including the treatment and management costs. This projection is often used as advocacy material with local governments.

## DRIVERS OF CHANGE

There are a number of factors that drive the improvement of urban FSM in Indonesian cities. Among others are:

- The National Sanitation Development Acceleration Program as a high-profile and overarching national platform for sanitation development in Indonesia, including in urban areas;
- The sanitation development target in the 2015–2019 National Medium-Term Development Plan that has identifies adequate on-site systems and FSM as the main option for domestic wastewater management system;
- Greater political commitment from local governments to improve the public health and environmental quality of their cities;
- Strong collaboration and synergy among various stakeholders at central and local levels;
- Affordability to develop and operate onsite systems for most cities in Indonesia, and the expectation that well-organized FSM should generate sufficient funds to self-finance the operation;
- Greater public sanitation awareness and willingness to participate in and pay for better sanitation services.

It is also suggested that the newly-enacted and more stringent effluent standards set by the Ministry of Environment and Forestry have started to influence the construction and improvement of the treatment plants, including septage treatments. This is also perceived to be a potential driver of change at the level of local governments in establishing FSM.

## LESSONS LEARNED

Indonesia only recently introduced the improved urban FSM initiative, and currently it is applies to less than 5 percent of Indonesian cities. However, several lessons have already been learned from recent efforts. These lessons concern:

- **Commitment:** the commitment by heads of the local governments is absolutely crucial in the preparations for improved urban FSM, as is the willingness of designated institutions to realize this commitment. The commitment should be translated into allocation of sufficient funds, establishment of local regulations, and preparation of implementation plans. The delayed facilitation in half of cities initially

facilitated by the government was due to a lack of willingness to implement the commitment.

- **Operators and service providers:** the designated institution needs to be equipped with a clear mandate, roles and responsibilities as specified in the local regulations. The type of institution can vary depending on the characteristics and capacity of the city. As shown in Table 2, each city has a different type of institution as service provider. Capacity of the institution to manage monthly billing of customers is an important consideration in the selection of the appropriate service provider, as is the ability to introduce – or not – regular desludging. The city water utility is often the appropriate institution in cities that have a water network that serves the majority of residents. However, where this is not the case, alternatives may need to be considered.
- **Regulations:** local regulation should set the roles of local government in the provision of public wastewater services, including septage management, and will be treated as the legal basis for local government in planning, implementing and monitoring the improved urban septage management, as well as in the budgeting process with local parliament. It is also important to have regulation requiring building owners to have a proper septic tank, desludge periodically, and pay for the service.
- **Operations:** implementing regular desludging is a more complicated operation than on-demand emptying, and must be suitable to meet the service coverage target. It needs to consider the emptying period, zoning and scheduling, as well as the ability to charge and collect a monthly tariff. Availability of trucks for desludging and transport from the containment location to the treatment plant is crucial, and these could be provided through partnerships with local private tanker service providers.
- **Finance:** sustainability of the services should be established and maintained through adequate operation and maintenance funding. Although this will be covered by tariffs paid by customers, local governments need to provide seed funds until the services can achieve economies of scale and costs can fully recovered by the tariff. It is important to design a payment mechanism system that will ensure high billing efficiency.
- **Technical aspects:** well-operated and adequate capacity septage treatment plants are crucial. Quite often current capacities limit the scale of FSM to be introduced. Therefore, the capacity of local government to operate and maintain, and design, the treatment plant need to be improved. Some evaluations have reported that technical failures related to the utilization of septage treatment plants are due to miscalculations by local consultants.
- **Promotion:** although the customers in pilot stage are households that have standardized septic tanks, promotion to all households needs to be undertaken to ensure that the services can be delivered at scale. Therefore, improving public awareness and understanding, and people's willingness to engage desludging services is extremely important.

## NEXT STEPS AND PLANS FOR GOING TO SCALE UP

The development of improved FSM in Indonesian cities will continue. More cities are planned to be supported by GoI with support from donor-funded programs and the local governments. Next steps and plans include:

- **Developing, improving and promoting manuals and guidelines**, not just on technical aspects (especially guidance on how to design, operate and maintain septage treatment plants) but also on how to develop local regulations, prepare the operational schemes, etc.
- **Providing intensive capacity building to local stakeholders**, i.e. local governments, potential service providers, and local consultants, which make up the support system at city level.
- **Making available a variety of sludge treatment technology options to local governments**, taking into account land availability, electricity supply, service area coverage, etc. An incremental approach to developing treatment plants will also be introduced to local governments, as an option that can be adopted as the customer base grows.
- **Including FSM development in the city sanitation strategy** and master plan for the domestic wastewater management.
- **Improving the criteria for cities to receive financial or technical assistance from national government**. Clear readiness criteria as the basis for selection will help enable smoother implementation.
- **Strengthening collaboration with relevant development partners and international NGOs**, not only in support for implementation, but also in capacity building and advocacy agendas.
- **Improving the quality and expanding the scale of FSM as a criterion** in selection of the winners of clean city awards.
- **Introducing national regulation requiring all local governments to develop domestic wastewater management system**s that include FSM.
- **Continuing the onsite upgrading program**, by increasing the involvement of authorized certification agencies to ensure the technical quality of the system provided, and involving other financial schemes for scaling up.

## REFERENCES

Assessment of Sludge Accumulation and Pit Filling Rates in Indonesia (WSP, 2013)

East Asia Pacific Region Urban Sanitation Review – Indonesia Country Study, World Bank 2013

Evaluation of Indonesian Septage Treatment Plants, Ministry of Public Works, 2012

Reports on Septage Management Pilots and Capacity Building in Indonesia (GWASE East Asia and Pacific, May 2016)

WHO/UNICEF Progress on sanitation and drinking water – 2015 update and MDG, 2015

WSP 2013, Assessment of Sludge Accumulation and Pit Filling Rates in Indonesia (P130771)

WSP 2015, Improving On-site Sanitation and Connections to Sewers in Southeast Asia – Insights from Indonesia and Vietnam (P146352)

## ACKNOWLEDGEMENTS

Reini Siregar, Foort Bustraan, USAID, WSP-World Bank funding, SNV, USDP Project

# Scaling up Faecal Sludge Management in Kenya's Urban Areas

S. O. Okoth, J. K. Ronoh, A. Dubois and D. Mbalo

## EXECUTIVE SUMMARY

As in many countries across the developing world, in Kenya, on-site sanitation systems predominate in towns. In most cases, faecal sludge from on-site systems is emptied and directly discharged into natural channels, or transported and disposed of untreated into the environment. In 2011, the Government of Kenya, through the Water Services Trust Fund, commissioned a sanitation up-scaling concept "Up-scaling Basic Sanitation for the Urban Poor (UBSUP)", which took into consideration the entire sanitation value chain. Key components of this concept include infrastructure, equipment, and services across the sanitation value chain. Implementation of the model is based on three key pillars: technology, social marketing, and the business and financing model. These sludge management solutions are effective, practical, affordable, and do not require significant changes to the toilets, which people currently use. From the start of the programme, seven decentralised treatment facilities (DTFs) with the capacity to serve 70,000 people have been constructed in seven towns in Kenya. The programme has also streamlined emptying services by integrating relevant laws into framing a concept for the emptiers. The goal of the programme is to provide a replicable urban sanitation service provision model that can be implemented nationally as a medium-term response to the FSM challenges in Kenya's towns.

## CONTEXT AND BACKGROUND

Sustainable faecal sludge management (FSM) continues to be a key contributor to the low access to sanitation services in Kenya. The up-scaling programme in Kenya was implemented based on the findings of the study commissioned by GIZ in 2009, 'Improving Urban Sanitation Systems: A rapid response to improve environmental sanitation'. The study revealed that the different sectors involved in on-site sanitation do not pay enough attention to the safe disposal and re-use of human waste. It further established that wastewater management in Kenya has long been neglected, with very little being done to maintain and improve systems. The treatment efficiency at the plants operated by the WSPs is only around 20 percent. For instance, in 2009, only 3–4 percent of human waste and wastewater produced in urban areas was treated. This means 96 percent of sludge ends up on open ground or is diverted into surface waters. The study further notes that financial and geographical factors also limit the extent to which large sewer systems can solve the sanitation crisis by reaching millions in the medium term. These limitations gave credence to the viability of on-site facilities with treatment systems. It was therefore recommended that a combined approach of large sewer systems and on-site based systems was necessary to increase access. Key to the approach was to prioritize urban low income areas (LIAs) to close the sanitation gap between the rich and the poor. Under the water sector reforms, Water Services Trust Fund (WSTF) was mandated to develop and up-scale a sanitation concept.

### Sanitation situation in Urban Kenya

Kenya is a country of 46 million people and a gross domestic product of USD 63.4 billion. The urban population is around about 25.6 percent or 12.0 million people, and is growing at 4.2 percent per annum. Of the urban population, 33 percent still live below the poverty line and most live in Kenya's 2,000-plus Low Income Areas (LIA). This situation points to a bleak future for sewerage systems, because on-site technologies are used far more widely than sewerage systems in most urban areas. On average, only 11 percent of Kenya's urban population is connected to sewers; and these are limited to 15 towns serving approximately 1.3 million inhabitants. This means that the remaining 89 percent rely on other types of sanitation, including pour flush with septic tanks or conservancy tanks, ventilated improved latrines and ordinary pit latrines.

### Regulatory and institutional framework

In 2002, water sector reforms in Kenya culminated in the passing of the Water Act 2002, which introduced

new water management institutions to govern water and sanitation. Under the law, which was revised in 2016, The Ministry of Water and Irrigation (MoWI) set up several institutions including the Water Services Regulatory Board and water services providers (the public water utilities in Kenya) among others (see Figure 1). To operationalise the new service provision structure for sanitation, MoWI developed the Water Sector Sanitation Concept Paper and Implementation Plan (2009) to guide the implementation of sanitation. The water service providers (WSPs), which are the mandated water and sanitation service providers in the urban areas of Kenya, were to take the lead in implementing the concept, including strengthening of FSM services.

Sanitation is a basic human right under the 2010 Constitution (2010) and several national laws. In addition, Kenya also has laws regulating the management of human waste that are applicable to the management of sludge by other state agencies. These include the Public Health Act 2012, which prohibits nuisance caused by offensive waste that is injurious or dangerous to health. The National Environment Management Authority (NEMA) also has regulations about the types of vehicles that emptiers can use, and requires that emptiers hold a waste transportation permit as stipulated in the Environmental Management and Coordination Act of 1999. Recently, the Ministry of Health (MoH) introduced an environmental sanitation and hygiene policy, which requires that relevant regulatory agencies, including the Water Services Regulatory Board (WASREB), provide guidelines for solid and liquid waste management. Thus, the WSPs are expected to take on the role of managing sludge from the on-site systems within this regulatory framework as mandated under the 2012 Public Health Act. However, some WSPs argue that they are responsible only for sewerage management, not for on-site sanitation. Furthermore, most WSPs do not have vacuum trucks needed, leaving the on-site sanitation service largely to the private sector, with the public sector's role being reduced to regulatory and oversight.

## EXISTING FSM SERVICES

On-site sanitation FSM services include emptying and transportation, followed by treatment and disposal. The emptying is usually done mechanically by vacuum truck. The average fee charged by truck owners (private sector or WSP) per cubic metre varies from around USD 15.00/m³ in Mombasa to USD 9.00/m³ in Nairobi and USD 7.00/m³ in Kisumu. However, if people cannot afford the mechanized services or the plots are not accessible by vacuum trucks, households often

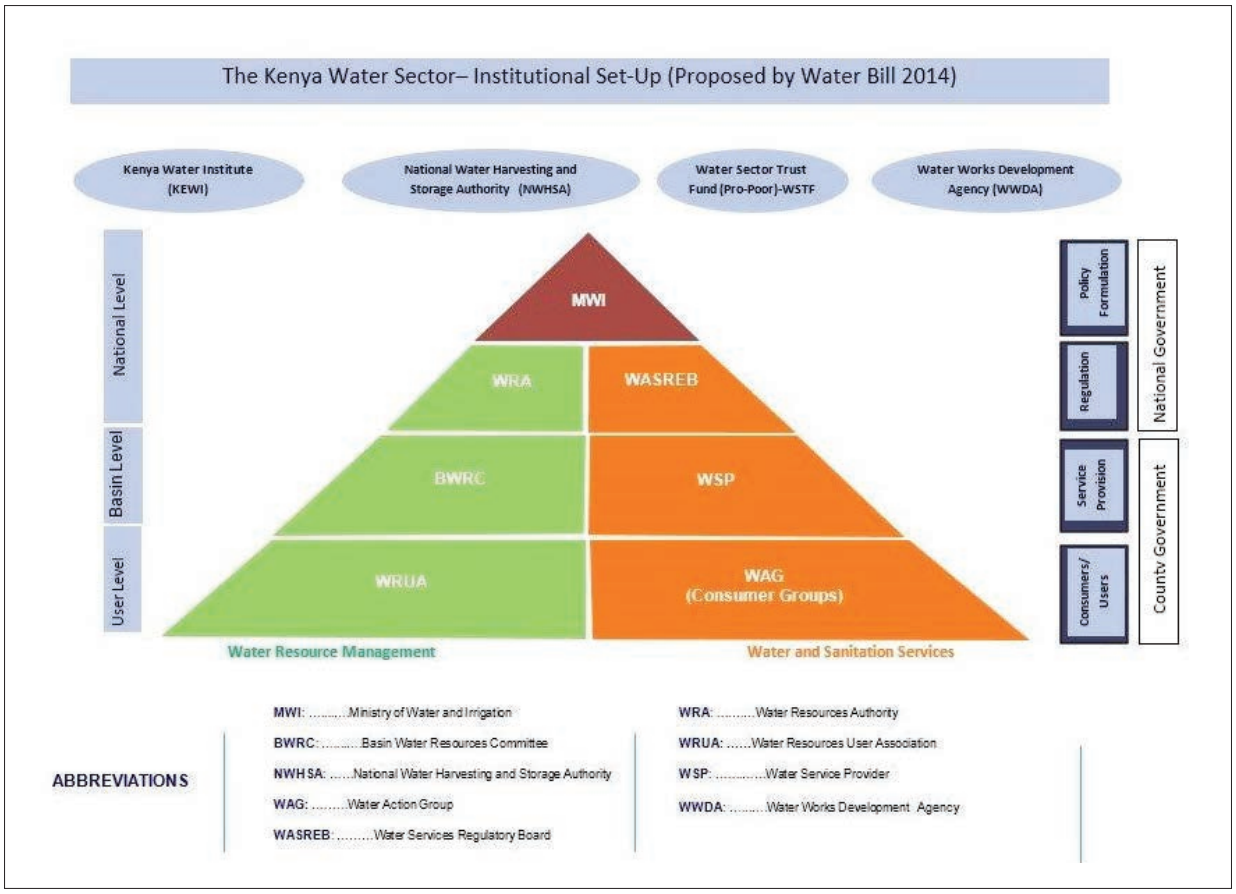



*Figure 1: Water sector structure in Kenya*

*Figure 2: Indiscriminate dumping of faecal waste from manual emptying*

resort to manual emptying. In Kisumu for instance, mechanical emptying costs on average USD 52.00, while manual emptying costs an average of USD 30.00 per trip. Studies conducted in Kibera, a large slum area in Nairobi, show that 33 percent of households use mechanical emptying and 28 percent have their pit latrines emptied manually. Other techniques used include gravitational emptying, where the content of septic tanks directed to flow to lower channels.

Due to limited law enforcement and lack of sludge disposal options, faecal sludge from on-site facilities rarely reaches a treatment or disposal facility. Manual emptiers and private vacuum trucks tend to dump their sludge loads where it is most convenient for them, including nearby streams, rivers or lakes and bushes, thus creating environmental and public health hazards.

Challenges are most severe in urban LIAs where residents face financial constraints, have little space to build toilets, and limited accessibility by mechanized emptying services. Even though in the long term, sewerage remains the preferred option, exploring lower-cost technologies such as decentralized, neighbourhood-based treatment options is needed if poor Kenyans in urban LIAs are to benefit from improved sanitation. In the short term, with many existing treatment plants (conventional and ponds) operating well below design capacity, it is possible that some of the sewerage networks could be extended without the need to invest in additional treatment.

## THE FSM COMPONENT OF UBSUP

About 89 percent of Kenya's urban population is not connected to sewers and depends on on-site sanitation technologies. This poses grave environment and health risks to both the urban and rural populations from contamination, which results from the haphazard dumping of sludge from on-site systems. Thus, in the medium term there is a need to emphasise improving the 'back end' of the toilet including emptying, transportation, treatment and disposal. Under the framework of the water sector reforms, Water Services Trust Fund (WSTF) with technical support from German Development Cooperation (GIZ) initiated a nationwide intervention to improve the sanitation situation through the "Up-scaling Basic Sanitation for the Urban Poor (UBSUP)" programme. The programme is built around the sanitation value chain principle. It has brought together the regulatory and legal frameworks of the various ministries and state agencies to formulate a national FSM approach, and influence new laws so that they prioritise on-site sanitation based on the principles of complete sanitation service delivery.

The programme, which targets 400,000 people in small and medium towns that do not have sewer networks, is funded by the Bill and Melinda Gates Foundation and the German Development Bank (KfW). To date, seven decentralised treatment facilities (DTFs) have been


*Figure 3*

*Figure 4: Motorised SaniGo*

constructed with the capacity to treat 24m$^3$ of sludge per day and serve 10,000 users. A total of 70,000 people are expected to benefit from the FSM systems.

The DTFs are designed to be located conveniently within the towns to provide sludge treatment for both the newly constructed UBSUP toilets and all existing toilets that are of a standard that permits emptying. The DTFs are small-scale decentralised wastewater treatment plants that cater for sludge from dry and wet toilets brought in by the exhausters trucks, SludgeGo or SaniGo. The design of the DTF also incorporates components for processing sludge by-products such as organic compost, soil conditioner, treated effluent for irrigation, and biogas.

There are significant differences between the DTFs and the conventional wastewater treatment systems. DTFs are intermediate technologies suitable for most small- and medium-sized towns that have no plans to construct sewerage infrastructure and conventional treatment facilities. Unlike conventional systems, the DTFs approach emphasises low investment and running costs. The UBSUP sludge management model is a better fit for these towns than the sewer networks and conventional wastewater treatment plants, which are difficult and expensive to implement, operate and maintain at a decentralized level.

## FINANCIAL AND ECONOMIC ASPECTS

UBSUP is designed to create business opportunities for service delivery along the sanitation value chain for the WSPs and the private sector (small-scale entrepreneurs). Through effective social marketing techniques and post-construction incentives (PCI), UBSUP has sold a total of 7,330 new toilets, including Double Vault Urine Diversion Toilets (UDDTs) and flush toilets connected to septic tanks or existing sewer networks. These comprise 98 percent pour flush toilets and two percent UDDTs. Of the pour flush toilets, 70 percent are connected to a septic tank and 30 percent to a sewer.

The WSPs are expected to generate revenue from billed water services. The charge for new toilets connected to the sewer is 75 percent of the user's initial water bill. However, in most cases, both new and existing standard toilets are connected to septic tanks, which need occasional emptying. The WSPs that own vacuum trucks offer the services of collecting and transporting wet sludge from septic tanks and pit latrines. In areas where the WSPs do not have vacuum tracks, these services are generally provided by existing private entrepreneurs. Emptying tariffs charged by public and private providers vary from around USD 100 (8m$^3$ truck) to USD 150 (18m$^3$ truck). In the case of UDDTs, local groups of emptiers are identified, trained and equipped by the WSPs with customised motor tricycles called SaniGo, valued at USD 400 each. Emptiers operating the SaniGo charge the toilet owner an average of USD 20.00 to empty one vault of the UDDT, which are emptied twice a year. The SaniGo can transport up to 1m$^3$ of dry faecal matter, which is equivalent to two vaults. UBSUP encourages the WSPs to outsource the collection and transport services to private entrepreneurs in order to ensure a steady supply of wet and dry faecal sludge for further treatment.

To complete the sanitation value chain, and more specifically, provide appropriate sludge treatment facilities for WSPs where no sewerage treatment plants exist, UBSUP has funded the construction of 13 DTFs, which belong to and are operated by 13 WSPs. The capital and running costs are recovered from the discharge fee. This includes treatment and safe disposal of the sludge. The DTF can receive up to 22m$^3$ of wet sludge per day, which corresponds to approximately three vacuum trucks.

**Sustainability of the services**

For the DTF to operate in a financially and economically sustainable way, each WSP establishes its own tariff structure, which is approved by the Water Service Regulatory Board (WASREB). The

discharge fees applied at the DTF by the WSP vary from USD 15.00 to USD 35.00, depending on the capacity of the vacuum truck. The discharge fees set by the WSPs ensure that proper treatment and safe disposal of the faecal sludge as well as taking care of the running costs of the DTF, which operate 300 days a year. The tariff takes into consideration investment cost of the facility to be recovered on average around 15 years. Disposal of dry sludge at the DTF collected by the SaniGo is usually free of charge, under the conditions of partnership agreed between the group of emptiers and the WSP.

## DRIVERS OF CHANGE

The indicator for the sanitation goal of the SDGs requires evidence of access to sanitation and of the percentage of population using safely managed sanitation services. This means that all interventions must address the entire sanitation value chain. WSTF has seen the opportunity to contribute to this indicator by formulating a national urban sanitation concept built on the principle of the complete sanitation value chain and anchored in sector institutions.

The development of the decentralised and medium-range sludge management technologies has ensured that services that previously needed large urban populations in order to achieve economies of scale are now affordable to medium and small towns. Backed up with a sound business model along the sanitation value chain, many WSPs are now interested in implementing the FSM concept. The business orientation of the DTFs, the SaniGos and the SludgeGos is already promising sustainability in sludge management operations in these towns.

The regulator, WASREB, recognises the opportunity for the WSPs to increase and expand services in their service areas even in the absence conventional sewerage systems. Likewise, the private sector, which had initially shied away from engaging in emptying and transportation of faecal sludge due to lack of interest as well as a lack of treatment/disposal facilities in small towns, are now more encouraged.

However, getting to the up-scaling phase of the programme has not been an easy task. The barriers and challenges that have had to be overcome include:

- A lack of standards for toilet facilities that permit sustainable emptying when full. This prompted the design teams to set design standards for toilets that would make emptying easier.
- The institutional perspective has always been that one day, sewerage systems will be built in all towns. This made it difficult to convince institutional stakeholders to accept and adopt the intermediate response to faecal sludge management that UBSUP introduced. The programme had to embark on awareness raising and marketing of the concept among the key stakeholders, who held a strong belief that conventional sewerage was the sole solution for sludge management.
- UBSUP introduced new designs and structures which, given the complexity of implementing sound sludge management, needed a testing process that integrates customer-aided-design. This is a reiterative process that takes time to allow for the involvement of all stakeholders in the design and learning process before the up-scaling.

## LESSONS LEARNED

Up-scaling of the UBSUP programme was carried out after testing and piloting. These phases helped identify lessons that could support the sustainability of the up-scaling concept. Many lessons were learned during the implementation of these two phases of the UBSUP programme, including the following:

**National up-scaling works best with sector structures**

Sector structures are designed to reach every corner of the country, which provides ideal ground for proven concepts to be simultaneously replicated in different areas. In the context of the UBSUP programme, WSPs are mandated by law to provide water and sanitation services, which has made the WSPs and other sector players more aware of sanitation needs and the opportunities that come with up-scaling programmes. This awareness helps drive the integration of up-scaling concepts into government strategies, policies and budgets.

**Tried and tested concepts influence policy**

While it is widely believed that policies inform interventions, it is also possible that properly tried and tested concepts influence policy. From lessons learned, UBSUP made a significant contribution to several chapters of Kenya's Environmental Sanitation and Hygiene Policy, including giving shape to the chapters on urban sanitation and sludge management, sanitation types and financing.

**A range of technology options is needed**

At the start of the programme, urine diversion dry toilets (UDDTs) were promoted exclusively for their low capital investment and the ease of managing the dry faecal matter emptied from the toilet when it is full. The script changed however when the sanitation marketers engaged with residents of the LIAs to market the technology. It turned out that UDDTs were not a popular choice, accounting for less than

two percent of the toilets. This proved that providing consumer choice is important for acceptance. Appropriate use of UDDTs is possible only if they are constructed within one household compound; use and maintenance is difficult if they are constructed on a plot with multiple households.

**Willingness to pay for sanitation services**

Contrary to the common belief that the poor do not prioritize paying for sanitation services, UBSUP has shown that with enforcement, appropriate sanitation options, and organised sludge management systems in place, residents of urban LIAs are willing to pay for quality services.

**Developing sustainable demand for sanitation services takes time**

From piloting of the programme in three towns to the implementation of the first phase of the programme, demand for sanitation services was not usually obvious and picked up very slowly, thus calling for patience during sanitation marketing. However, after rigorous marketing, construction of improved toilets by households and the first payment of post-construction incentives (PCI) to the landlords by the WSPs, demand picked up exponentially. This suggests that with a little support poor households are willing to improve their sanitation.

**Awareness creation is a necessary for up-scaling**

As awareness has grown, demand for improved sanitation services has grown in many towns in Kenya. Local governments are already planning to finance improvement of sanitation services in various towns based on the up-scaling model. With the successes gained in the areas that the programme has been implemented, it is also expected that convincing potential clients will be easier.

**Outstanding challenges, next steps and plans for going to scale**

During implementation, challenges arose that impeded progress. Outstanding challenges include:

- Internal procedures (in all implementing partners) that delay response to demand for improved sanitation in areas where demand has been created.
- Delay in full operationalisation and use of the decentralised treatment facilities to capacity due to the fact that decentralised technologies are fairly new in Kenya.
- Lack of resources to meet the demand for these facilities in many small and medium towns across the country.
- Marketing of the by-products of sanitation, including biogas and processed manure, is not an easy task as the WSPs lack the capacity to market these products. This slows down maximising revenue from these recycled products.
- Completely integrating the exhauster operators into the up-scaling programme by harmonising tariffs.
- Training intermediate entrepreneurs to offer services in places where there are no exhausters.
- Standardisation and compliance with toilet standards that guarantee sustainable emptying of sludge.

Going forward, the programme has incorporated the lessons learnt into the scaling up concept. These lessons will be considered when implementing the second phase. A robust social marketing strategy based on best practices in the first phase will shorten the lead time.

To sustain the momentum to meeting sanitation needs, the programme is already lobbying the government for funding for scaling up. Other funding sources will also be approached.

To others that are planning to go to scale, the programme recommends they consider making use of existing sector structures and engage teams that have already gone to scale in order to learn lessons.

## REFERENCES


World Bank Open Data (http://data.worldbank.org)

Kenya National Bureau of Statistics, 2013

MadjiData (Kenyan online water and sanitation database on low income areas, available at http://www.majidata.go.ke/)

Environmental Sanitation and Hygiene Policy 2015–2030, Ministry of Health, Kenya


## ACKNOWLEDGEMENTS


Special acknowledgement to the funders of this programme, Bill and Melinda Gates Foundation, German Development Bank (KfW), Government of Kenya, and German Development Cooperation (GIZ). We also acknowledge the collaboration of the Water Services Regulatory Board (WASREB), Water Service Providers, Ministry of Health (MoH), private exhausters and entrepreneurs in implementation of the programme.

# Serviced Household Toilets, FSM, and ICT in Antananarivo, Madagascar: Lessons Learned

V. Gardiner, P. Gardiner, A. Segretain and A. Andriamahavita

## EXECUTIVE SUMMARY

In the absence of conventional sewerage, container-based sanitation (CBS) systems have emerged as a possible solution. The toilet provides simple containment while the waste is collected and stored for regular removal to fully functioning, and ideally value-generating, fecal sludge management infrastructure. Done right, CBS systems can offer a hygienic and aspirational experience to users; an operational and sustainable business to service providers; and the safe deposit of unpolluted waste into FSM systems.

The challenges to creating successful and scalable CBS systems are (1) User and service provider interface with the toilet that captures and stores waste – for users, the toilet needs to be clean and odorless, while for servicers, the stored waste must be properly contained to avoid exposure when servicing; and (2) Providing an efficient and assured service – servicing household toilets in dense urban areas requires excellent customer communications, scheduling, route planning, and a means to ensure that the waste reaches its appropriate destination.

Since September 2016, 100 household toilets linked to value-generating FSM have been serving paying customers in Antananarivo, the capital of Madagascar. The toilets use innovative technology to deliver a clean and odorless experience to users. A consumable, biodegradable polymer film refill is loaded into the toilets to capture and seal human waste. The refill combined with the toilet's sealing system solves the issue of human interface with waste, for both the toilet users and the toilet servicers. The refills are bar-coded for scanning, and the toilets are serviced using a mobile app and web platform. The app and platform track waste as the servicers take it from toilets to the treatment facility.

When the CBS challenges are successfully addressed, the system will fit a variety of urban contexts and can be linked to a wide range of treatment systems. This linkage provides opportunities to scale through partnerships with utilities, municipalities, NGOs and other important players in the sanitation value chain.

## CONTEXT AND BACKGROUND

Completion of the sanitation value chain requires innovative approaches to onsite sanitation. Onsite sanitation facilities today usually consist of a septic tank, latrine, or dry toilet – technologies that require either mechanical or manual extraction of sludge, followed by fecal waste treatment. Today 2.7 billion people in urban and rural areas worldwide use such facilities.[1] They store fecal sludge in which suspended ammonium and helminth eggs are usually ten times more concentrated than in wastewater.[2] Globally, only 22 percent of that sludge from onsite sanitation is currently being managed safely, while the rest is causing widespread fecal pollution.[3]

A majority of cities in Africa and Asia have almost no regulation of or formalized system for dealing with fecal sludge from onsite sanitation. The quantity of sludge produced is not well understood, and FSM is a low priority for local and national governments.[4] In Antananarivo, Madagascar, a city of two million people, approximately 83 percent of households use onsite sanitation or open defecate. Of these, nine percent use septic tanks, 67 percent use pit latrines and seven percent practice open defecation.[5] Of the pit latrines, two percent are emptied by the municipal service, ten percent by private companies and 60 percent by manual laborers. The remaining 28 percent cannot be emptied, or are left to overflow during the rainy season. The municipal and private emptying services dispose of more than 4,000 $m^3$ of fecal sludge per year directly into the Ikopa River, while manual laborers dispose of waste in open sites around the city.[6]

By investing in new approaches to onsite sanitation that facilitate collection and treatment, urban utilities can offer more hygienic and efficient ways to complete the sanitation value chain. In Madagascar, such an

investment is likely to offer valuable return. Almost 30 percent of all deaths in Madagascar are still caused by preventable infectious and parasitic diseases, many of which are attributed to poor sanitation.[7] Diarrheal diseases are the second leading cause of death and affect 51 percent of children under five.

CBS systems have emerged as a possible solution to facilitate FSM for onsite sanitation, as evidenced by a handful of NGO-subsidized commercial operations globally including Soil (Haiti), Sanivation (Kenya), Sanergy (Kenya), Clean Team (Ghana), XRunner (Peru) and Loowatt (Madagascar). Combined, these companies currently treat the waste of an estimated 60,000 toilet users each day.[8] In principle, these toilets capture and store waste onsite in containers to facilitate hygienic and efficient emptying and transport to FSM facilities (once or twice weekly). In practice, these toilets require an intelligent user interface for hygienic servicing, and the assistance of information and communications technologies (ICT) to increase efficiency and assurance for the service.

## EXISTING FSM SERVICES

Antananarivo has several organizations in place to handle fecal sludge. At the municipality level, SAMVA (Service Autonome de Maintenance de la Ville d'Antananarivo) is responsible for the city's waste collection, including emptying latrines and septic tanks; however, most households cannot afford this service (USD 47.00–USD 98.00 per $3m^2$ of sludge using vacuum trucks).[9] And SAMVA struggles to provide quality services due to damaged facilities, poor maintenance and inadequate operating budgets,.[10]

At the *fokontany* (district) level, water user associations (WUAs) together with a structure called the RF2, collect funds from water sales and local taxes and use the funds for the maintenance and staffing of public toilet blocks and promotion of hygiene. The WUAs do not have the means to provide FSM, other than paying informal latrine services to periodically empty septic waste from public toilet blocks. The city's regulatory oversight of FSM in Antananarivo is enforced at the district level with varying efficacy. Rules around waste disposal are developed by the Bureau of Municipal Hygiene and stipulate against the movement of fecal sludge during daylight hours, a stipulation that exacerbates unsafe working conditions. The Bureau also forbids dumping waste in the environment, but this regulation is not enforced because of the lack of legitimate disposal options.

NGOs offer technical and managerial support at municipal and district levels and are seeking ways to tackle the absence of functional FSM. Water and


*Figure 1: Map with digesters indicated*

Sanitation for the Urban Poor (WSUP) and several other organizations have invested in decentralized anaerobic digesters for fecal sludge treatment. Six such projects are now underway including:

- A concrete overground reactor in Manjakaray commissioned in 2014, funded by the NGO EAST and turned over to SAMVA for operation.
- Loowatt SARL digester, a modular digestion-pasteurization facility with electricity production in Andraisoro, funded by BMGF and privately operated by Loowatt SARL, commissioned in 2016.
- A further digester funded by EAST in Ambatomaro (commissioned in 2016), managed in a public-private partnership between SAMVA and a group of local pit-emptying businesses.
- A geotextile digester funded by WSUP and operated by SAMVA, commissioned in Anosibe in 2016.

These decentralized systems process waste in local areas around the city and combined can now process just over seven tons of fecal sludge per day, which is less than one percent of the city's total requirement.

At the household level, for the owners of Antananarivo's onsite sanitation facilities, the cost of emptying varies widely, but is high overall and depends upon a wide range of factors from local site conditions to the whims of informal service providers. Interviews with latrine emptiers and emptying services in 2016 found the cost of emptying/removing $1m^3$ of latrine waste to range from the USD 14.00–USD 39.00 charged by informal service providers (waste disposed in canals/courtyards, or in rare cases, NGO-constructed digesters) to the USD 75.00 for emptying by truck (waste disposed into the Ikopa River).[11] Interviews with household latrine owners in 2014 found that most rely on informal service providers and pay USD 12.00–USD 31.00 per service between one and four times per year (for an average annual cost of USD 53.00, or USD 1.03 per week). In contrast, the municipal service provider, SAMVA, charges USD 47.00–USD 98.00 per service.[12]

*Figure 2: Roso Toilets*

The 2014 study, which focused on relatively poor areas of the city – Manjakaray and Antalamohitra – employed a bidding-game methodology to calculate an estimated willingness-to-pay figure for customers seeking serviced onsite sanitation. The results of this were fairly consistent, with estimated costs of informal latrine emptying at USD 0.82–USD 1.00 per week. On this basis, cartridge-based toilet services in Antananarivo could charge at least USD 3.40–USD 4.00 per month, which is less than has been estimated for similar services elsewhere. CleanTeam in Ghana, for example, charged an estimated USD 8.00 per month in 2016.[13]

In this low-margin context, it is essential to minimize costs, maximize capital and operational efficiency, and reach high volumes quickly for financially sustainable operations (5,000-10,000 households). Government subsidies and/or cross subsidies from system by-products (such as fuel or fertilizer) can also accelerate growth.[14] Numerous recent studies have also suggested that the use of mobile-enabled ICT can lead to a step change in efficiency of service and payment, and offer regulatory assurance related to tracking and documenting waste collection.[15]

## SUMMARY OF FSM SERVICES AND CHANGE

An innovative approach to onsite sanitation is illustrated by Loowatt SARL's toilet and treatment system in Antananarivo, Madagascar. Loowatt toilets package human waste in biodegradable polymer film within cartridges beneath the toilets, and the cartridges are removed weekly by a service. As of September 2016, 100 household toilets are serving approximately 600 customers and generating 235l of fecal waste per day. The Roso toilets are clustered around two treatment facilities that take in Loowatt waste (maximum radius of 2km) – the EAST digester in Manjakaray and the Loowatt digester in Andraisoro.

In its collection service, Loowatt has introduced two innovations for onsite sanitation: (1) the use of a polymer refill and sealing technology that provide a

clean product interface between users, servicers, and toilets, and (2) the implementation of a mobile app and web platform that daily generates paperless data on key servicing metrics and enables the head office to track assets and waste through to the treatment system.

Loowatt's Antananarivo toilets were implemented in three product stages: the Tsiky toilets, featuring Loowatt sealing units inside locally made pedestals and cubicles (12 installed in 2014-15); the Milay toilets, a prototype design with a smaller sealing technology, designed for in-home use (28 installed in 2015); the Roso toilets (60 installed in 2016) which have the same sealing technology as the Tsikys, built into off-shelf pedestals from Envirosan (South Africa), and featuring an updated cubicle design. Figure 2 shows examples of Roso toilets.

Key to Loowatt's clean product interface is the toilet refill, consisting of a tube of biodegradable polymer film, which is locally assembled and purchased by household customers. The refills are simply knotted at each end, when being loaded and unloaded. The refill works with the toilet's sealing technology to separate the users from the waste, providing a clean bowl for every use. Figure 3 shows that when the unit is serviced, the refill separates the servicer from the waste. This separation transforms the job of emptying the toilet. The design of the refills and their interface with the toilets make possible the elimination of waste odor for household users and of contact with human waste for the servicers. The refills are thus a valuable consumable in the system.

The refill's biopolymer film is imported. Although some biodegradable raw material is currently available in Madagascar, it is not suitable for use in toilets. Loowatt is currently testing a range of biodegradable polymers, some of which are being separated for composting and some shredded and fed into anaerobic digestion (Figure 4). The cost of biodegradable materials at the current number (100 toilets) does not allow for operating margins, thus funding to reach sufficient volumes (5,000-10,000 toilets) is a major consideration in plans for scaling up. Additionally, new materials and technologies are becoming available for the

*Figure 3: Roso Toilet emptying process*

*Figure 4: Biopolymer film and transportation*

*Figure 5: Scanning the bar and code and a sludge treatment facility.*

sustainable breakdown of a wider range of polymers including non-bio options, which are much more widely available and about 70 percent cheaper than biodegradable polymer. Reducing the refill's operating costs is thus a function of both material supply and options for resource recovery.

Loowatt customers pay a deposit of USD 15.00 to show their commitment and to begin a contract. The toilets are moveable and can be removed if customers cease to purchase refills. Refills come in two sizes, depending on customer preference (household size and usage patterns to last seven days): small, priced at MGA 2,500 (USD 0.75 per refill per week) and large, priced at MGA 3,500 (USD 1.00/ per refill per week). The figure below indicates purchase patterns for Roso toilets by household customers since the full number was installed in September 2016.

It is important that the refills, which are bar-coded along with the cartridges (gasketed barrels, locally sourced), interface with the mobile app to enable tracking. The Loowatt mobile app runs on basic Android smartphones used by the toilet servicers (Figure 5). The refills and barrels are scanned upon delivery to households, collection from households, and delivery to the treatment facilities. The data is transmitted via the Cloud and assembled on a web platform that the Loowatt head office in Madagascar uses to monitor servicing. Because the information can be viewed anywhere, it also provides a valuable tool for the Loowatt London team.

Through SMS messages sent to it free of charge, the web platform increases efficiency by facilitating both the tracking of customer payments with mobile money and the scheduling of toilet servicing and maintenance visits. The mobile app and platform provide assurance that the waste has reached its appropriate destination. This assurance is especially valuable in the absence of functioning regulatory frameworks for FSM.

## FINANCIAL AND ECONOMIC ASPECTS

In Antananarivo, the USD 1.00 charge per Loowatt refill per week is comparable with the cost of pit emptying (USD 1.03 average weekly cost), while it offers a superior experience for toilet owners and servicers. This same toilet and refill approach to onsite sanitation can be customized to a wide range of markets and various FSM contexts (anaerobic digestion or other systems). Capital costs at the current 100-unit volume are USD 350, but as volumes exceeds 10,000, toilet unit costs fall to approximately USD 150. At this volume, and depending on other market considerations such as distribution networks and raw material choice, refills purchased by customers yield adequate margins to reach financial sustainability for the toilet service.

The web app and platform add to management costs for implementation and training. Costs will be recovered through the increase in servicing efficiency achieved through collection scheduling, delivery route tracking and planning from the Antananarivo head office and the ability to make payments with

| | Oct 2016 | Nov 2016 | Dec 2016 |
|---|---|---|---|
| **Small** | 62% | 65% | 62% |
| **Large** | 33% | 35% | 35% |
| **Total purchase rate** | 95% | 100% | 97% |

*Table 1: Roso purchases from the past 3 months*

mobile money. These innovations are considered crucial across the CBS sanitation sector, and become increasingly essential beyond 500-1,000 toilets.

Sustainability of customer demand is tracked on a weekly basis, facilitated by the web platform. Customer income levels are vulnerable to seasonal and other variations. At higher volumes, this tracking function becomes crucial. For example, drop in usage across an entire community could lead a treatment facility to drop to sub-optimal processing conditions. Waste would then have to be rerouted, and transport costs would rise, as already happens in the UK with sludge treatment.[16]

To cover the costs of removing waste from onsite sanitation facilities, SAMVA would ideally be adequately funded by the state water provider and the WUA, but this does not currently happen.[17] Adequate funding would help support infrastructure costs and enable wider partnership with local entrepreneurial pit latrine emptiers. Presently, gate fees are being charged to support operating costs – but this deters pit emptiers from bringing waste to the treatment facilities and dumping remains prevalent. The concept of waste-to-value treatment (such as anaerobic digestion to produce natural gas and fertilizer) has been considered as a way to create further subsidy through valued by-products. For this reason NGOs have funded the capital cost of the digesters, though it has yet to be shown that their operational returns will cover their operating costs.

By tracking collected waste, Loowatt's mobile app provides assurance that fecal sludge is taken to such facilities. This information helps NGOs and other stakeholders leverage funds to finance treatment infrastructure. By making the process of waste removal from onsite sanitation facilities more hygienic and practical than latrine emptying, the refill approach also improves the value proposition of this approach to FSM.

Operating costs will be vulnerable to challenging conditions beyond the control of sanitation organizations. The economic situation in Madagascar, for instance, is challenging. Inflation rates are high, and imports are double-taxed. The USD exchange rate has deteriorated significantly, from MGA 2,175 per USD 1.00 in October 2013 when the first democratic elections were held since the 2009 coup to MGA 3,370 per USD 1.00 in January 2016 – a 55 percent drop.

## DRIVERS OF CHANGE

The Loowatt System in Antananarivo was made possible by grant funding (from The Bill & Melinda Gates Foundation) to design, build and commission the infrastructure. Further support came from the GSMA Mobile for Development Utilities Innovation Fund to build and implement the web app and platform. Private investment was also required to fund unavoidable costs not supported through grant funding, such as business overheads. The Bill & Melinda Gates Foundation support brought additional value through technical support and expanding our network of global FSM colleagues, assisting our technology and business model developments. The GSMA grant has added value through the link to mobile network operator (KYC) practices, and marketing and customer service practices used in Bottom of the Pyramid (BOP) markets that have been proven to accelerate market penetration for other utility sectors (solar power), and will do the same for sanitation.

Before the Loowatt SARL digester was commissioned, we opened 40 toilets around the EAST digester in Manjakaray (EAST 2014), forming a partnership with SAMVA that gave Loowatt access to their treatment facility in exchange for Loowatt's providing technical support for digester operation. This partnership enabled us to set up a service that tapped into existing treatment infrastructures, and we aim to replicate this model with other digesters now being commissioned around the city.

Locating the waste treatment system in a densely populated urban area with a strong surrounding customer catchment has been a challenge. For other NGOs that have recently installed fixed digesters, once the land had been located, obtaining the permit for a permanent structure took an average of two years. Loowatt SARL's strategy of building digester containerized infrastructure, which is technically mobile, made the licensing process much faster: once the land was found in Andraisoro, the environmental permit was granted just three months from application.

We developed and rolled out the mobile application in tandem with the introduction of toilets and the installation and commissioning of the anaerobic digestion system. Implementing three innovative aspects of the sanitation value chain at once presented concurrent and disparate challenges to the management and technical teams. But it also enabled iterative system design and tweaks – for example, we adapted the mobile app to reflect features of the service in situ, and we improved the toilet cubicle design in stages to streamline installation, which now can be done in half a day.

A key driver for uptake is and will remain the provision of a clean, odorless, aspirational toilet.

In Madagascar, where latrines are widespread and generally unpleasant, the concept of seeing value in toilets is novel. Customer satisfaction with the toilets and the service provided, as reflected in refill purchase patterns, will remain crucial.

## LESSONS LEARNED

Mobile ICT can help to address challenges to efficiency, assurance and customer service, but because the platform with 100 toilets has been operational only since September 2016, it is too soon to detail its degree of impact. However, potential is beginning to show in the following areas: (1) Efficiency – sub-optimal logistics lead to unsustainable collection costs across the FSM sector, for container based toilets and latrines alike. ICT offers mechanisms for scheduling and route planning, as well as mobile payment rather than cash collection. (2) Scale – significant market penetration is needed for sustainable margins to be generated. ICT can facilitate scaling by optimizing customer service to maintain customer loyalty. (3) Distribution – engagement with mobile network operators offers the opportunity to tap into their distribution networks for product and service promotion.

**Demand versus financial sustainability**

Having toilet technology that offers a clean, pleasant experience for users and servicers removes major obstacles from the challenge of introducing a novel, paid, serviced toilet into markets where people are used to basic latrines. Our marketing teams have had no difficulty finding customers, and since becoming subscribers, customers have been purchasing toilet refills regularly.

Though demand is thus clear, this challenge remains: to reach financial sustainability, the current business model requires much larger volumes of units (5,000-10,000). This is largely because of the need for higher volumes of the consumables (refills) to drive down costs. As we look to fund scale-up, an interim local fix would be to increase the refill retail price, which was set based on studies of consumers' willingness to pay in the poorest areas of Antananarivo. We could also consider a price increase in the future, when introducing the service in more well-to-do neighborhoods. It is even possible that prices could vary according to customer conditions, and an internal cross-subsidy could benefit the overall financial position.

**Speculative value by-products**

The Loowatt FSM treatment system (anaerobic digester and pasteurizer system) uses 60 percent of the energy produced from the biogas to pasteurize the liquid fertilizer by-product to ensure the complete removal of soil transmitted helminths. Approximately 40 kWh/day of energy remains available for export. In addition, the system generates approximately one ton of liquid fertilizer (digestate) per week, and when composted with rice straw is converted into compost and through further processing into vermicompost. These three products (liquid fertilizer, compost, vermicompost) are currently being prepared for market entry, branded and tested by farmers and scientists. Sales will begin in March 2017.

Thus far, Loowatt treats the byproducts of human waste as a speculative revenue source. Despite significant value potential, profits may be challenged by concerns about products made from human waste, distribution and other issues. Therefore, we aim to target that the household service business as financially independent of any cross-subsidy from system by-products.

**Need for Partnerships**

The Loowatt system is currently operating at a micro-scale and executing the entire sanitation value chain as a pilot. To expand, the capital costs of implementing end-to-end systems at scale present a significant but unnecessary barrier. The benefits of an odorless and hygienic toilet and an ICT-streamlined household service can be applied to many types of treatment systems and operated by utilities. A faster route to scaling will be to work with partners that are ready to fill links in the chain.

## OUTSTANDING CHALLENGES, NEXT STEPS AND PLANS FOR GOING TO SCALE UP

In Antananarivo, our next key challenges are:

- review the biopolymer film material options and availability, reassess the volume of toilets required to reach financial sustainability, and devise the plan to reach this number;
- consider the results from sale of byproducts (energy and fertilizer), which will inform strategies for potential future partnerships; and
- develop partnerships with the operators of the new digesters now operating in the city, so as to provide toilet systems in their catchment areas and build a strong case for city-wide expansion.

Globally, we are looking to expand our impact through partnerships with utility providers which might have parts of a functioning FSM value chain – for example, a treatment facility, or an improved service – while also looking to provide households with products that are pleasanter, safer and easier to service than a pit latrine. Such partners have been identified, but we are still looking for more.

## NOTES

[1] Bassan et al. (2014) *Faecal Sludge Management Systems Approach for Implementation and Operation.* Strande, L., Ronteltap, M. and Brdjanovic, D. (eds.) IWA Publishing.

[2] Klingel, F., Montangero, A., Koné, D. and Strauss, M. (2002) *Gestion des boues de vidange dans les pays en développement* Manuel de planification. Première. Institutde Recherche sur l'Eau du Domaine des Ecoles Plytechniques Fédérales (EAWAG) et Département Eau et assainissement dans les pays en développement (SANDEC) (ed.) Institutde Recherche sur l'Eau du Domaine des Ecoles Plytechniques Fédérales (EAWAG) et Département Eau et assainissement dans les pays en développement (SANDEC).

[3] Hawkins, P., Blackett, I. and Heymans, C. (2014) *The missing link in sanitation service delivery : a review of fecal sludge management in 12 cities.* WSP water and sanitation program.

[4] Chowdry, S. and Kone, D.D. (2012) *Business Analysis of Fecal Sludge Management: Emptying and Transportation Services in Africa and Asia.* The Bill & Melinda Gates Foundation.

[5] Artelia Madagascar (2014) *Elaboration du Schéma Directeur d'Assainissement Urbain du Grand Tana.* Grand Tana: Artelia International.

[6] *Ibid.*

[7] World Bank: Systematic Country Diagnostic, August 25, 2015

[8] Data from practitioners: Sanergy, Sanivation, Cleanteam, X-Runner

[9] Tucker, J. and Mason, N. (2013) Get to scale in urban sanitation. WSUP Water and Sanitation for the Urban Poor.

[10] Artelia Madagascar (2014) Elaboration du Schéma Directeur d'Assainissement Urbain du Grand Tana. Grand Tana: Artelia International.

[11] Practica, Antananarivo, 2016

[12] Chan, Mei Yee: *Effective demand for a waterless toilet system in Antananarivo*, *Madagascar.* Cranfield University, MSc 2014, sup. Richard Franceys

[13] CleanTeam, 2016

[14] Ernst & Young: *Why Wait for Sewers?* WSUP Report, 2017

[15] Hystra: *Designing the Next Generation of Sanitation Businesses,* 2014

[16] Arup, 2016

[17] Gilbert, Amandine; *Faecal sludge management in Antananarivo, Madagascar,* Cranfield University, MSc 2015, sup. Alison Parker


## ACKNOWLEDGEMENTS

Thank you to:

The Bill & Melinda Gates Foundation for funding our work in Madagascar and for providing intelligent support along the way.

The GSMA Mobile for Development Utilities programme for funding creation of the Loowatt mobile app and web platform and introducing us to the world of mobile-enabled utility provision.

Christof Dornbierer and Michael Steiner of Acrea

Tong Biotin and her excellent team at Chengdu DeTong

Jo and Mark Clayton of Qube Renewables

Members of the burgeoning CBS Alliance, who we are grateful to have as colleagues.

Members of the Loowatt teams in Madagascar and London who are not authors of this report but who were instrumental in our system design and implementation.

# Sanitation and Sewerage Management: The Malaysian Experience

Dorai Narayana

## EXECUTIVE SUMMARY

Malaysia stands out in South East Asia as having made significant improvements in sanitation and sewerage management. The top-down strategy by the federal government, effectively over-riding the local governments, produced quick results. A holistic approach was adopted to manage centralised, community and on-site sanitation systems, which put in place strong regulatory frameworks and a strong driver with a clearly defined role, and tasked the private sector to do what it does effectively.

There have been interesting experiences with scheduled desludging, tariffs and cost recovery, introduction of technology in an incremental manner, all of which produced mixed results, and brought forth several generally applicable lessons for other places aiming to improve sanitation and sewerage management. Malaysia intends to forge ahead in this sector, charting the most appropriate and sustainable path for itself. This too is a reference for other cities that are developing their own sanitation and sewerage strategies.

## THE CONTEXT

Malaysia a country in South-east Asia with an area of about 330,000 $km^2$ and a population of 30 million people. It is highly urbanised, with almost 75 percent of the population living in towns and cities. Most urban centres are small, except for the Kuala Lumpur conurbation, which alone supports more than 7 million people. The country is rich in natural resources such as oil, tin and other minerals. There is a large manufacturing sector, and a substantial tourism industry too. GDP per capita exceeds USD 10,000 (2016).

Over the last 50 years, Malaysia has made tremendous progress and has invested in quality infrastructure. Sanitation and sewerage management, although perceived to be lagging behind other sectors, has also seen dramatic improvement. Almost 100 percent of the population has access to toilets and safe sanitation. Nearly 70 percent of the population now has access to sewerage services that drain into off-site treatment facilities. Close to 20 percent use proper septic tanks, while the remainder use modified septic tanks, pour flush or pit latrines. About 20–30 percent of the on-site facilities are regularly emptied and treated before disposal, while the rest are emptied as and when requested.

Historically, Malaya was a predominantly agricultural community, blessed with a good climate and fertile soils, and free from natural disasters. The local population lived in villages, coastal and riverine settlements, answering the call of nature in rudimentary toilets or in the open, and letting nature do the rest.

The land attracted large numbers of immigrants from the region, and this led to economic activity and urbanisation. The coming of the European colonialists beginning in the 1600's accelerated urbanisation. Rubber and tin were the commodities that drove the economy. Major urban centres arose around these production centres and ports. And with the urban sprawl came the attendant problems of waste disposal.

The incidence of waterborne diseases such as cholera, dysentery and typhoid was widespread, causing much suffering and death. By the late nineteenth century, local sanitation boards came up with mitigating strategies. Faecal matter was contained, in pits or buckets, and carried away for safe disposal.

By the early twentieth century, the colonial authorities had laid out piped sewerage in some of the larger towns, notably Georgetown (circa. 1930) and Kuala Lumpur (circa. 1940). The sewerage was limited to the inner core of the town, while the fringe areas used bucket latrines, direct discharge of waste and pit latrines. Most of the collected sewage and untreated nightsoil was discharged to a nearby river, or the sea. In rare cases, oxidation ponds were built to treat the sewage. The bucket toilets were emptied by night soil carriers, who sold the human faeces to nearby farmers. Pits when full were usually abandoned,

and new pits dug. Where emptied, faecal matter was dumped in rivers, the sea or applied on garbage dump sites. Pit latrines often contaminated wells. The diseases continued.

## DEFINITIVE ACTIONS POST-INDEPENDENCE

After the country's independence in 1957, the sanitation challenge was approached in a more holistic manner. In the larger towns, bucket latrines and other such rudimentary systems were gradually phased out. Proper multi compartment septic tanks with filters/ soakaways and pits were introduced. Piped water supply became available in most towns, and flush toilets were common. A rural sanitation improvement programme provided proper toilets with pit latrines, and relocated them away from wells. All these steps effectively addressed the public health hazards of faecal matter at household level.

## RAPID DEVELOPMENT AND EMERGING SANITATION SHORTCOMINGS

The 1970s and 1980s saw rapid economic development, driven by petroleum and oil palm. In almost all urban areas, housing estates and commercial complexes mushroomed, putting severe strain on the capabilities of local authorities. The federal government advised a policy requiring housing developers to build internal sewerage infrastructure to serve their developments. Small developments had to provide individual septic tanks, built to specifications, while larger developments exceeding 30 houses were required to provide a piped sewerage system, with a local sewage treatment plant. Grey water was also required to be included in the sewerage systems. This was an excellent move, because it ensured sewerage infrastructure was provided for all developments, and relieved the burden on the local government. However, it was not holistic, and eventually led to several serious shortcomings.

- **A logistical operational nightmare arose for local authorities**, resulting from the large number of sewerage systems being built by developers, with a wide variety of designs, systems, equipment and arrangements, and with little standardisation.
- **Local authorities generally lacked technical personnel with adequate knowledge of sewerage systems**, and the private sector was no better. Moreover, there were no regulations or guidelines in place. Some systems were inherently defective in design and the quality of the designs and the built infrastructure was sorely deficient.
- **Whole life costs and operability considerations were ignored.** Developers were driven to a large extent by commercial considerations. The options selected were therefore difficult to operate and maintain, or had high operational and maintenance costs. These facilities often developed serious defects soon after commissioning.
- **Neighbourhoods suffered overflows, odours, and nuisances** from these community treatment plants, which were located in close proximity to residential areas, especially when the treatment plants malfunctioned, which was often.
- **Serious issues of personnel, expertise and financial resources in the local authorities** resulted in large scale operational shortcomings, with most sewerage systems falling into neglect and disrepair. Theft and vandalism added to the problems, and as a result the sewerage infrastructure soon began to crumble. Discharges and overflows of raw or poorly treated sewage were widespread.
- **Enforcement of regulations was weak.** The Environmental Quality Act 1974 established the discharge standards for sewage effluent discharges to inland waters, but these were seldom applied. The fact that the offenders were local authorities may have been a factor.
- **Septic tanks began to malfunction, and sludge overflows were a major source of pollution**, because accumulated sludge was not emptied regularly. Septic tanks were generally well designed and built to specifications, but were desludged only on request, and there was no proper treatment of the sludge. It was often applied on land or discharged into the sea or rivers.

A few large local authorities such as Kuala Lumpur and Penang obtained funding from the World Bank or the federal government, and could implement some sewerage improvements. But most local authorities paid scant attention to this sector.

As a result, problems with the regulatory framework, institutional arrangements, capacity, awareness, financial and other resources, and overall management led to the deterioration of the physical infrastructure provided by developers.

In the meantime, a substantial percentage of the population continued to use poorly managed septic tanks, or even less satisfactory systems such as sub-standard septic tanks, pits or direct discharge, polluting ground and surface waters.

The result was a serious pollution of water bodies – rivers, lakes and coastal areas. Water supply sources were being affected. Sewage was polluting recreational and tourism areas. The number of polluted rivers was increasing. The problem became very visible, forcing the federal government to take notice.

## FEDERALISATION AND PRIVATISATION BEGINNING IN 1994

The ineffective sewerage and sanitation management seemed incongruent with the rest of the country's infrastructure development. The obvious conclusion seemed to be that local authorities were ill-equipped to make the quantum shift that was called for.

Partly stemming from a private initiative by a group of entrepreneurs (which would later become Indah Water Konsortium, IWK), the federal government decided to federalise sewerage services beginning in 1994, through the enactment and promulgation of the 1993 Sewerage Services Act. A regulatory department was set up at the federal level called the Sewerage Services Department. The operations were privatised under a 28-year concession agreement with Indah Water Konsortium (IWK). Indah Water Konsortium comprised local and foreign partners, including North West Water, a British water and sewerage operator.

The concessionaire operated in urban areas and its responsibilities included:

- Operation and maintenance of public sewerage systems
- Scheduled emptying of septic tanks
- Safe treatment and disposal of sludge
- Refurbishment of all sewerage infrastructure
- Planning and construction of new sewerage infrastructure

## IMPROVEMENTS

This federal government strategy adopted a top down approach, but most local authorities and states were happy to give up what they saw as a problematic role. All states, with the notable exception of the East Malaysian states of Sabah and Sarawak, the opposition-led Kelantan state and the city of Johor Bahru opted to handover the responsibilities to the federal government.

The initiative resulted in spectacular improvements in the sewerage sector, with substantial funds invested for refurbishment, upgrading and operation of the dilapidated sewage treatment plants. Regulatory


*Figure 1: Indah Water Konsortium Service Areas*


*Figure 2: Improvements in Sludge Treatment Technologies*

control was tightened. Sewerage catchment planning, incorporating land acquisition and reservation, was carried out. Developer guidelines were published, designs were scrutinised before approval, and construction was supervised, resulting in better quality developer built systems. Intensive capacity building programmes were carried out, and over the years thousands of technical and professional experts were created. Operation and maintenance of facilities was systematic and effective.

**Co-existence of a range of sanitation systems**

The de-facto policies and philosophies of sewerage infrastructure development accepted the reality that a whole range of sanitation / sewerage systems will co-exist, and that through specific demand drivers, this range will evolve, shedding the simpler and less effective systems and upgrading to better systems up the sanitation ladder. The concession agreement stipulated the targets for the eventual mix of sewered and on-site (septic tank) systems for different categories of urban areas. It required the gradual phasing out of pits and pour flush systems in urban areas, and refurbishment of all sewerage systems to meet regulatory standards.

**Perceived value of sewerage and septage services**

The nature of sanitation and sewerage as public goods means that after a certain point (usually outside the immediate vicinity of the household), the user does not perceive any added value, and the benefit is more to the community or larger environment.

This was a key factor, which constituted a flaw in the model of full cost recovery from tariffs. The concession agreement intended to pass on full responsibility for capital and operating expenditure to the concession company, which in turn had to recover these costs from tariff revenue. In hindsight, a "user & beneficiary pays" model would have been more appropriate.

Moreover, this model of charging users directly was introduced abruptly without adequate information and awareness raising. Most local authorities had never imposed direct charges for sewerage, and for septage emptying services, the charge was minimal, on provision of service. Also, there was no scheduled emptying, and the charges were very low, considering that the septage was not treated, but simply dumped.

Most people considered sanitation and sewerage the responsibility of local authority, already paid for by the local property tax. With federalisation and privatisation, users had to pay a separate monthly sewerage/septic tank charge. This was perceived as double charging.

Sanitation and sewerage services are generally invisible to the user, which made the charging of tariffs even more unacceptable. The tariff of MYR 8.00 (USD 2.00) per month per house (introduced in 1994 and unchanged since then) was very low, and certainly affordable for almost all Malaysians. But the above factors, and the fact that payment could not be easily enforced, resulted in a very low willingness to pay.

The tariff was heavily skewed with high tariffs for commercial customers. This caused a political backlash resulting in downward revision of the commercial tariff.

**Scheduled septic tank emptying (1994–2008)**

A major responsibility of the concessionaire was the scheduled emptying of close to 800,000 septic tanks (now 1.2 million). The users would be billed MYR 6.00 (USD 1.50) per month per house (1994 -2008) and their septic tanks would be desludged once in two years.

The immediate challenges were:

- Creating a database of the locations of septic tanks, starting with trawling through local authority records and later through painstaking ground surveys
- Scheduling emptying and issuing notices, using this database
- Some tankers had been transferred to IWK from local authorities, but many of these were decrepit and had to be scrapped. New tankers were acquired
- There were almost no sludge treatment or disposal facilities. A sludge strategy with immediate, short, medium and long term plans was drawn up. The immediate strategy involved co-treatment in oxidation ponds and other treatment plants. In the meantime, sites were identified for treatment / disposal, and approvals obtained from the environmental authorities.
- Initially basic systems such as trenching were used, and gradually these were upgraded to drying beds, mechanical dewatering and full scale regional sludge treatment plants. The liquid portion was usually co-treated with sewage.
- The focus was on removing the sludge, treating and disposal, while reuse and resource recovery was neglected.

Thanks to the efforts of IWK, the success rate of desludging was about 30 percent, which although low, was by no means a small achievement considering the

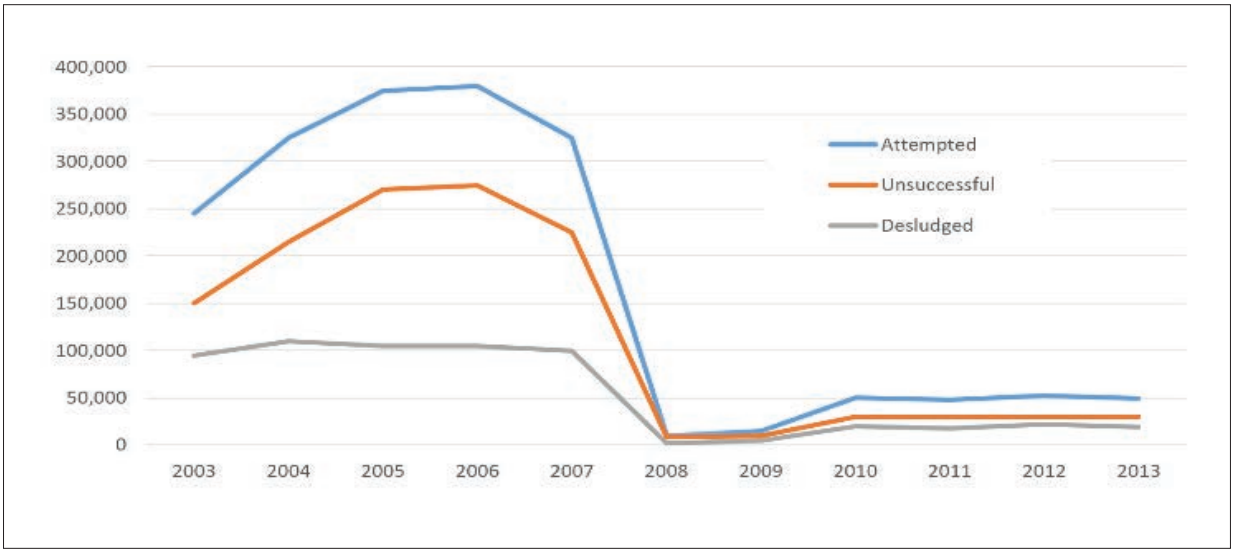



*Figure 3: Trends in Desludging overtime*

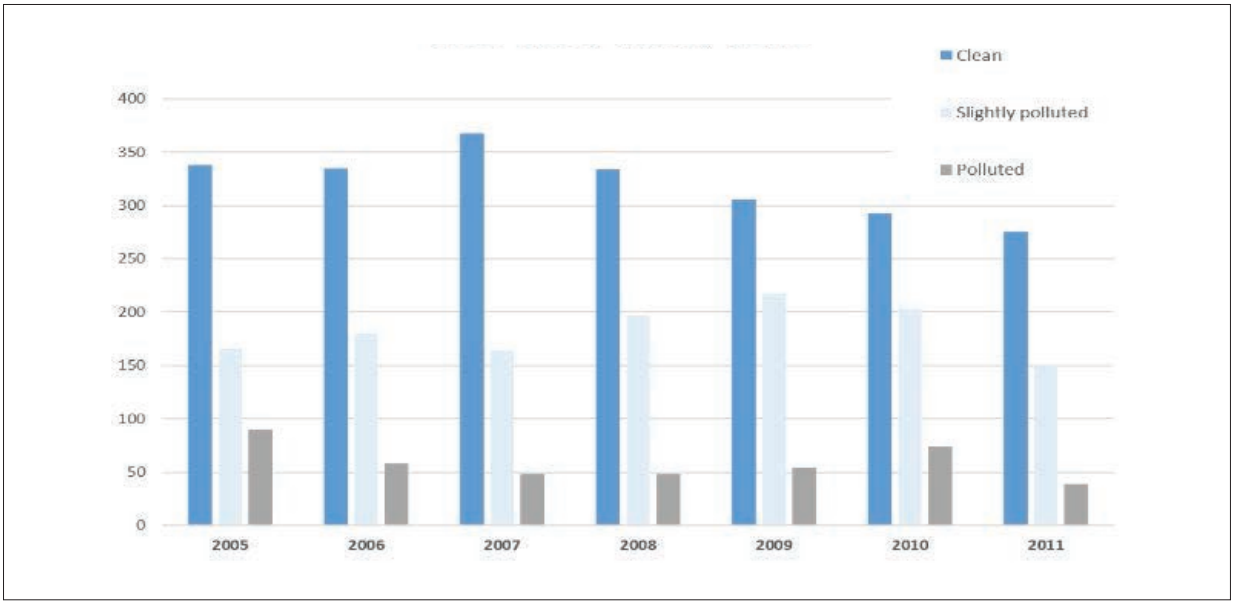



*Figure 4: Trends in River water quality*

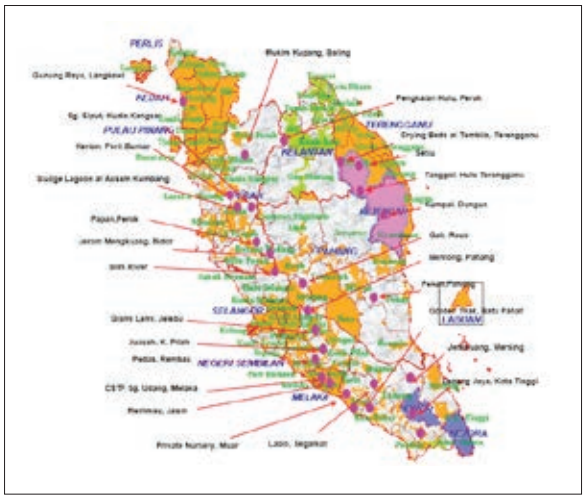


*Figure 5: Operations through-out Malaysia*

lack of enforcement by the regulators. The reasons for the low success rate were:

- Owner refusal: lack of awareness of how the septic tank functioned and why it had to be desludged
- Owner not present at time of scheduled emptying
- Inaccessible premises or septic tanks
- A total lack of enforcement

In 2006, the government passed the Water Services Industry Act, which came into force in 2008. This law shifted the responsibility of desludging to the houseowner. Houseowners were obliged to get IWK or any licenced tanker operator to desludge their septic tanks once every three years. However, sludge had to be brought to an approved facility.

As a result, scheduling by IWK was stopped, leading to a huge drop in sludge removal and a significant decrease in river water quality.

The latest proposal being considered by the regulator is a volumetric tariff, which will be the same as the tariff for connected services. Septic tanks will be desludged once every three years. IWK will manage scheduled desludging, and partly contract out the task to licenced tanker operators.

Today, IWK provides sewerage and sludge services to almost 24 million people nationwide. Its workfoce of 3,360 operates through 21 unit offices (and 51 operating centres) covering 87 local authorities. It manages 6,488 sewage treatment plants (STPs), 62 dedicated sludge treatment facilities and 18,000 km of sewers.

As Figure 6 shows while tariffs have remained stagnant, business costs have soared. Although operating costs and resources have increased in tandem, performance levels measured in terms of compliance to effluent standards (97% in 2015) and customer service (97.6% in 2015) have improved vastly.

## CHALLENGES

IWK had a rough journey from the beginning, and several serious issues arose.

- **The abrupt introduction of a commercial model that charged customer tariffs**. Although the tariff was quite low (USD 2.00 per month/household) and affordable to most, the bulk of consumers believed sewerage services should be part of municipal services, for which they were already paying local taxes. The fact that sewerage services are generally not visible did not help. As a result, there was massive default on payment of sewerage bills.

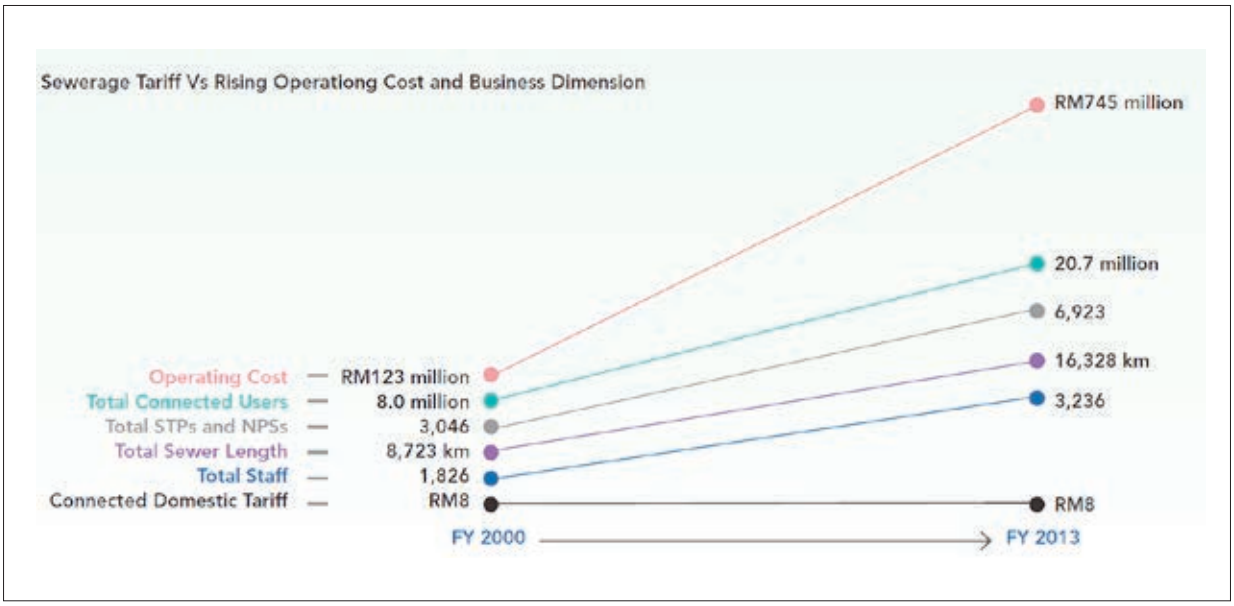



*Figure 6: Operating Costs and Tariffs*

- **Massive refusals meant that only 30% of septic tanks were emptied**, despite being scheduled. This was in part due to poor enforcement by the regulators, coupled with a lack of sludge treatment facilities and difficulty obtaining suitable sites.
- **The financial model of the concession was faulty**, and the scale of the physical infrastructure, work required, costs and other factors had been underestimated. The tariff was inadequate.
- **Lack of political will** to review the tariff, enforce collection and make the concession viable.
- **With federalisation, the role of state and local governments shrank** to almost negligible levels, causing them to be left out of the process.
- **Water and sewerage management were separated**, with water supply remaining in the hands of state government.

As a result, Indah Water (IWK) ran into serious sustainability problems. While a lot of physical and management improvements took place, community acceptance was poor and financial viability was seriously lacking. This resulted in the federal government acquiring the entire equity of Indah Water Konsortium in 2000, and it continues to operate today as a government owned company. Public acceptance has improved, but tariffs remain low. The company regularly records an annual deficit of several hundred million ringgits, which is covered by the government in the form of a subsidy. As a government owned company, commercial considerations have generally taken a backseat.

In 2008, the government decided to decentralise sewerage management by integrating it with the state water supply companies. The Water Services Industry Act (WSIA) intends to gradually bring about the integrated management of water and sewerage under separate state entities, eventually resulting in a single volumetric water/sewerage tariff. The Act also envisages an asset-light model for the service licensees (operators), with the assets held by a separate entity, the facility licensee. This process is ongoing, but progress is very slow.

## LESSONS LEARNT

In spite of these problems that caused the government to reverse the privatisation, the sector has achieved great traction and momentum. This has been a resounding win. What are the achievements?

- A very strong regulatory framework, supported by institutional arrangements with clear roles for funding, asset provision, regulation, operation and management, as well as for various support roles.
- Focused investment, resulting in excellent infrastructure improvements, making many of them world class. Dilapidated treatment systems and sewers were rehabilitated and refurbished to good operating condition.
- The scheduled desludging regime, in spite of its limited success, has proven its value. Sludge transport and treatment / disposal in a safe and orderly manner has been established.
- The regulatory and institutional framework helped control developer investment, with good quality infrastructure being provided by developers, which on completion was managed by IWK.
- Systematic planning of sewerage and sludge management ensured that the required infrastructure was provided in stages.
- Development of systems and procedures for operation and management of sewage and sludge management infrastructure.
- Pervasive awareness was created of the importance of good sanitation and sewerage management.
- Training, skills development and capacity building has been largely successful in creating industry capability.

What were the factors that contributed to the success?

- There was a very strong **driver** (the federal government) and political push for the whole process.
- While there was no written **policy** governing sanitation / sewerage, de-facto policies were recognised and institutionalised in laws, guidelines and procedures.
- Strong **legislative** arrangements gave legal basis to the initiatives. The Sewerage Services Act and its successor, the Water Services Industry Act and its various derivative legislation, provided a strong framework for the improvements.
- **Roles** and responsibilities of government, the regulator, operators, developers and others were clearly defined
- Federalisation resulted in **focused funding allocation** and massive investment in infrastructure improvements.
- **Private sector participation** helped develop guidelines, operating instructions and systems to bring the whole range of related activities, from planning, design, construction, operation and maintenance and overall management, to levels of excellence.
- **Appropriate technologies** were adopted with gradual upgrading giving time and space for learning and adaptation
- Internal **monitoring and control** together with stringent regulator oversight ensured everything

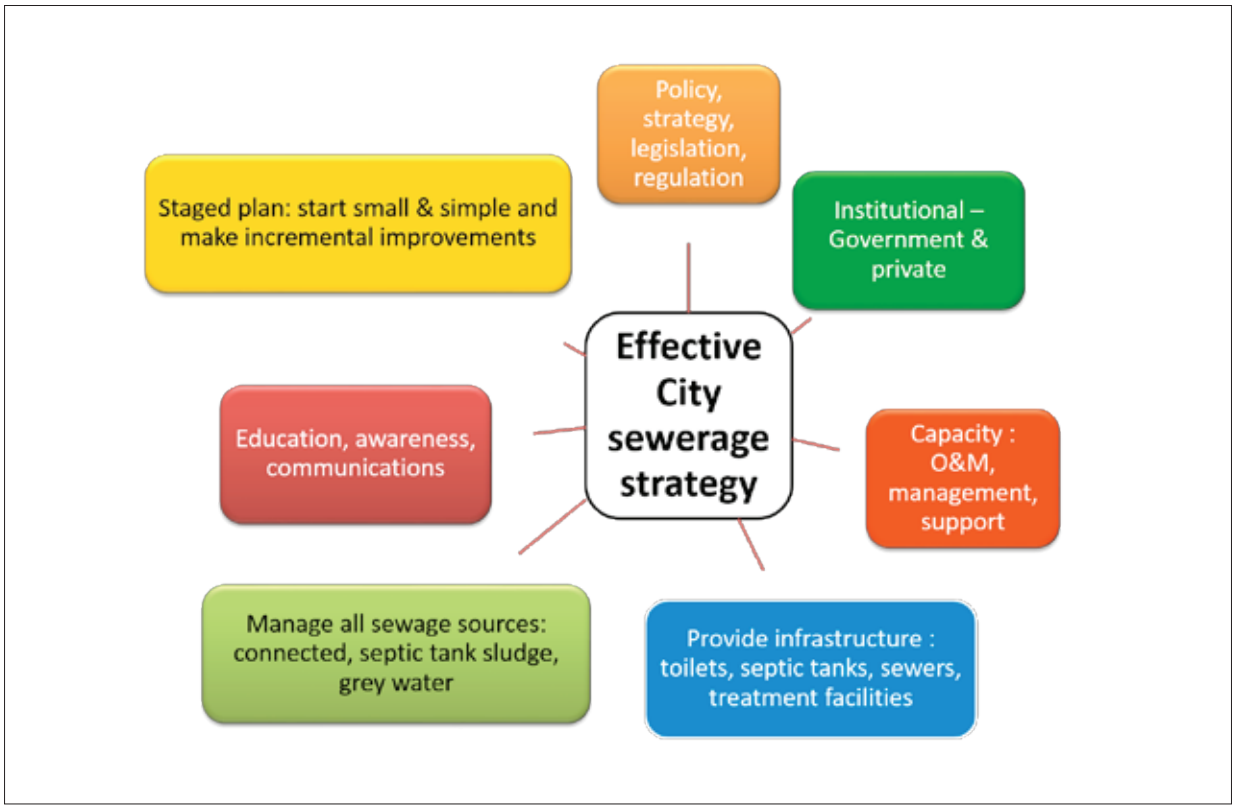



*Figure 6: Success factors.*

was well controlled and weaknesses were identified and addressed
- Strong efforts by IWK in particular created **awareness and enhanced communications** among the community.
- **Training and capacity building** efforts, again spearheaded by IWK, created a large pool of people with the expertise and skill to support the industry.

On the downside, however:

- Although the federalisation approach brought quick gains, state and local governments despite being key stakeholders were left out of the process, giving rise to various issues.
- Sanitation and sewerage became federal government matters, while water supply remained a state government responsibility. This broke the synergy between water supply and sewerage management.
- The financial model of CAPEX / OPEX recovery from the tariff was seriously flawed, and there was a wide gap between revenue and costs. Even after CAPEX responsibilities had been assumed by the gederal government, IWK needed a huge shareholder subsidy to continue to operate.
- Public acceptance of the tariffs was low and collection rates were poor.
- Developer investment in sewerage infrastructure far outstripped government investment. Coordination issues resulted in wasteful investment in many cases. Developer built infrastructure often suffered from quality issues.
- The policy of developer built sewerage infrastructure caused an increasing number of sewage treatment plants(STPs) to be built, most of them small and of various design, resulting in logistical nightmares for the operator.
- In the whole process, opportunities for resource recovery (effluent reuse, sludge biosolids reuse and energy recovery) were completely left out.
- The well-intentioned scheduled desludging regime met with failure due to lack of follow though enforcement.
- Sub-standard systems and grey water continue to be a major issue in many parts of the country.

## OUTSTANDING CHALLENGES AND NEXT STEPS

Malaysia has come a long way in the last few decades in sanitation and sewerage management. Much has been achieved in terms of physical infrastructure, regulatory and institutional structures, capacity, education and awareness. However, shortcomings remain. Looking back over the last few decades, the way forward is clear: Malaysia intends to forge ahead in this sector by charting the most appropriate and sustainable path for itself.

- The coming years will see the sector consolidating its primary roles to continue to protect public health and protect water resources, while striving to provide

nuisance free living space for the enhanced quality of life for the people.

- Priority will be given to resource optimisation, reuse and recovery.
- Attempts will be made to define and coordinate the roles played by various agencies in line with national goals.
- Public and private investment in the sector will be coordinated and innovative funding sourced, both for CAPEX and OPEX.
- Appropriate waste management strategies based on local needs will be formulated.
- Elements of whole life cost, low-energy systems, standardisation and low carbon footprint will be incorporated.

All these considerations have been included in the National Sewerage Planning Policy and Strategy, which will form the basis of the National Sewerage Development Plan. This is expected to take the sector in Malaysia to even greater heights.

## REFERENCES


Indah Water website at https://www.iwk.com.my/

National Water Commission (SPAN) website at http://www.span.gov.my/index.php/en/

Indah Water Konsortium Sustainability Reports at https://www.iwk.com.my/corporate-profile/sustainability-reports

Malaysia Water Industry Guide 2011–2013

"Malaysia's Quest for a Clean Environment", Dorai Narayana, Urban Sanitation Magazine, Jul–Sep 2016

"Centralized and Decentralized Wastewater Management in Malaysia – Experiences and Challenges (Part 1)", Ingenieur, pp.18–23, Vol. 42, June-August, 2009 , Ir. Haniffa Hamid, Ir. Dorai Narayana & S. Anusuyah Bai (Indah Water Konsortium Sdn Bhd),

Some thoughts on driving the development of sewerage infrastructure under the new WSIA regime, Haniffa Hamid & Dorai Narayana: Asia Water 2008, Kuala Lumpur

Datuk Ir. Abdul Kadir Mohd Din: "Transforming the Wastewater Industry – Malaysia's Experience", 2nd ADB-DMC and Partners Sanitation Dialogue, Manila, Philippines, 23–25 May 2011

Mohd Ridhuan, Ismail, National Water Services Commission, Malaysia, "Sanitation Policies & Initiatives in Malaysia", ADBI-JSWA-JSC Regional Workshop on Sanitation in Asia-Pacific, pp. 4–6 September 2011, Tokyo, Japan

# Emerging Lessons on FSM from Maputo, Mozambique

O. Muximpua, P. Hawkins, J. Stricker, Z. Mugabe, O. Matendjua and A. Madamuge

## EXECUTIVE SUMMARY

This case study describes a process to establish FSM services across an entire municipal district (population 150,000) in Maputo. Small-scale solid waste collection enterprises have successfully moved into the FSM business, where they have become economically viable. Key enabling factors were the problem-based approach of the municipal council, a systematic sanitation diagnostic, the enactment of by-laws recognising and regulating FSM services, and the existence of the solid waste micro-enterprises, supported by seed funding and a dedicated technical assistance team. Outstanding challenges include the development of funding and payment mechanisms to make the services affordable to the poorest residents, and of improved technology for emptying pit latrines. There is also a need for a degree of consolidation in the FSM market to create larger and more robust enterprises capable of providing a full range of faecal sludge emptying and transport services. Looking further ahead, improvement of, and linkages with the upstream (on-site facilities) and downstream (treatment and re-use) parts of the sanitation service chain merit further applied research.

## BACKGROUND AND CONTEXT

Maputo, with a population of about 1.2 million, is the capital city of Mozambique, and forms part of the largest conurbation in the country, with a population fast approaching two million. About a third of Mozambique's population (of 27 million people) is urban, which is close to the average for Sub-Saharan Africa. But of these, a high proportion (about 80 percent) lives in informal settlements, a proportion that is not decreasing as urban migration continues, with an annual urban growth rate of 3.6 percent. Although the Greater Maputo area is richer than the rest of the country, that must be taken in the context of a national GDP per capita of less than USD 600, which places the country amongst the poorest five percent, and growing (though hard to quantify) urban poverty.

About ten percent of Maputo residents are connected to sewerage, about 40 percent use a septic tank (though many are quite crude) and 60 percent use a pit latrine. Open defecation is uncommon, practised by only around one percent of the urban population. As the water supply network expands into the unplanned areas and water availability increases, residents are rapidly switching from pit latrines to septic tanks. Between 2011 and 2013, in the area where the work presented here was undertaken, household water connections rose from 36 percent to 79 percent, the use of septic tanks increased from 15 percent to 46 percent, and the use of pit latrines decreased from 85 percent to 54 percent. Despite the overwhelming prevalence of on-site sanitation, faecal sludge management (FSM) services are limited, especially in the unplanned peri-urban areas, where the majority of the sanitation facilities are emptied manually by traditional pit emptiers (43 percent) and family members (20 percent). The faecal sludge is dumped into open drains, open spaces, solid waste collection points, or buried it in backyards, which are now becoming full due to repeated sludge burial and the densification of housing.

Recognising that on-site sanitation is too important to be left to individuals and an unregulated informal sector, Maputo Municipal Council (MMC), in partnership with the World Bank's Water and Sanitation Program (WSP) and the NGO Water and Sanitation for the Urban Poor (WSUP) undertook a project to improve sanitation across the entire district of Nhlamankulo, an unplanned area with a population of about 150,000. In this context, eight FSM service providers were set up in April 2014, based on pre-existing primary solid waste collection micro-enterprises. They were trained and equipped with manual and mechanical emptying equipment, with the objective of understanding the business logic of small-scale pit emptying enterprises for subsequent scaling-up across the four other peri-urban districts of Maputo.

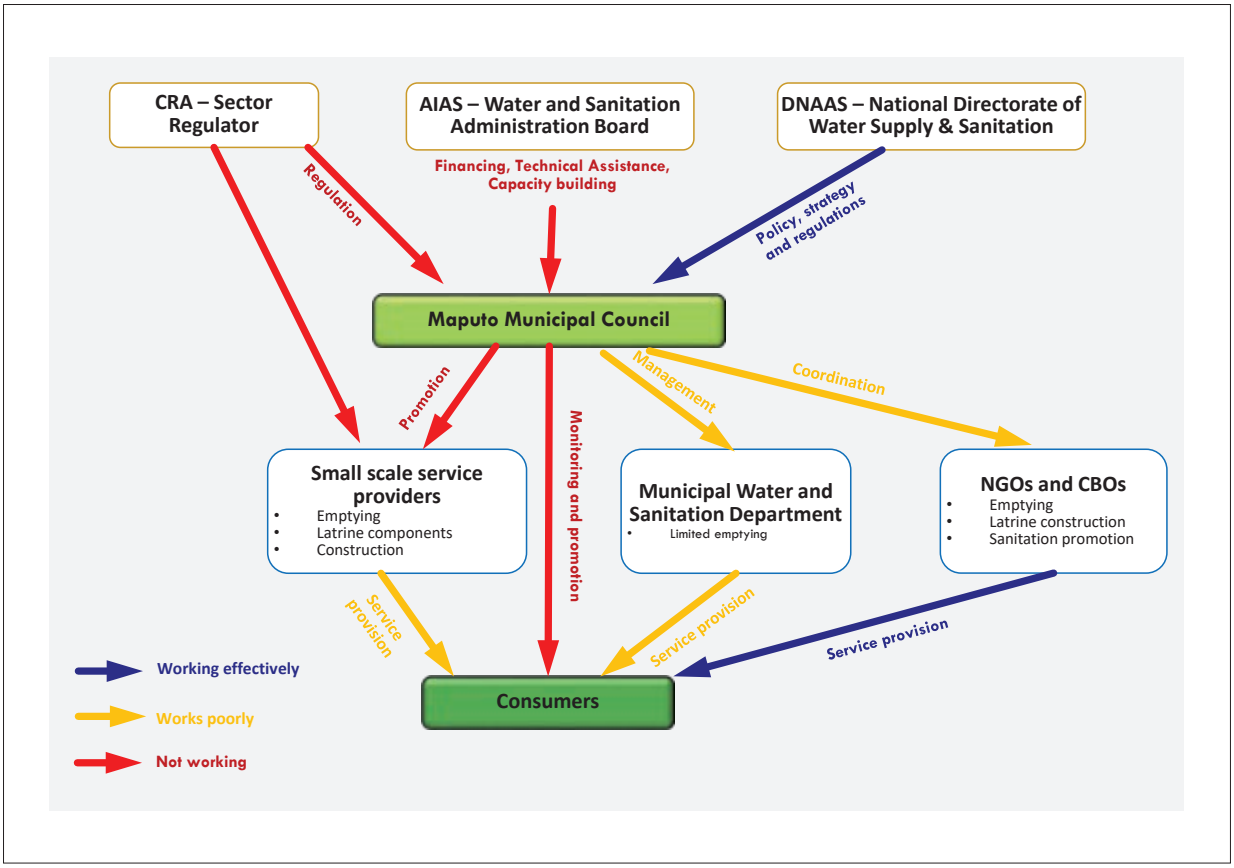



*Figure 1: Institutional framework for urban sanitation*

Although sanitation is the responsibility of the municipal councils in Mozambique, on-site systems, while recognised as an option in national policy, have been left largely to individual initiative. Residents build facilities that are not subject to building inspection in the unplanned areas, and emptying services were unregulated until the enactment of new sanitary by-laws in 2016.

## FAECAL SLUDGE MANAGEMENT PRIOR TO THE INTERVENTION

Replacement of pits when full is still quite common, practised by about 50 percent of households in the less densely settled peripheral areas of the city, and 30 percent in the inner city slums, where population density reaches about 200 people/hectare, and of which Nhlamankulo is an example. About a quarter of the facilities are inaccessible by road for emptying by vacuum tankers, and many that are accessible still have to be emptied by other methods. About one third are unlined or lined with tyres or oil drums, and would collapse if emptied by vacuum truck. Across the city, 37 percent of emptying is done by vacuum tankers, 43 percent by informal manual service providers, and the rest by the householders themselves. Only the faecal sludge emptied by vacuum tankers is taken to the municipal treatment plant (a pond system in an advanced state of disrepair), while the rest is buried or discharged locally.

Responsibility for sanitation in peri-urban Maputo is not clearly defined. The Water and Sanitation Infrastructure Board (AIAS) – under the Ministry of Public Works and Housing – is the national agency in charge of sanitation in urban areas, while the water and sanitation sector regulatory agency (CRA) regulate sanitation services. Maputo Municipal Council (MMC) has ultimate legal responsibility for providing sanitation services to its citizens, but is not delivering very effectively on this mandate, due to weak institutional capacity and unclear definition of the services required.

While there are reasonably clear policies and strategies and a defined institutional framework for sanitation service delivery, implementation at municipal level leaves a great deal to be desired. Most of the existing institutions are not discharging their responsibilities effectively, and service provision is highly fragmented and poorly coordinated. The main constraints are in financing, regulation and monitoring, all of which are key elements in effective sanitation delivery. Both CRA and AIAS have only recently been assigned responsibility for sanitation, and still have a long way to go in developing their capacity so that they are able to support local governments to tackle the

sanitation agenda. CRA has the mandate to regulate private sector service providers and the autonomous sanitation departments envisaged for the larger cities under current legislation, whilst AIAS is responsible for investing in infrastructure and capacity-building for municipal sanitation entities.

MMC is currently developing a framework to improve sanitation services in Maputo, including the introduction of a sanitation tariff, enacting a new sanitation by-law that directly addresses FSM, and planning – on the basis of the work described here – the roll out FSM service provision by private operators across the rest of the city.

Vacuum trucks charge USD 30.00–USD 80.00 per service (average USD 53.00), whilst the manual emptiers typically charge USD 7.00–USD 13.00 for latrines (often a partial emptying only, depending to the user's ability to pay) and USD 30.00–USD 70.00 for septic tanks. The manual emptiers also require the user to buy creosote to reduce odours and, usually, home-brewed spirit to be drunk before starting the job.

Based on an analysis of the situation, principal FSM needs emerged as:

- Developing services capable of emptying on-site sanitation facilities that are difficult to empty or inaccessible by road;
- Phasing out (or displacing) unhygienic manual emptying practices;
- Upgrading the treatment facility; and
- Recognising and regulating FSM services.

## PRINCIPAL COMPONENTS OF THE INTERVENTION

Although this was a pilot, it was designed to be at a scale and under a management structure that could be replicated, and so was designed to cover one of the four peri-urban districts of Maputo. The design of the pilot was based on a sanitation survey from 2011, when the ratio of pit latrines to septic tanks in the district was about 3:1. The FSM service model was consequently designed around transfer stations (simple underground storage tanks) to allow for primary collection of relatively small volumes from pit latrines using small equipment capable of moving through narrow alleyways, and secondary transport using larger equipment. The data quoted in this study refer to the period between April 2014 and April 2016, by which time the majority of residents were using septic tanks.

Eight pilot operators were selected through a competitive process, organised through AMMEPS, the association of MMC's existing peri-urban solid waste management contractors. Although the FSM business was new to all of them, all had intimate knowledge of the challenges of working in the peri-urban areas of Maputo. Five "primary" operators were equipped to provide services from collection to the transfer station, using a 0.5m$^3$ plastic tank mounted on a handcart. Three "secondary" operators additionally received a 2m$^3$ plastic tank that could be transported the longer distances to the treatment facility on a small truck. All operators were also equipped with buckets, appropriate hand tools, personal protection equipment for the workers, a Gulper for use on pit latrines, and a diesel-powered trash pump for use on the more liquid sludge from septic tanks.

Despite the support of the MMC, local resistance rendered the construction of transfer stations impossible, so each secondary operator was equipped with a 6m$^3$ vacuum tanker trailer instead. This gave the secondary operators excessive power over the primary operators, and by the end of the project, both primary and secondary operators were using the much cheaper option of the 2m$^3$ plastic tank for transport to the treatment plant on any suitable truck (easily available for hire in Maputo). Additionally, the handcarts proved difficult to operate on the rough, muddy and narrow alleyways in the area, and were abandoned in favour of direct transfer to the 2m$^3$ tanks for delivery to the treatment facility. A further reason for the abandonment of the 0.5m$^3$ handcarts was the large-scale shift away from pit latrines to septic tanks, which greatly reduced the number of emptyings of less than 2m$^3$ (Figure 1).

Customer feedback showed that the new service was appreciated for its improved hygiene, and the operators noted that the stigma associated with manual emptiers did not extend to them. However, almost 40 percent of those contacting an operator reverted to alternative methods, primarily due to price.

Initially, the plan was to charge the pilot operators commercial interest rates for the equipment. But the

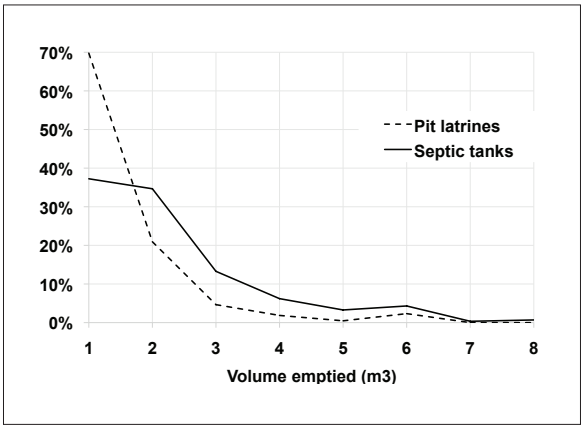



*Figure 2: Volumes emptied by facility type*

| Operator | No. of emptying's: Pits | septic tanks | Revenue | Cost | Operating profit | Depreciation | Net profit (loss) |
|---|---|---|---|---|---|---|---|
| **Primary Operators** | | | | | | | |
| Acadec | 52 | 61 | $7,645 | $4,975 | $2,670 | $2,832 | ($162) |
| Bejoel | 3 | 63 | $4,307 | $1,800 | $2,507 | $2,832 | ($325) |
| Magoanine | 76 | 79 | $7,589 | $2,963 | $4,626 | $2,832 | $1,794 |
| Modac | 0 | 41 | $1,675 | $1,293 | $383 | $2,832 | ($2,449) |
| (Phatima)* | 1 | 7 | $661 | $470 | $191 | $2,832 | ($2,641) |
| **Secondary Operators** | | | | | | | |
| Mbonga Mbilo | 49 | 185 | $10,996 | $6,488 | $4,509 | $11,495 | ($6,896) |
| Sizema | 77 | 69 | $8,635 | $4,107 | $4,528 | $11,495 | ($6,967) |
| Oliveira | 0 | 42 | $4,976 | $1,119 | $3,857 | $11,495 | ($7,638) |
| **Total** | **258** | **547** | **$46,485** | **$23,213** | **$23,271** | **$48,645** | **($25,374)** |

*Table 1: FSM operating costs and revenues for pilot operators*

interest rates were too high to allow for repayment while keeping the service affordable to Nhlamankulo residents. Furthermore, it seemed reasonable not to charge for the equipment for a service model that was still under development. The pilot operators were originally charged 3 percent of receipts, which was paid to a fund held by AMMEPS. This was later replaced by fixed monthly payments of USD 10.00 or USD 12.00 for primary and secondary operators respectively. In addition to the equipment, the

*Figure 3: Small business desludging operations with a trash pump and small tankers*

pilot operators received technical and business management support.

The service was promoted in the media and through two local sports tournaments. A major spike in emptying after the TV campaign clearly demonstrated the power of such advertising, and the potential of a franchising approach for marketing FSM services. The logo and slogan ("clean toilet" in the local language) were taken up by the service providers and used in flyers. The local authorities were also frequently mentioned by users as a source of knowledge about the services. It was also clear that micro-enterprises, which were also community-based organisations with strong community roots, were easily able to garner customers. Interestingly, the mere occurrence of emptying operations during daylight hours (traditional emptiers tend to work at night, due to the social stigma) also attracted a significant number of customers who would otherwise have been unaware of the services.

## COSTS AND FINANCIAL DATA

It should be noted that because the operators were paying 3 percent of their receipts towards the equipment, the number of jobs and the operating profits are probably significantly under-reported. Despite this, the primary operators essentially covered their full costs over the first 24 months (see Table 1), and are now operating at a profit after refining their business model. The deficit of the secondary operators after subtracting depreciation reflects the high cost of the vacuum trailer tanks, which have turned out to be inappropriate compared with the cheaper option of plastic tanks that can be carried by a light truck.

Prices charged are negotiated with clients, taking into account both the costs of the job (for example, distance to the treatment plant, or the amount of compacted sludge to be dug out) and the perceived ability of the client to pay. The average price per emptying is USD 58.00. As already mentioned, this is too much for some poor households, even with the option of paying in two or three instalments, which some of the operators are offering.

The demand for FSM services is very variable, rising in the wet season but also due to other factors, such as preparing to receive visitors in the holiday season, or in response to marketing activities. Because of this variability it is important to control fixed costs. A strategy adopted by nearly all of the operators was to contract their trained workers on a daily basis, maintaining only the foreman on a regular salary. Magoanine, a primary operator, arranges to carry out emptyings in coordinated batches, and in this way has managed to reach the same levels of operating profitability as the secondary operators. A specific advantage of the Maputo operators is that they all have primary solid waste collection contracts with MMC, which provides a modest but stable basic income which can be supplemented by FSM work (perceived by them as more profitable) when work is available.

Seven of the eight operators entering the FSM business are still operating and covering costs after two years, several have invested in additional equipment, and two that were community-based associations have now registered as companies in order to access bank credit. These facts clearly show that the business is profitable at the prices they are charging. However, these prices are similar to those charged by vacuum tankers, and well above those charged by traditional manual emptiers – and beyond the willingness to pay of poor customers. This reflects a basic fact of the FSM business, which is that much of the cost resides in transporting the faecal sludge to the treatment plant, and that it will therefore always be difficult for improved emptying with transport to compete on price with traditional emptying and local disposal.

## DRIVERS OF CHANGE

One of the key triggers for the project was the micro-enterprises themselves, through their association, AMMEPS. They were already undertaking local primary solid waste collection under arrangements similar to those in other developing country cities, providing essential public services while generating employment in low-income communities. They approached the World Bank (which had sponsored the establishment of these arrangements in Maputo) looking for ways to boost their income. In the ensuing discussion the FSM business emerged as a promising business area, which the World Bank later helped them to enter. Building FSM into pre-existing solid waste collection businesses was successful due to a number of factors: (i) the operators were already established in the target communities and familiar with their potential customer base; (ii) the nature of FSM is similar to solid waste collection and was therefore relatively easy for them to manage; and (iii) the fact that they were already providing solid waste collection services facilitated FSM, in that less solid waste, which is a serious complicating factor in pit emptying, ends up in latrine pits.

The Maputo Municipal Council had, in common with many other cities around the developing world, a decade-old sanitation master plan with detailed and unfunded plans for sewerage, and some vague

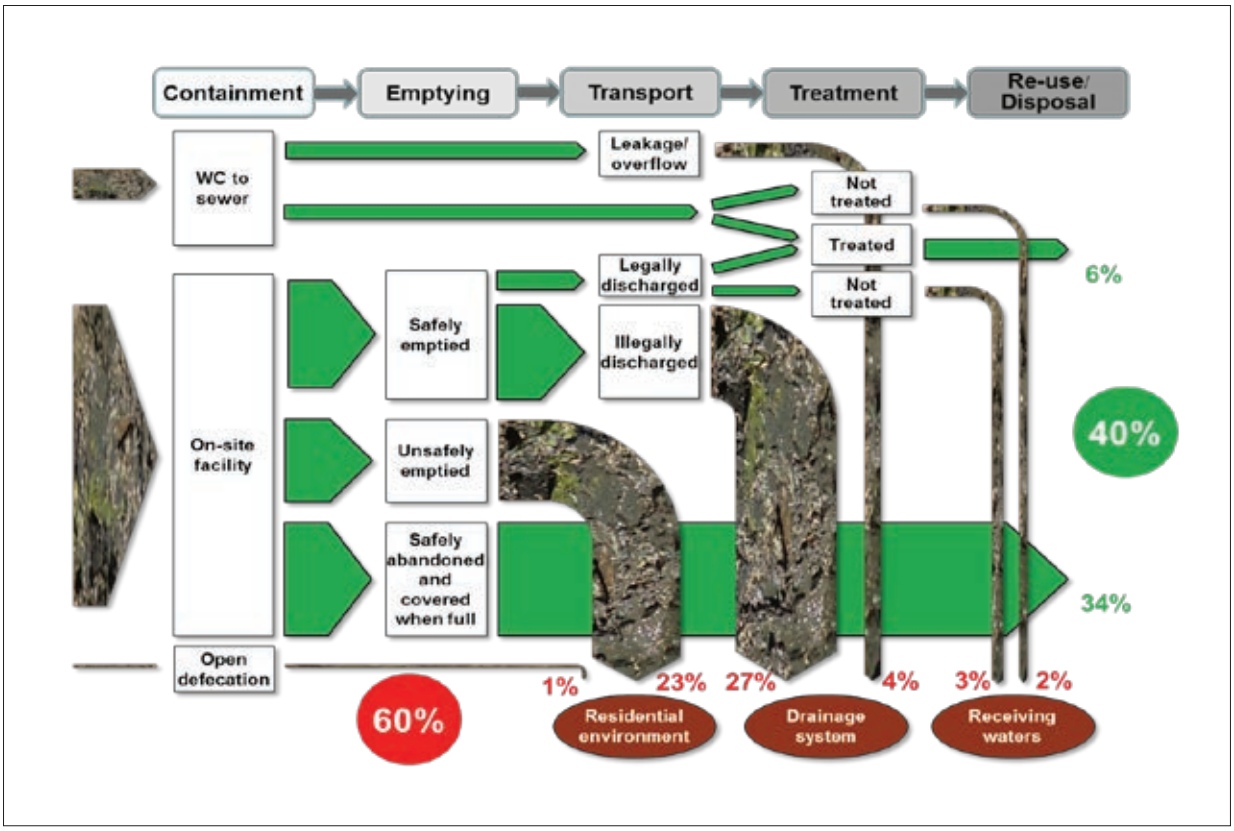



*Figure 4: Faecal waste flow diagram for Maputo*

remarks about on-site sanitation for the non-sewered areas. Around the city there were a number of uncoordinated small-scale NGO-funded sanitation initiatives in progress. Realising that neither of these approaches would lead to city-wide improvement, MMC decided to undertake a city-wide sanitation diagnostic, assisted by the Water and Sanitation Program (WSP). From this it became clear that faecal sludge management in the peri-urban areas was the most pressing sanitation issue (see Figure 4), and this informed the design of the project described here, which aimed to develop appropriate FSM services for the peri-urban areas and understand how they might be scaled up city wide.

To overcome various challenges to consolidating and sustaining FSM services, MMC has developed a city-level legal and regulatory framework to guide service provision and private sector engagement. Among the regulatory tools, MMC has drafted the Municipal Sanitation By-law, which allows for and regulates FSM service provision in peri-urban areas, based on the lessons learnt from this pilot. It also includes a set of regulations and guidelines for setting up FSM businesses, technical specifications for service provision and financial and administrative requirements for service delegation by the Municipal Department of Water and Sanitation. Although the by-law itself does not solve the challenges outlined in this report, it creates incentives for service expansion into the peri-urban areas, promotes service models that improve access for the poorest households, and establishes tools to help citizens be more vigilant in protecting their health and environment.

## KEY LESSONS LEARNED

### Technical factors

Manual emptying cannot be completely abandoned, but better tools are needed in order to improve hygiene and reduce the cost of emptying. There are technical limitations on the mechanised emptying of thicker sludge from dry pits and dense bottom sludge from both pits and septic tanks. This makes pit latrines – on which the poorest people depend – relatively more expensive to empty than septic tanks.

Substantial improvements in piped water supply over the project period resulted in a large number of pit latrines being replaced by septic tanks, which require larger volumes of more liquid sludge to be removed. This had profound implications for the equipment used, and it is important when designing a FSM service to ensure that pumps and tank volumes are aligned with the nature and volume of sludge to be removed.

The FSM business is highly seasonal, peaking in the wet season. Therefore, a micro-enterprise needs complementary sources of income to survive – provided in this case by year-round solid waste collection. Alternatively, it may be possible to spread

demand over the year with scheduled emptying. Operators quickly moved to a casual labour system, calling on their trained labourers only when required, retaining only the foreman full time.

**Marketing and consumer acceptance**
A television campaign incorporating a strong brand image had a major impact on uptake of the improved emptying services, and individual operators made use of the brand in flyers, which they found quite effective in generating business. Some of the operators were part of community-based organisations, and were able to use their strong community networks to promote sales.

Consumers appreciated the cleanliness and positive environmental impact of the new services, which were definite selling points. However, a sizeable minority (24 percent) found the service too expensive and continued to use traditional manual emptiers. This is perhaps to be expected, since a major added element is transport away from the local area to the treatment plant, which is the most expensive component of the service. How to subsidise this effectively and sustainably should be the subject of future work.

## OUTSTANDING CHALLENGES AND NEXT STEPS

This work has demonstrated that small-scale FSM businesses can serve dense, unplanned peri-urban areas inaccessible to large vacuum tankers. However, the poorest households are not willing to pay an economic price when traditional manual emptying services, which are intrinsically cheaper as they do not involve transporting the faecal sludge away from the neighbourhood, are available. Experimentation is required to work out the best way of applying potential resources from the sanitation fee soon to be applied to water bills, and of maximising user contributions through flexible payment mechanisms, so as to make FSM services affordable to all and to phase out unhygienic manual emptying.

The experience shows that a mix of emptying equipment types and transport options could be more profitable than the current model. It would allow operators to serve a greater variety of clients and compensate for equipment downtime. This consolidation could occur in a number of different ways, ranging from outright mergers to the formation of looser groupings such as franchises or cooperatives. Well-organised groups of FSM operators could invest in a wider variety of equipment, make more effective use of available equipment, and combine their marketing effort. Whatever the option chosen, transport will remain the principal cost factor and technical constraint. All available vehicles should be used as economically as possible, and for this the efficient coordination of emptying crews is crucial, irrespective of the way it is institutionally organised.

Factors such as inaccessible location, lack of access covers, consolidation of sludge, and the ingress of solid waste, contribute greatly to the cost of emptying on-site facilities. Better technology for dealing with consolidated sludge will always be needed, and should be developed. However, all of the factors mentioned are susceptible to better design and construction of latrines and septic tanks. Over the longer term, improved toilets with reduced emptying costs could have a lifetime cost less than the current poorly designed toilets, which are difficult to empty. This could best be delivered as a complete service package including the toilet and regular emptying, similar to the way mobile phone contracts are structured, with all or part the capital cost and all normal operational expenses covered by a fixed monthly service fee. The keys to making such a concept work would be adequate scale and a means of funding the up-front investment costs.

On the downstream side, the opportunity should be taken when funds become available to rehabilitate the municipal sewage treatment plant, to build facilities specifically for processing faecal sludge. This would avoid damage by faecal sludge to the sewage treatment process, and reduce the cost of producing usable products such as solid fuel or compost. The choice of end product should be made carefully, taking into account local markets for potential products and the costs of producing them.

Services similar to those described here are being rolled out across the rest of Maputo and in other cities. They should incorporate the learning already gained, and seek to develop solutions to the many remaining issues.

## ACKNOWLEDGEMENTS

This work was funded by WSP-World Bank, The Japan Social Development Fund, and the Public-Private Infrastructure Advisory Facility, all administered by the World Bank. Much of the work was executed by Water and Sanitation for the Urban Poor under the leadership of Carla Costa and Vasco Parente, and none of it would have been possible without the enthusiastic backing and support of MMC, notably Victor Fonseca, Councillor in charge of Infrastructure, Circy Chaly, head of the Water and Sanitation Department, and Análio Tembe, leader of the sanitation section.

## REFERENCES

Chowdry, S. & Kone, D. (2012) Business Analysis of Fecal Sludge Management: Emptying and Transportation Services in Africa and Asia. The Bill and Melinda Gates Foundation

Hawkins P. & Muximpua, O. (2015) Developing Business Models for Fecal Sludge Management in Maputo, World Bank WSP Technical report

Strande, L., Ronteltap, M. & Brdjanovic, D. (2014) Faecal Sludge Management. Systems Approach for Implementation and Operation. IWA Publishing

# Dumaguete Philippines Fecal Sludge Management Program: A Case Study

David Robbins and Josie Antonio

## EXECUTIVE SUMMARY

In 2003, Dumaguete City began a quest to achieve city-wide sanitation. A city sanitation assessment in 2004 identified risk of contamination in deep and shallow wells, deteriorating surface waters due to a lack of a centralized sewer system, and more than 20,000 poorly designed septic tanks in use in the city. Water quality analysis revealed that the bay had contamination levels 22 times higher than the regulatory standards. The concern was that both groundwater and surface water contamination would have measurable impacts on health, tourism and livelihood if unabated.

Septage is now treated in waste stabilization ponds and constructed wetlands to produce an effluent suitable for discharge. The facility is officially licensed and legally compliant. The city also developed their own local ordinance on septage management, which sets out policies and procedures, the fee structure, and penalties for non-compliance.

The financial model was based on the concept that if everyone paid a little, there would be enough money to support the program. The original tariff of PHP 2.00 (USD 0.04) per cubic meter of water used or about USD 1.00 per family per month remains unchanged six years on. Households that use less than 10 cubic meters of water per month pay a minimum fee of around USD 0.44/month. These tariffs were sufficient to achieve full cost recovery in about five years.

The program has resulted in measurable improvements to the environment and significant economic development. Continued and ongoing promotions campaigns are important activities that will drive the program in the future through increased demand and willingness to pay for the service.

## INTRODUCTION

The Dumaguete City Septage Management Program was the first in the Philippines to be initiated, planned and funded by local government. In 2015, or five years

*Figure 1: Dumaguete Septage Treatment facility uses waste stabilization ponds, constructed wetlands and sand drying beds. Josie Antonio, Chief Planning Officer 2003–2011 in foreground.*

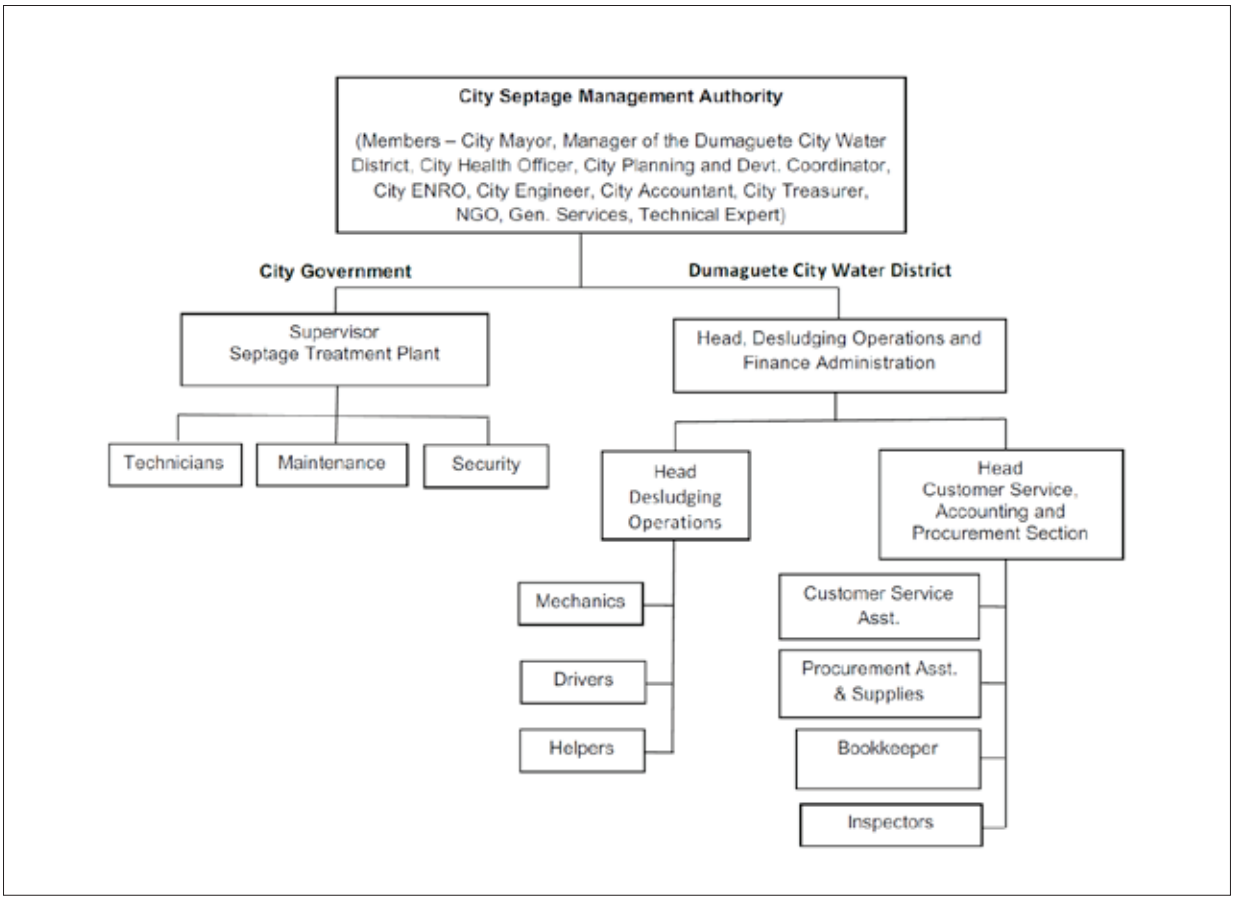



*Figure 2: Dumaguete City Septage Management Program organizational chart.*

after the system became operational, it achieved full cost recovery through tariffs averaging about PHP 44.00 (USD 1.00) per family per month (poor people pay a lower minimum fee).

Today, the eight vacuum tankers and 40 staff – four to maintain the treatment plant, ten to maintain the grounds, and 26 to operate and maintain the eight desludging trucks, which collect an average 67 cubic meters of septage per day. 27,000 families pay the tariff, and approximately 3,015 tanks are desludged each year.

The fecal sludge management program in Dumaguete City utilizes a business model, which is a partnership between the local government and the local water utility. Under this arrangement, the city owns and operates the treatment plant and the local water utility conducts the desludging program. A tariff is attached to the water bill that covers the debt service on the plant and trucks and enables septic tank desludging on a rotating five-year cycle

The city government and Water District financed the program's start-up costs, including construction of the treatment plant and access roads, and purchase of desludging vehicles using their own resources. The city government and Water District also co-manage the program (see Figure 2).

From 2003 to 2006, Dumaguete City received technical assistance from the Local Initiative for Affordable Wastewater Treatment (LINAW) program, and from 2006 to 2010 through the Philippine Sanitation Alliance, both initiatives of the United States Agency for International Development (USAID).

## CONTEXT AND BACKGROUND

Dumaguete is a coastal city with a current resident population of 135,000 and a daylight population of between 300,000 and 400,000, known throughout the Philippines as the City of Gentle People. It boasts Silliman University and medical center, a larger than average ex-pat community, and a thriving "scene" on Rizal Boulevard, the main thoroughfare fronting the Bohol Sea. Back in 2004, due to the growing sewage problem, the Boulevard was no longer attractive and inviting due to the stench from raw sewage entering the bay. Dumaguete City was at risk of losing its prestige as a leader in environmental conservation, and a tourism destination as a clean city.

Former Mayor Agustin R. Perdices (1934–2011) soon came to realize the importance and value of improving sanitation in terms of the city's economic development and poverty alleviation strategies. The direct result was that wide latitude was given to the city's departments

of health, environment, planning and engineering to work together to solve this problem.

During the 2000's the trend in the Philippines was towards decentralization of regulatory authority from the national government to local government units (LGUs). While the national government departments of environment and health provided some oversight of sanitation through their policy and permitting requirements, it was the local city government of Dumaguete, led by the city mayor that initiated, developed and implemented the city's septage management program.

Through the help of the LINAW staff early on, the magnitude of the sanitation problem was identified as follows:

- 16 deep wells and many of the 1000 shallow wells were contaminated with *E. coli* bacteria;
- Effluent from residential septic tanks drained into surface waters and into the bay;
- Indiscriminate dumping of septage by the private tanker operator, either directly into the drainage system or uncontrolled into open space was causing a serious nuisance problem; and
- Failing septic tanks, especially from the public market and other institutional buildings also discharged directly into the bay.

The net result of wastewater entering the surface waters was that the pollution levels in the bay fronting the city exceeded the national environmental standards by a factor of 22.

Compounding the need for improved sanitation at the start of the program was increasing urbanization and demand for clean water. Through consultations with LINAW, the City resolved to launch a City-wide septage management system and begin construction of decentralized wastewater treatment systems for key institutional buildings. A multimedia targeted promotions campaign was launched focusing on what was determined to be the key motivators of the population – health of children, making the bay swimmable again, and saving the Boulevard.

The city utilizes a bottom-up, stakeholder driven planning process to implement their programs. One glaring issue was the failing septic tanks at the public market, which were discharging raw sewage into the drainage system leading right to the bay, creating an intolerable situation. This issue gave rise to increased awareness of sanitation issues, and public support for overall sanitation improvement in the city including the Septage Management Program. With the assistance of the Bremen Overseas Research and Development Authority (BORDA), a proper on-

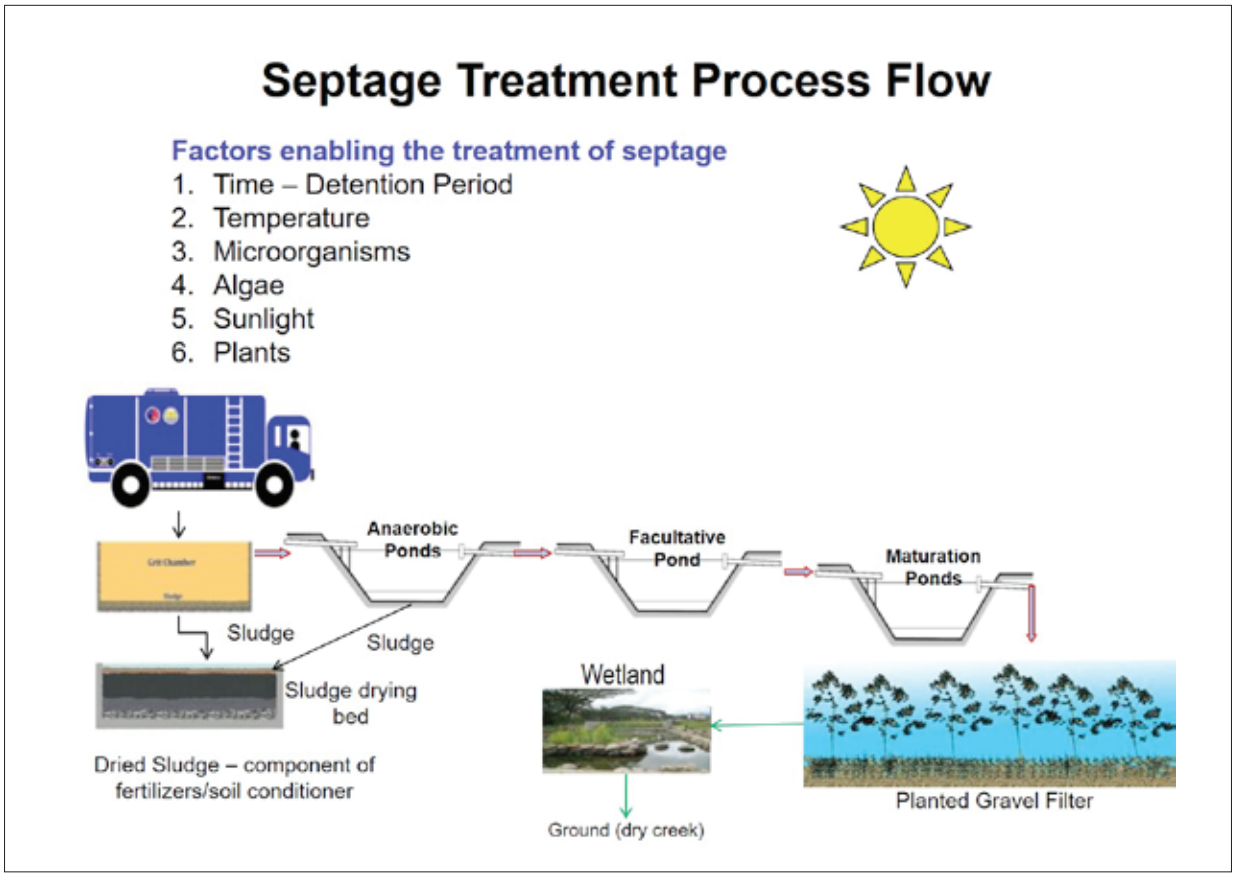



*Figure 3: Process flow diagram. The septage is treated naturally through the action of microbes, algae and plants in the presence of sunlight. The system produces a highly-treated effluent.*

site wastewater management system was installed at the public market in 2006. By 2009, when the septage treatment system was in its final stages of construction, the city teamed up with the local water utility (Dumaguete City Water District, a government owned and controlled corporation) to jointly operate the city's septage management system. Under this arrangement, the city is responsible for the operation and maintenance of the treatment plant, while City Water District operates and manages the collection and transport of septage to the treatment plant. They also administer the billing for the septage program, adding the fee to the users' water bills. The partnership has successfully operated the system for the past six years. This partnership between city government and the Water District (the water utility) in septage management was first of its kind in the Philippines, and presents a viable model for replication.

Finding a site for the proposed treatment plant proved to be difficult and controversial. The non-mechanized system (see Figure 3) required a large, two-hectare site. The only "suitable" site large enough was in a village near the banks of the Okoy River. The perceived future flooding risk and potential odor and health risks of the proposed treatment plant were used by local villagers to object to the location, and this delayed the progress of the program. Ultimately, a river bank analysis and design of flood control structures were conducted and incorporated in the program. Doctors also spoke to the villagers about the health aspects of the program, which helped to change minds and attitudes. Additionally, economic development plans for the host village were agreed to by the city and village, which resulted in jobs for residents, improved roads and power supply, improvement of a public village health care facility and school, and college education assistance, all paid for by the septage management program.

From the beginning, Mayor Perdices decided that the Septage Management Plan should be developed by the city government, which would use its own personnel and resources to design and construct the system. This differed from the normal practice of sub-contracting – a model that has been widely used by government agencies to implement programs in the Philippines. The mayor was confident in the ability of his engineering staff to construct and supervise large civil works, and his planning department to organize and manage the step-by-step process.

## FSM SERVICES (EXISTING OR PRIOR TO INTERVENTION) AND LOCAL CONTEXT

Prior to the intervention, septage was managed informally by unlicensed private operators using septage vacuum trucks, colloquially referred to as "*Malabanan*", based on a call-for-service business model. Only one operator provided the service, which was unregulated in terms of disposal location and fees


*Figure 4. The Department of Health is a national government agency that issues sanitary permits, which include provisions for worker health and safety.*

*Figure 5a: Motor pool building installed in 2012 to better maintain the trucks. 5.b: Fleet mechanic inspects old desludging truck tank. To keep costs down, vacuum tanks are now fabricated on site.*

charged. Collected septage was disposed of either to land, with runoff flowing directly to surface drainage, or directly to the drainage system. The service was expensive, at around USD 240 per emptying, which is approximately four times the current charge levied by the city's Septage Management Program.

The Philippine Clean Water Act was promulgated in 2004, just after the start of this project. It mandates that *"...each Local Government Unit shall appropriate the necessary land, including the required rights-of-way ... for the construction of sewage and/or septage treatment facilities"* and that *"...they may raise funds to subsidize necessary expenses for the operation and maintenance ... through local property taxes and enforcement of a service fee system".* The Act also mandated the formulation of a National Sewerage and Septage Management Program (NSSMP) to provide guidance and cost share guidelines to local governments implementing program. The NSSMP was enacted into law, receiving final approval in May 2012.

The mandate of the Philippine Clean Water Act is cited as the first rationale for Dumaguete City in pursuing their local ordinance on septage management. Others include:

- septic tanks within the city not being properly designed[1], installed or operated;
- groundwater being a fragile resource and the city's only water source;
- the installation of a piped sewerage system being beyond the city's ability to finance and implement at this time;
- the city's concern about the public health implications of the poor sanitation; and
- the deteriorating water quality of the bay fronting the city.

Thus, City Ordinance 18, Series 2006 was adopted by the city council, thereby establishing the Septage Management System in the City of Dumaguete.

Dumaguete City's Septage Management Ordinance:

- Requires that all homes and buildings have an approved excreta disposal system (septic tank or other approved structure);
- Prohibits discharge of septage anywhere other than the city-owned and operated licensed treatment facility;
- Provides model septic tank design criteria;
- Provides permit requirements for new construction;
- Requires that septic tanks should be desludged every 3–5 years, or when 1/3 full of sludge;
- Requires the creation of a City Septage Management Authority (CSMA) to oversee the program;
- Provides a tariff structure to sustain the septage program; and
- Provides penalties for non-compliance.

Three national government departments have duties and responsibilities in septage management, as follows:

- Department of Health – issues sanitary clearances for new septage management collection and treatment systems (Figure 4);
- Department of Environment and Natural Resources – reviews technical plans, and issues construction permits for septage treatment systems, and monitors efficiency of treatment plants; and
- Department of Public Works and Highways, the agency managing the NSSMP.

## WHO DID WHAT AND WHEN – SUMMARY OF FSM INTERVENTIONS AND CHANGES

Timeline of major activities:

2003 – LINAW/USAID technical assistance program engages Dumaguete as one of four model cities for sanitation improvement;

2005–2006 – i) Stakeholder and Technical Working Group outputs shape the project with LINAW/USAID

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Current septage tariff per cubic meter of water | 2 | Pesos | | | | | | | | |
| Community Growth Rate - residential | 5% | 5% | | | | | | | | |
| Community Growth Rate - Commercial/Institutional | 2% | | | | | | | | | |
| Adjusted overall growth rate | 3.8% | 3.8% | | | | | | | | |
| Annual Inflation rate | 9% | 9% | | | | | | | | |
| Daily flow at year 0 | 60 | cubic meters | | | | | | | | |
| Average monthly cost per residential user | 48 | Pesos | | | | | | | | |
| Average monthly cost per commercial user | 60 | Pesos | | | | | | | | |
| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
| Number of homes | 22,000 | 23,100 | 24,255 | 25,468 | 26,741 | 28,078 | 29,482 | 30,956 | 32,504 | 34,129 |
| Number of commercial/institutional | 3,500 | 3,570 | 3,641 | 3,714 | 3,789 | 3,864 | 3,942 | 4,020 | 4,101 | 4,183 |
| Daily flow (cubic meters per day) | 60 | 63 | 65 | 68 | 70 | 73 | 76 | 78 | 81 | 85 |
| Monthly Income - Residential | 1,056,000 | 1,108,800 | 1,164,240 | 1,222,452 | 1,283,575 | 1,347,753 | 1,415,141 | 1,485,898 | 1,560,193 | 1,638,203 |
| Monthly Income - Commercial | 210,000 | 214,200 | 218,484 | 222,854 | 227,311 | 231,857 | 236,494 | 241,224 | 246,048 | 250,969 |
| Total monthly income | 1,266,000 | 1,323,000 | 1,382,724 | 1,445,306 | 1,510,885 | 1,579,610 | 1,651,635 | 1,727,122 | 1,806,241 | 1,889,172 |
| Total Annual income | 15,192,000 | 15,876,000 | 16,592,688 | 17,343,668 | 18,130,624 | 18,955,324 | 19,819,621 | 20,725,464 | 21,674,897 | 22,670,064 |
| Total residual (annual) | 2,381,168 | 2,080,442 | 1,693,168 | 1,206,295 | 605,031 | -127,379 | -1,009,914 | -2,064,054 | 1,209,922 | -263,536 |
| Collection expenses | 6,265,706 | 7,068,532 | 7,974,225 | 8,995,964 | 10,148,619 | 11,448,964 | 12,915,922 | 14,570,842 | 16,437,807 | 18,543,987 |
| Operation expense subject to inflation | 2,021,100 | 2,202,999 | 2,401,269 | 2,617,383 | 2,852,948 | 3,109,713 | 3,389,587 | 3,694,650 | 4,027,168 | 4,389,614 |
| Fixed Operations Expenses | 4,524,027 | 4,524,027 | 4,524,027 | 4,524,027 | 4,524,027 | 4,524,027 | 4,524,027 | 4,524,027 | 0 | 0 |
| total Expenses | 12,810,832 | 13,795,558 | 14,899,520 | 16,137,373 | 17,525,593 | 19,082,703 | 20,829,535 | 22,789,518 | 20,464,975 | 22,933,601 |
| Total Residual (cumulative) | 2,381,168 | 4,461,610 | 6,154,778 | 7,361,073 | 7,966,104 | 7,838,725 | 6,828,811 | 4,764,757 | 5,974,678 | 5,711,142 |

*Figure 6: Initial projections for the project assumed full cost recovery for the treatment plant and trucks by year 8. According to the Water District General Manager Esperato Dicen, the system actually achieved full cost recovery at the end of year 5, in part due to lower than expected operating expenses, and additional revenue sources.*

support, ii) surveys are conducted, preliminary designs prepared, and the local ordinance establishing the program and tariffs is drafted, and iii) flood study of the Okoy river is conducted;

2007 – City obtains Environmental Compliance Certificate from the Department of Environment and Natural Resources (DENR), and the Department of Health (DOH) Sanitary Clearance for the city's proposed septage system is issued;

2008 – i) With USAID technical assistance, the city engineering and planning departments develop the detailed designs, ii) city-wide multimedia promotions campaign launched, iii) BORDA develops new sewage treatment facility for public market;

2009 – The city and Water District sign a memorandum of understanding for joint management of the program. The city will be responsible for operating the treatment plant and the Water District for desludging operations and collection of tariff with water bill. Net profits, if any, would be evenly split;

2010 – i) construction of the septage treatment plant is completed, ii) fleet of six refurbished vacuum trucks is purchased, iii) the user fee system comes on line, and iv) the system begins receiving and treating septage;

2012 – i) administration building and motor pool building are installed on site to better manage the system (Figure 5.a). Mechanical skills are developed to allow for on-site vacuum tank manufacture (figure 5b);

2015 – Full cost recovery is achieved, including all OPEX and CAPEX (operational and capital expenditures).

## FINANCIAL AND ECONOMIC ASPECTS

The development of the financial model and business plan proved to be a turning point in the early phase of the program. It was based on the concept that if everyone paid a little, there would be enough money to support the program; and that making monthly payments on top of the water bill instead of having to pay a lump sum at the time of service was perceived as being more affordable. The septage management tariff was tied to the water bill and set at PHP 2.00 (USD 0.05) per cubic meter of water consumed. With average consumption at about 22 cubic meters of water per family per month, the average septage bill is PHP 44.00 (USD 1.00) per month. To make the tariff pro-poor, rates are adjusted to allow for a low minimum payment for the septage service for those families that consume less than 10 cubic meters per month. For these families, the septage fee is PHP 22.00 or about USD 0.50 per month. Based on interviews and surveys conducted at the time, this tariff was deemed affordable. This billing mechanism was seen as an especially effective way of collecting the tariff, because more than 90 percent of households in Dumaguete City have metered piped water.

The tariff offered an opportunity for residents to pay by the month for septic tank cleaning services, instead of paying a lump sum at the door. Eliminating "payment at the door" helps to guard against illegal dumping as there is no longer an economic incentive to do so, at least within the city limits. With 22,000 household and 2,400 business customers at the time of the program inception, the projected revenue of about USD 25,000

per month was enough to pay both the capital and operating costs.

In developing the financial model, a Microsoft Excel-based toolkit was written to help the user develop a business plan specific to the local community (Figure 6). Variables considered in the toolkit include:

- Frequency of the desludging service (number of years between servicing);
- Size (volumetric capacity) of the vacuum truck;
- Number of days of operation per week, and
- The desludging increment or how much septage will be collected from each containment tank.

It also considered population growth and inflation rates.

Figure 6 shows the projections page of the toolkit. It projected that the septage user fee of PHP 2.00 per cubic meter of water consumption as a septage user fee would be sufficient to support the program, with some residual left over for related projects in the host community. The initial capital invested by the city and Water District to build the system and purchase the trucks was PHP 25 million (USD 550,000). According to the projections, full cost recovery would require eight years. However, the amount spent on capital investment was fully recovered in five years, because actual operating expenses were lower than anticipated, at about PHP 11 million (USD 250,000) per year in 2012 (Figure 7) compared with the PHP 14.9 million initially projected. Also, the actual

Budget Income Statement
For the Budget Year Ended 2012

| | Item | | Pesos | Pesos |
|---|---|---|---|---|
| 1 | Septage "User Fee" Revenue | 24,000 households x 25cum/month x 12 months x P2.00/cum | | 14,700,000.00 |
| | Assessment/Production Meter | | | 640,000.00 |
| | Less: Billing Adjustment Memo | | 24,000.00 | |
| | Senior Citizen Discount | | 1,200.00 | 25,200.00 |
| | Net "User Fees" Revenue | | | 15,355,200.00 |
| | Other Income (Charges) | | | |
| | Bank Interest | | 7,200.00 | |
| | Bank Charges | | (4,200.00) | 3,200.00 |
| | Total Income | | | 15,358,400.00 |
| | | | | |
| 2 | Operating and Maintenance Expenses | | | |
| | a. Salaries, Wages and Honoraria | | | 4,306,488.00 |
| | b. Fuel and Oil | | | 2,182,600.00 |
| | c. Depreciation | | | 1,500,000.00 |
| | d. Financial assistance to host barangay | | | 1,002,300.00 |
| | e. Maintenance expenses | | | 838,000.00 |
| | f. Security Services | | | 360,480.00 |
| | g. Travelling and Training Expenses | | | 200,000.00 |
| | h. Representation Expenses | | | |
| | i. Taxes, Insurance and Licenses | | | 131,400.00 |
| | j. Truck and Plant supplies | | | 108,400.00 |
| | k. Utilities Expense | | | 75,600.00 |
| | l. Medical and Vaccine expenses | | | 65,000.00 |
| | m. GSIS, Philhealth, and other contributions | | | 54793.52 |
| | n. Office supplies expenses | | | 50,000.00 |
| | o. Miscellaneous and General Expenses | | | 218,000.00 |
| 8. Total Operating and Maintenance Expenses | | | | 11,243,111.52 |
| 9. Net Income | | | | 4,115,288.48 |

*Figure 7: 2012 balance sheet for the Dumaguete City Septage Management Program. Source: Dumaguete City Planning Department.*

population (2015: 135,000 or 27,000 households) was higher than the initial projection, resulting in higher monthly revenue from tariffs. Finally, in later years, there was additional income from commercial and institutional users, which used more water than originally projected. This resulted in additional revenue from septage tariffs from this sector, from desludging outside Dumaguete, and from establishments with private deep wells that pay a tipping fee to access the treatment plant.

## DRIVERS OF CHANGE

Most significant was the drafting of a new city ordinance establishing a septage management program and minimum criteria for on-site wastewater treatment systems. A promotions campaign was initiated to raise community interest in and willingness to pay for the program, as well to promote the new ordinance. At the same time, plans were developed for the city's septage treatment plant and the decentralized wastewater systems for key institutional buildings. Other drivers of change include:

- The city mayor recognizing that improving sanitation, especially if it could restore the water quality of the bay along the Boulevard, could stimulate economic development. This gave his governmental offices a clear focus and established motivation for collaboration (Figure 8);
- The Philippine Clean Water Act of 2004 and its mandate that local governments implement septage management programs if sewerage systems are not affordable. This was the primary reason cited for the promulgation of the local septage ordinance;
- The community, through stakeholder meetings, agreeing to the need for the septage management program. This was also driven by the multisector awareness campaigns;
- Showing that the program would be a money maker and not a burden to the city coffers. The toolkit turned out to be a very good advocacy tool for decision-makers. After a five-minute introduction, they operated the tool for themselves to see how changes in certain variables affected costs and revenues. Later, the Technical Working Group (TWG) used the toolkit to optimize their program;
- Coming to an agreement with the host village for the Septage Treatment Plant;
- The sustained awareness and multimedia promotions campaigns, which gained support for the program; and
- Interest and technical assistance from USAID;

## LESSONS LEARNED AND IMPACTS

The program initially started out to introduce a scheduled desludging program, with trucks going house-to-house throughout the city on a five-year cycle. Participation was voluntary, but since families were paying for the service through their monthly water bills, the percentage of participating families was initially high. It is believed that the promotions

*Figure 8: Rizal Boulevard today, an important part of Dumaguete City's identity, and a driver of tourism and economic development.*

**SUMMARY OF DESLUDGING OPERATIONS, May 2010 - April 30, 2014**

| | Source | No. of Septic Tanks Desludged | % | Volume of Septage collected, cum. | Average vol., cum |
|---|---|---|---|---|---|
| 1 | Residences (Estimated Number of households = 25,000) | 11,323 | 79 | 44,627 | 3.94 |
| 2 | Commercial Establishments | 1,600 | 11 | 11,030 | 6.89 |
| 3 | City and Provincial Govt. Offices, Other LGUs | 964 | 7 | 10,104 | 10.48 |
| 4 | Public Schools | 182 | 1 | 2,174 | 11.95 |
| 5 | Others (private schools, churches, NGOs, LGU) | 255 | 2 | 2,344 | 9.19 |
| | Total | 14,324 | 100 | 70,279 | 4.91 |

*Table 1: Summary of desludging operations – May 2010 – April 2014. Number of septic tanks desludged by facility type during the four-year period from May 2010 to April 2014. Just under half of the residential tanks in the city were desludged, which was significantly lower than the target.*

campaign drove this initial success. However, following a drop in the participation rate about two years in, it no longer made sense to go door-to-door, so the model switched to a call-for-service program. It is believed that participation dropped because promotional initiatives, which were an important reminder of the need for the service ceased.

There are theoretical advantages to a scheduled desludging model, including economies of scale and greater program efficiency. In practice, however, these were not realized when the program shifted to the call-for-service model. The current program in Dumaguete City is working, but not everyone calls even though they are paying for the service. The net result is less septage being collected and treated than anticipated, resulting in lower operating expenses (Table 1).

There appears to be a direct correlation between the promotion campaigns and the level of interest in the program. When the promotion campaigns tapered off, so did the participation rate.

The tariff structure with its pro-poor features was widely accepted by the community. This was at a time when the promotion campaign promising to "Save the Boulevard" was in full swing. The timing of the promotion campaign, which involved public hearings about the local ordinance, was very effective.

Private desludgers, which used to indiscriminately dispose of septage, now dispose of collected sludge into the city's treatment plant for a small fee.

Numerous local government units, private groups and international development agencies have visited the city's septage system and are encouraged by the city's innovative approach to sanitation. The city's system is now a model to other local government units.

## OUTSTANDING CHALLENGES, NEXT STEPS AND PLANS FOR GOING TO SCALE

The treatment plant continues to generate a high volume of treated bio solids, which require a storage facility or disposal site for proper management. In part, this is due to low utilization of the bio solids for agricultural purposes.

The refurbished desludging trucks need professional maintenance and the tanks require replacement after three years. The Water District hired a full-time mechanic in 2013, which helped address this issue. Use of coatings on the tank to prevent corrosion may help to increase the longevity of the tanks.

One of the greatest challenges is to increase participation in the program. Currently (2016 data), the program is falling short of the pumping target by just over 2,000 tanks per year. Pumping these additional tanks would meet the goal of pumping every tank within a five-year period. It is believed that bringing back the promotion campaign would be a good start to addressing this issue.

Households and business establishments located outside Dumaguete City are requesting desludging services. The fee charged varies by distance from Dumaguete and the volume of septage removed. The city government needs legislation to allow its facilities to serve areas beyond its political jurisdiction.

One next step has emerged as a priority. This is to expand the septage management services to other neighboring municipalities, which would require expanding the capacity of the treatment plant.

## NOTES

[1] City of Dumaguete Septage Management System, City Government of Dumaguete, 7/21/2012. http://documentslide.com/download/link/city-government-of-dumaguete-republic-of-the-philippines-septage-management. Accessed 1/21/2017.


## ACKNOWLEDGEMENTS

City Government of Dumaguete: Mayor's Office, Planning Office, and Engineering Department;

Dumaguete City Water District, General Manager Esperato Dicen;

United States Agency for International Development with technical assistance provided by the Local Initiative for Affordable Wastewater Treatment (LINAW) and Philippine Sanitation Alliance (PSA) projects.

# Piloting Pit Emptying Service in Kigali, Rwanda

R. Sklar, L. Stupin, N. Greene and A. Muspratt

## EXECUTIVE SUMMARY

Pivot recently launched a new division of the business, Pit Vidura, which offers a safe and hygienic pit latrine emptying service in low-income and informal settlements in Kigali. Prior to Pit Vidura, the only option for emptying a full pit latrine was to do so manually – a procedure that involved a person getting inside the pit and shoveling it out and then dumping the waste in the immediate vicinity.

Pit Vidura is currently the only pit exhausting service that is safe, reliable, and affordable to residents in dense settlements in Kigali. Pit Vidura's potential market includes urban households with full pit latrines that need a safe and affordable pit emptying service. In Kigali, an estimated 103,000 households use pit latrines across the city. Many of these latrines are in dense settlements, inaccessible to traditional exhauster trucks. Even if these pit latrines are accessible, the exhauster trucks refuse to service them due to the added complications of the weak structural integrity of the pits (unable to cope with strong vacuum) and high volumes of solid waste.

Between the beginning of May and the end of October 2016, 152 pits were emptied by Pit Vidura using an eVac pump. The eVac was used to excavate sludge from household pit latrines, and a truck was hired to transport sludge, contained in barrels, from households to the Pivot Works fuel factory. A group of six pit latrine emptiers were trained to do the work safely and equipped with the appropriate personal protective equipment (PPE). An in-depth cost analysis was carried out for this period. Among the findings are that customer prices are set too low because household revenues are insufficient to cover the operational costs of the service. A better understanding of the target market's willingness to pay is needed to determine a price point that achieves cost recovery while continuing to serve our target market. To lower the cost of service delivery, Pit Vidura will focus on developing a pit-to-road pump technology to enhance the efficiency of the emptying process.

## LOCAL CONTEXT AND BACKGROUND

### Background and Motivation

Pivot is a dual sanitation renewable fuel company that converts fecal sludge into solid fuel for industrial use. Since September 2015, Pivot has been operating a demonstration plant in Kigali, Rwanda, which receives approximately 100 $m^3$ septage per day from exhauster trucks.

To achieve operational break-even at the Pivot Works factory from fuel revenue alone (i.e. without payments from government), increasing the volume of sludge delivered to the plant each day is necessary. Pit latrine sludge has been identified as a key source of waste in Kigali, and since May 2016, Pivot has been working to develop a pit latrine emptying business, Pit Vidura.

Informal settlements represent 66 percent of Kigali's total population, yet there are no legal fecal sludge management services for these areas. In the absence of a mechanical pit emptying service, manual emptiers are hired to dig out pit latrines and bury or dump the waste in the community. This job is usually done using shovels and buckets, and with no protective gear. Although manual emptying has been deemed illegal due to the immense public and environmental health hazards it poses, the practice prevails due to lack of available alternatives.

### Context: Kigali, Rwanda

Rwanda's rapid rate of urbanization (4.1 percent) is the result of demographic growth and migration to urban areas as well as the return of refugees following the 1994 genocide. The urban population increased from 4.6 percent in 1978 to 16.5 percent in 2012, and Rwanda's Vision 2020 prepares for this figure to reach 35 percent in 2020. The average urban density is 1,871 inhabitants per square kilometer – twice what it was in 2002 – and is characterized by a high percentage of informal settlements. Kigali, Rwanda's capital and largest city, has a population of 1,132,686 (2012). Of these residents, 66 percent, or 744,175, are thought to live in informal settlements (Table 1).

| | Population | % Total |
|---|---|---|
| **Informal settlements** | 744,175 | 66 |
| **Formal settlements** | 488,923 | 44 |
| **Total** | 1,132,686 | 100 |

*Table 1: Population of Kigali (Data from the Fourth Rwanda Population and Housing Census (2012))*

**Kigali Sanitation Access**

According to the 2015 Joint Monitoring Program, the urban population with access to improved sanitation fell from 61 percent in 1990 to 59 percent in 2015 (WHO/UNICEF, 2015). This was largely due to the rapid urban growth and the difficulty in keeping up with access to improved sanitation facilities for new urban residents.

The City of Kigali (CoK) has committed to upgrading informal settlements as part of the Vision 2020. The upgrading program will focus on enhancing livability in informal settlements, including 'sufficient sewerage and disposal systems'. However, gaps remain in the planning and design of an affordable and complete sanitation system for human waste.

Introducing a pit latrine emptying program that is safe and affordable for urban residents will strengthen the CoK upgrading program by reducing human and environmental exposure to infectious human waste due to current haphazard pit latrine emptying and waste disposal practices. The project is being carried out in collaboration with Water for People (WfP). WfP's sanitation focus in Kigali is to improve the public and environmental health safety of pit latrine emptying. As such, WfP has sourced a mechanical latrine emptying device – the eVac – to replace the manual emptying process.

## EXISTING FSM SERVICES

**Kigali FSM Context:**

Kigali has no sewerage system so households rely on septic tanks serviced by exhauster trucks or on pit latrines serviced manually. From our experience and research in some of these communities as well as conversations with city officials, we assume that pit latrines are the most common type of toilet in the informal areas.

The lack of pit latrine emptying services that are both safe and affordable for low-income residents in informal areas has led to the emergence of informal coping mechanisms that pose threats to public health and the environment. Manual laborers typically empty pit latrines and the extracted waste is dumped in a dug ditch (Figure 1) or in the nearest waterway, drain, or garbage dump. An alternative practice may be sealing the latrine and building a new one.

**Volumes Removed and Costs of Manual Pit Emptying Services**

Prior to deploying the service, a rapid market assessment of 505 households in five of Kigali's settlements was conducted to understand current sanitation practices and pit emptying demand.

**Volumes Removed and Reported Costs of Existing FSM Services**

Table 2 compares the reported median prices of vacuum truck exhausting, manual pit emptying, and Pit Vidura's pit emptying services. Vacuum truck services are over double the price of hiring a manual pit emptier, demonstrating how vacuum truck services are cost prohibitive for low-income households that elect to use manual pit latrine emptying services as a more affordable, though illegal, alternative (Table 2).

| | Median Cost of Service (USD) |
|---|---|
| **Building a New Latrine** | 96.00 |
| **Septic Tank Exhausting** | 132.00 |
| **Manual Pit Latrine Emptying** | 60.00 |
| **Pit Vidura Exhausting** | 48.00 |

*Table 2. Summary of Costs to Manage Pit Latrine Waste and Septic Tank Waste*

*Figure 1: Emptying observation. a: Pit excavation of 10-meter burrow hole using one jerry can; b. Dumpsite located ~30 meters from the pit.*


*Figure 2. Pit Vidura team emptying a pit in the Gitega sector of Kigali.*

Pit Vidura is the only legal exhausting option and the price within range of other fecal sludge management options on the market.

**Existing fecal sludge treatment**

The sludge from septic tanks and pit latrines emptied by vacuum trucks in Kigali is brought to an open pit at a landfill site in Nduba, outside the city center. The waste emptied from pit latrines in informal settlements is commonly disposed of in ditches or waterways. Until recently, there was no facility to treat the fecal sludge. However, in 2015, the Pivot Works plant started receiving all of the fecal sludge currently transported to the Nduba landfill each day. The plant at Nduba receives 80-100 $m^3$ fecal sludge per day from vacuum trucks. Pivot has the capacity to process this waste and generate about 0.5 tons of fuel per day. Currently, there is no complete treatment plant – effluent from Pivot Works is discharged into pits that were dug by the city. Plans to build a larger scale Pivot Works plant with effluent treatment are underway.

## WHO DID WHAT AND WHEN – SUMMARY OF FSM INTERVENTIONS AND CHANGES

**Pit Vidura: Service Description**

Pit Vidura offers a safe, effective, and affordable pit emptying service for low-income customers in high-density settlements. The Pit Vidura emptying team uses a portable vacuum pump to empty sludge into barrels that are sealed and transported to Pivot's waste to fuel plant for proper treatment and disposal. Households that are in the Pit Vidura service areas are invited to use the service for an average fee of USD 42.00.

*Figure 3. eVac in a Narrow Alleyway. (Figure from eVac User Manual (2015), PID Consulting Engineers and Project Managers)*

*Figure 4. Modified eVac designed to reduce splashing and labor requirements.*

Household payments are used to cover the costs of excavating the sludge and transporting the sludge to Pivot's waste-to-fuel plant. Pit Vidura's direct costs include the transport, labor, and consumables such as electricity and water that are needed to carry out the pit emptying. The costs of waste treatment and fuel production at the Pivot Works plant are not included in Pit Vidura's operational costs because the cost of treating the waste is covered by revenue generated from fuel sales.

Pit Vidura recruited members of the pit emptying team by identifying existing manual pit emptiers and providing them with the training, PPE, and de-sludging equipment necessary to provide a safe service. Working with existing emptiers was compelling because: 1) they know the market; and 2) collaborating and empowering the existing service providers instead of competing with them enabled Pit Vidura to enter the market more easily.

Interested customers may hear about the service during monthly government mandated community service meetings, from friends, from fliers distributed within the community, or from door-to-door marketing done by the service provider or Pivot's community liaison officer. Customers interested in the service call the community liaison or pit emptying service provider to schedule a pit evaluation, after which the pit latrine and surrounding structure are investigated to ensure that emptying is technically possible.

**Pit Vidura Emptying and Fecal Sludge Transport**

Traditional exhauster trucks are unable to completely remove the thick sludge from most pit latrines and have difficulty accessing households in most informal settlements. The development of the eVac has made removal of pit sludge more effective than existing methods because 1) the electric powered pumping system provides a quicker services than manual emptying methods, which use small buckets and shovels 2) the compact size and design allow the eVac to access narrow lanes and alleyways that vacuum trucks cannot reach (Figure 3).

Trash is removed before pumping sludge out of the pit with the eVac. The extracted sludge fills a cylinder, which we have modified by adding a valve at the bottom. The valve is opened to dispense from the cylinder into a 50-liter transport barrel. This valve modification was designed to reduce the spills and splashes associated with pouring sludge from the original eVac cylinder to transport barrels, as well as to eliminate the need for an operator to perform the pouring job (Figure 4).

Filled barrels are carried from the household to the truck, which transports the barrels to the Pivot Works factory. Barrels are emptied and washed at the plant and then returned to a storage depot located in the community.

| | |
|---|---|
| **People per household** | **5** |
| **% population with latrine coverage** | 91 |
| **% of latrines shared** | 41 |
| **Households per shared latrine** | 4 |

*Table 3. Assumptions in estimating number of latrines available for servicing in Kigali (Data for household size and latrine coverage from the Fourth Rwanda Population and Housing Census (2012), and for number of households per shared latrine from Pit Vidura Rapid Market Assessment (2016)).*

| | Average Cost/Pit Emptying Job (USD) | |
|---|---|---|
| | **Q1 May 1-July 31** | **Q2 Aug 1-Oct 31** |
| Transport | 32.40 | 40.70 |
| Labor (Pit Workers) | 21.00 | 16.30 |
| Discounts | 2.20 | 0 |
| Water and Electricity | 1.50 | 0.20 |
| Depot Rent and Upkeep | 6.90 | 4.00 |
| Marketing | 30.00 | 21.40 |
| Misc. Extra Labor | 0 | 0.20 |
| **Total Direct Costs (Transport, Labor, Water/Elect, Discounts)** | **57.00** | **57.20** |
| **Total Overhead Costs (Rent, Security, Cleaning, Marketing, Misc. Extra Labor)** | **37.00** | **25.50** |
| **Total Operational Costs (Direct and Overhead)** | **94.00** | **82.70** |

*Table 4. Costs Per Pit Emptied by Category and Quarter*

**Pit Vidura: Economic Rationale**

Maximizing feedstock from pit latrines has been identified as a key strategy in driving operational break-even at the Pivot Works waste-to-fuel factory. To estimate the quantity of sludge available from Kigali's informal settlements, we combined census data with assumptions from literature. The assumptions used to predict customer demand are shown in Table 3.

The number of pits in a given area is estimated as,

$$\left(\frac{\boldsymbol{Sector\ Population}}{\boldsymbol{Households\ size}}\right) \boldsymbol{x} \left(\%\boldsymbol{households\ not\ sharing} + \frac{\%\ \boldsymbol{households\ sharing}}{\boldsymbol{average\ no\ households\ sharing}}\right)$$

which gives an estimated 103,00 pit latrines across the city of Kigali. This represents a huge and untapped market for a fecal sludge emptying business. Pit Vidura aims to serve this market by using improved pit emptying technology and a refined business model specifically tailored to serving low-income areas.

**Financial and Economic Aspects**

Between the beginning of May and the end of October 2016, Pit Vidura emptied 152 pits. A variety of customer fee structures was trialed, including depth-based, volume-based, and flat fees. Because households are accustomed to paying for pit emptying on a per depth basis, our initial fee structure was designed on this basis. However, due to the irregular dimensions of most pits, we shifted from a depth-based fee to a volume-based fee. Charging per barrel was confusing for most customers, who were also unwilling to pay extra for trash removed. These customers were generally unaware of the excessive amounts of trash they had in their pits and the impact of the trash on the efficiency of the process. Thus, we changed to a flat rate pricing model with the aim of covering the direct costs of emptying two pits per day.

Direct and total costs associated with pit emptying for the two quarters are shown in Table 4. Direct operational costs include pit labor, transportation, water, electricity, and truck transport. Overhead costs include marketing (marketing liaison, commission for marketing contractors, and promotional materials including flyers, stickers, etc.), community depot rental and upkeep, depot security, and any additional labor. Administrative staff salaries (with the exception of the community marketing liaison) and capital equipment are not included in the calculation of operational costs.

Our current fee falls well short of covering the operating costs of the Pit Vidura service. With the current price for services averaging USD 42.00 per job, an average of 58 percent of total operational costs can be recovered per pit emptied (Table 5). Pit Vidura is currently taking several measures to improve cost recovery, including increasing the customer price per empty, looking at possibility of emptying more pits per day, and reducing the labor requirement per pit.. Due to process limitations – removing trash from pits and hauling full barrels long distances to the truck or community depot – increasing the number of pits emptied per day requires an improved strategy for identifying geographic clusters of customers to

| | % Cost Recovery/Empty (Direct Costs) | % Cost Recovery/Empty (Total Costs) |
|---|---|---|
| Q1 1 May - 31 July | 61 | 36 |
| Q2 1 Aug - 31 Oct | 143 | 58 |

*Table 5. Average Cost Recovery by Quarter*

overcome these distance and time constraints. To reduce labor costs (19 percent of total operating costs), a focus will be placed on developing technical improvements that replace the need for manual handling of barrels with a more efficient solution for moving sludge between the pit and truck.

A better understanding of the price elasticity and willingness to pay for emptying services is needed to determine a price point that achieves cost recovery but remains affordable to the target communities. Elucidating the demand elasticity can also help determine the extent to which subsidies can fill in the gap for the poorest customers whose ability to pay falls significantly outside of the range of cost effectiveness for private sector service providers.

## DRIVERS OF CHANGE

Pit Vidura still has several challenges to address. Among the challenges it has addressed so far are:

- Launch of reliable day-to-day emptying service with paying customers, and coordination of logistics from customer acquisition, to team dispatch, to sludge disposal.
- Gathering detailed cost data for emptying.
- Training a group of service providers to prioritize the safety of emptying processes and ensure that worker and community exposure to sludge is minimized during the process.
- Validating the eVac as a good technology for use in the Kigali context, including local maintenance and repair. Pit Vidura also initially trialed other pit pumping tools including a trash pump and a gulper, but found them to be less suitable. Finally, the Pit Vidura team modified the eVac with a valve and stand to dump directly into barrels and reduce the labor requirements.
- Rapid prototyping in the field from the wide variation of pits and conditions has led to quick learning and iteration, which would be difficult to reproduce in a lab.

## LESSONS LEARNED

**An improved value proposition is needed to further drive and sustain household demand**

Despite having a steady list of households interested in the emptying service, a disconnect exists between those who are marketed to, those who pay for the service, and the value proposition that we are promoting. Most of our marketing is directly to households; however, it is typically landlords who pay for the service. Furthermore, the marketing pitch centers around the public and environmental health benefit of Pit Vidura's service, which is not necessarily a compelling value to the customers we are serving. A better value proposition that sells the legality, speed, and effectiveness of our service as a competitive advantage is needed. This is likely to lead to technological innovation and an improved understanding of customers.

**Pit latrine structure and contents are unknown until the pit emptying job is underway**

The variability of the pit dimensions and construction, the sludge quality, and solid waste (refuse or trash) content has a significant impact on planning logistics and resources required for each job. In some cases, a full pit cannot be emptied due to the danger of structural collapse or the limitations of the equipment to empty pits that are deeper than reported by the customer. Such unknowns present difficulties in managing customer expectations. The eVac, along with other mechanized tools for removing sludge from onsite sanitation systems, can only work to a certain depth. This means that the eVac may not be able to empty deeper pit latrines. It is important to highlight this limitation to customers in order to avoid dissatisfaction and non-payment after service delivery. In addition, emphasis is placed on safely servicing the latrine, as opposed to full emptying.

**The majority of time during a pit empty is spent removing trash and hauling full barrels**

The high solid waste content that is found in many pits presents difficulties in removing sludge using a vacuum pump. Our empty time trials show that

removing trash from the pit can take up to three times longer than the time spent pumping the sludge out (Figure 5).

Hauling full barrels from the pits is the single most time intensive part of the emptying process. At least two people are needed to haul barrels, one by one, from the pit to the road in order to minimize the time spent loading them into the truck for transport to the waste-to-fuel factory.

**The total volume removed from the pit latrine is the single biggest driver of customer satisfaction.**
Many of the customers served are accustomed to manual pit emptying services in which emptiers put themselves at risk sludge and hazardous gas exposures in order to empty the total volume of sludge in a full pit. Pit Vidura, on the other hand, emphasizes providing a safe service using the eVac and minimizing operator contact with sludge. As such, the volumes removed by Pit Vidura are often less than would be removed by a manual emptier.

## OUTSTANDING CHALLENGES, NEXT STEPS AND PLANS FOR SCALING UP

By December 2017, our goal is to be emptying ten pits per day (~1/3 of expected market demand in Kigali) consistently and successfully. We will carry out the following activities to drive these scaling efforts:

**Cost Reduction through a pit-to-road pumping system and improved trash tools**
If Pit Vidura could eliminate barrels and pump the sludge directly to the road, a team of three could empty three to four pits a day, which would cut the cost of labor by up to 75 percent per pit. To this end, the Pit Vidura team has started field experiments with a pit-to-road pumping system that could save up to four hours per pit empty. This efficiency gain could increase the number of pits serviceable per team from two to three pits per day.

While there is likely no perfect pit trash removal tool, our goal is to build a "toolbox" of tools that may be more applicable at various stages of the pit empty. We are continually trialing improved trash hooks and other tools as we service customers.

**Price optimization and value proposition enhancement through targeted market research**
In 2017, we will embark on intensive marketing strategy development with an expert firm in order to drive technology innovation and review and refine the Pit Vidura business plan and scaling strategy. This work will include: 1) identifying new market segments and mechanisms for reaching them;
2) a strategy for positioning Pit Vidura competitors including manual emptying, chemical additions, and constructing new latrines; and 3) maximizing the

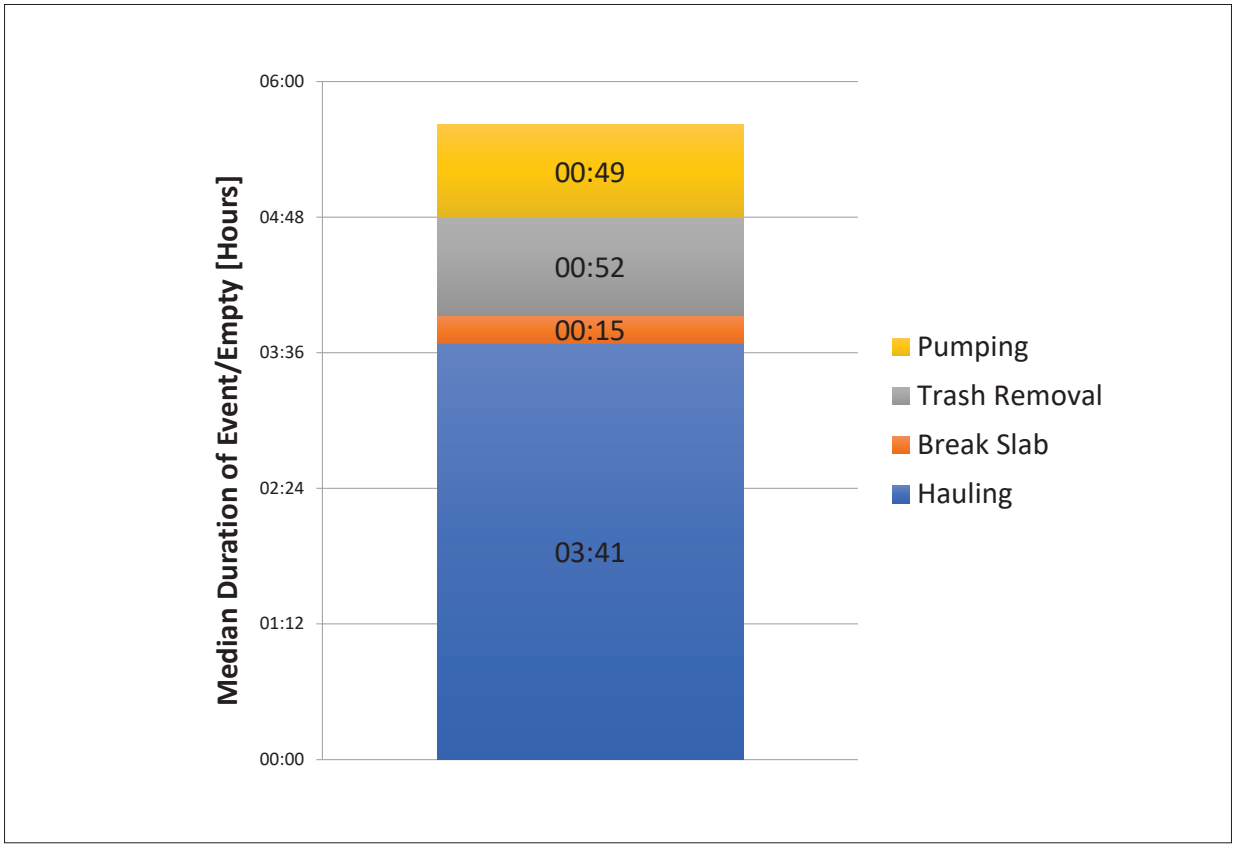



*Figure 5. Breakdown of Emptying Events by Median Duration*

overall value proposition of the emptying service to household customers. A three-month study will also be conducted to elucidate the demand curve for emptying services and determine the combination of optimal pricing and necessary subsidies to achieve cost recovery while serving the target population.

## REFERENCES


National Institute of Statistics Rwanda (2017). *The Fourth Rwanda Population and Housing Census (2012)*. Retrieved May 2015, from http://www.statistics.gov.rw/survey-period/fourth-population-and-housing-census-2012.

Tsinda, A., Abbott, P., Pedley, S., Charles, K., Adogo, J., Okurut, K., & Chenoweth, J. (2013). Challenges to achieving sustainable sanitation in informal settlements of Kigali, Rwanda. *International journal of environmental research and public health, 10*(12), 6939–6954.

World Health Organization, & UNICEF. (2015). *Progress on sanitation and drinking water–2015 update and MDG assessment.* World Health Organization.


## ACKNOWLEDGEMENTS


This work was funded by the Osprey Foundation and the Stone Family Foundation. The eVacs used for the trial were sourced and funded by Water for People. The City of Kigali especially the sector offices of Gitega, Gikondo, Kimisagara,

# eThekwini Municipality, Durban, South Africa – An FSM Case Study

T. Gounden and N. Alcock

## EXECUTIVE SUMMARY

The vision of the eThekwini Water Services (EWS) is to ensure integrated use of resources through sustainable water management. This means providing water and sanitation services in a manner that is equitable as well as environmentally, socially and financially sustainable, and technically excellent.

eThekwini Municipality (City of Durban) was forced to address a number of sanitation challenges in a relatively short time. This was due to a sudden increase in its geographic area of operation and a change from an infrastructure to a service delivery approach. This involved moving from 'first world' challenges of operating waste water treatment works and sewer networks to a mix of technologies across the sanitation services chain.

During the rollout of these sanitation systems the city has tested several innovative technologies and learned a number of important lessons.

Among other things, the city has learned that 'one size does not fit all' for community sanitation. Stakeholder engagement and education are critical for success and acceptance and continued academic research and assessment, will guide the implementation process and allow for re-imagining and re-development of the solution.

eThekwini Water Services (EWS) has also learned that partnerships with research institutes and collaboration with the private sector greatly assist with meeting the objective of providing adequate and acceptable sanitation for all.

## CONTEXT

### Background

eThekwini Municipality (Durban) is located on the eastern seaboard of South Africa within the province of KwaZulu Natal, and covers an area of 2,297 square kilometres. In 2015 the population estimated from the 2011 census was 3.5 million people, and the GDP per capita USD 13,000 (2014). Approximately 55 percent of the land is designated as urban (30 percent peri-urban, 25 percent urban), and 45 percent as rural. There has been significant influx of people to the city from rural areas, from other cities and from other parts of Africa. Population growth between 2001 and 2011 increased 1.13 percent, putting pressure on sanitation service delivery and other services. Most newly arrived people live in peri-urban areas and informal settlements that are scattered throughout the city and often near potential work opportunities. Most informal settlements are situated on steep land or flood plains, which are high risk areas and pose further challenges to service delivery and infrastructure development.

According to a survey in 2011, there were 912,000 households within the city, of which 54 percent were formal, 34 percent informal or backyard shacks, and 12 percent rural. The diverse nature of the landscape, the mix of urban, peri-urban, informal and rural households, and the inward migration rate pose a significant challenge to the city in terms of service provision.

### Shit Flow Diagram (SFD) Analysis

eThekwini FSM interventions can be summarised using an SFD matrix. The offsite and onsite services provided by eThekwini can be broken down as follows:

Onsite
- Urine Diversion Toilets
  - Burial on site
  - To Black Soldier Fly (BSF) plant
- Ventilated Improved Pit (VIP) Toilets
  - Burial on site
  - To LaDePa[1]
- Ablution Blocks on site (VIP)
- Flush toilets to septic tank
- Flush toilets to conservancy tank

Offsite
- Flush toilets to central sewer network
- Ablution blocks to central sewer
- Flush toilets to decentralised package plants

Table 1 provides the breakdown of sanitation services by dwelling type as well as backlog figures, and

was used to generate the SFD. The data used was secondary data from a desktop study and has not all been verified in the field or by surveys.[2]

The key issues depicted in the SFD are as follows:

- 74 percent of the excreta is safely treated before disposal or reuse
- 26 percent is released unsafely into the environment
- 16 percent of onsite sanitation is not contained due to the use of informal pits
- 7 percent of the waste going through the waste water treatment works is considered not treated to effluent quality standards
- 18 percent of the population have UD toilets, and it is assumed that the waste is buried or treated at the BSF plant
- 8 percent of the population have VIPs, septic tanks or conservancy tanks, and it is assumed waste is treated safely

## FSM SERVICES

### History

Prior to the first democratic election in 1994, the City of Durban comprised several council areas servicing white, Indian and coloured areas under the former apartheid system. Black areas were governed by a combination of the provincial government and the KwaZulu homeland structures. Following the election, the former council areas were amalgamated with the former black township areas to form the eThekwini Unicity, which had one water and sanitation department. The boundary of the city was later expanded to include the sparsely populated rural areas, which had little or no services. Between 1994 and 2000, the municipality focused on improving the operation of the waterborne sewer system in the former townships through upgrades and community education programmes.

The city also inherited approximately 35,000 VIPs in peri-urban areas where factors such as high density or topography prevented the construction of waterborne sewage.

In 2000/2001, a cholera epidemic broke out in the newly formed Metro region that affected more than 1,000 people and led to more than 15 deaths. The epidemic was particularly problematic in the rural areas, where no formal water and sanitation services were being provided. An extensive programme to roll out a basic water and sanitation service was developed and then implemented. The services consisted of a ground tank system providing six kilolitres of free water per month and a urine diversion toilet for each household.

The city also realised that the provision of housing to new residents living in informal settlements could not keep up with demand. A programme to provide community ablution blocks (CABs) with showers, toilets and laundry areas was developed and rolled out.

| Dwelling type | Total number of dwellings | Sanitation type per dwelling: Serviced with Urine Diversion Toilets | Within 200m of Ablution Block | Serviced with VIPs | Serviced with Septic Tanks & PPs | Serviced with Waterborne Sanitation | Backlog in Sanitation Service |
|---|---|---|---|---|---|---|---|
| Informal Settlements | 265542 | 5194 | 111868 | | | 15533 | 132947 |
| Informal Settlements - Formal Informal | 3096 | | | | 3096 | | |
| Backyard Shacks | 48975 | | | | | 48975 | |
| Rural - Traditional | 103715 | 77059 | | | | | 26656 |
| Formal houses not in Rural area (A1) | 409210 | | | 35000 | 99282 | 274928 | |
| Flats (B1) | 110225 | | | | | 110225 | |
| Formal houses in Rural area | 5147 | | | | 5147 | | |
| **Total** | **945910** | **82253** | **111868** | **35000** | **105525** | **449661** | **159603** |
| **Percentage** | **100%** | **9%** | **12%** | **4%** | **11%** | **48%** | **17%** |

| Dwelling type | Occupancy Rate |
|---|---|
| Formal house | 3.86 |
| Formal Flat | 2.9 |
| Informal single | 3.6 |
| Informal Backyard | 3.9 |
| Rural | 5 |
| Rural formal house | 4.65 |

| Dwelling type | Population Proportion per dwelling type: People with UD | People with ablution | People with VIP | People with Septic or Package Plants | People with Waterborne to central | People Unserved |
|---|---|---|---|---|---|---|
| Informal Settlements | 18698 | 402725 | | | 55919 | 478609 |
| Informal Settlements - Formal Informal | | | | 11951 | | |
| Backyard Shacks | | | | | 191003 | |
| Rural - Traditional | 385295 | | | | | 133280 |
| Formal houses not in Rural area (A1) | | | 135100 | 383229 | 1061222 | |
| Flats (B1) | | | | | 319653 | |
| Formal houses in Rural area | | | | 23934 | | |
| **Total** | **403993** | **402725** | **135100** | **409113** | **1627796** | **611889** |
| **Percentage** | **11%** | **11%** | **4%** | **11%** | **45%** | **17%** |

*Table 1: Breakdown of sanitation services by dwelling type*

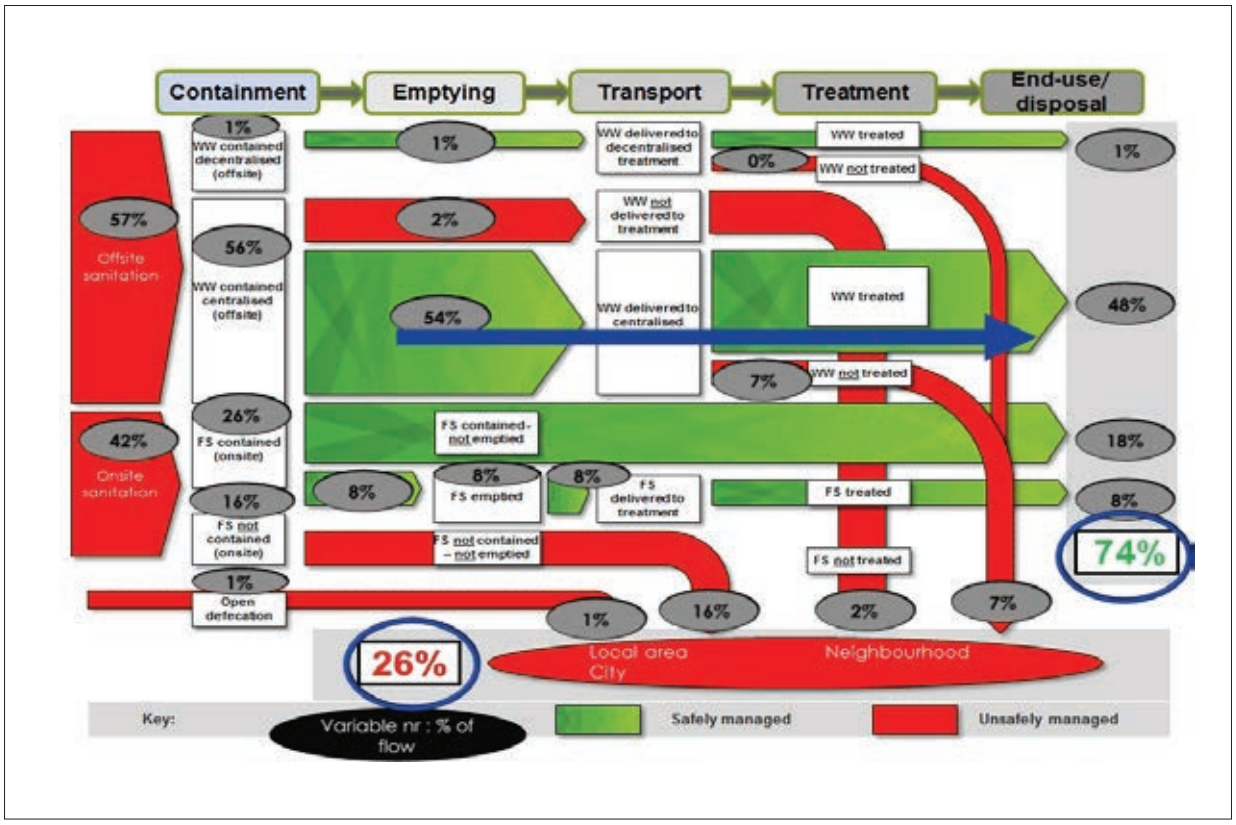



*Figure 1: Shit Flow Diagram for Durban*

This would ensure that each household had access to basic sanitation within 200 metres of their homes.

**Institutional mandate**

National policies and legislation focussed specifically on sanitation, to guide the delivery services in an equitable and fair manner including the policy of free basic services for all (Department of Water Affairs and Forestry, 1994).

While the right to access to adequate sanitation is not expressly provided for in the Constitution of South Africa, it does contain clauses that imply the right to basic sanitation. In addition, the 2001 white paper on Basic Household Sanitation explicitly acknowledges that "...government has a constitutional responsibility to ensure that all South African have access to adequate sanitation...", and the Water Services Act of 1992 the primary legislation relating to water and sanitation in South Africa also refer to a "right to basic sanitation." [3]

South Africa has a three-tier system of governance: national, provincial and local. Local government has the constitutional responsibility to provide water and sanitation services, while provincial and national government have a constitutional responsibility to set policy and support local government in a spirit of co-operative governance (DWAF 2001).

The Water Services Act sets out the regulatory framework for institutions tasked with the supply of water and sanitation services, and provides for different water institutions to be established as follows:

- The water services authority (WSA), which is the responsible municipality
- The water services provider (WSP), whose role is to physically provide water supply and sanitation services to consumers

Thus the eThekwini Municipality is the WSA and EWS is the WSP for the eThekwini Municipal Authority. EWS has the responsibility of providing water and sanitation services to more than 3.6 million people within the municipal area, which includes both urban and rural areas. This has given rise to a number of challenges, such as provision of basic water and sanitation services to communities outside the waterborne edge, a lack of awareness about how to use water supply and sanitation services correctly, illegal connections, blockages and vandalism.

The challenges facing the WSP in the provision of water and sanitation services are to:

- Manage the conflict between different users in different catchments
- Provide a means of providing access to services to those who are still without

- Maintain and improve services already supplied in a sustainable manner
- Provide measures to assist those who do not have the economic means to pay normal service charges
- Provide water services in support of all forms of economic development

These challenges need addressed in a manner that supports the preservation of ecosystems and in conjunction with an education and awareness programme to ensure proper use and management of water and sanitation systems.

Government policy provides for free sanitation for indigent households (the minimum level of service being a VIP latrine) and access to free basic water. Specific funding streams are available to municipalities for these services; however the details of delivery are left up to the local service provider.

The main strategic planning instrument for local government is in the Integrated Development Plan (IDP). The IDP is a single, cross sectoral plan intended to integrate and co-ordinate all developmental activities and associated budgets within the municipality and which includes the development of a Water Services Development Plan (WSDP).[4]

**The Role of the Private Sector**

EWS provides the most sanitation services throughout the sanitation chain although private sector entities are used for the collection and transport of faecal sludge from septic tanks, VIPs and urine diversion (UD) toilets. A number of decentralised treatment plants are also privately operated. The private sector is also utilised for the construction of new UD toilets and Community Ablution Blocks (CABs).

**Active Regulatory Aspects or Gaps**

eThekwini Water Services has an active approach to policy when developing a new sanitation technology. The approach is to first pilot the technology based on the research findings. New policy is then developed before rollout at scale according to the approved policy. Recently developed is the policy on UD toilets, which will be emptied by the municipality every two years free of charge rather than the onus being on the resident to empty the toilet. Adopting the principle that 'good science makes good policy', this decision was based on research by PRG into viable pathogens in UD content that pose a risk to householders who emptied chambers. An example of a new policy area being explored is in relation to control of private septic tank emptiers. EWS is exploring the use of a GPS tracker system to monitor septic tank emptiers in order to prevent unofficial dumping of waste in the environment. Gaps in regulatory aspects relate mainly to by-laws that restrict onsite sanitation where sewer infrastructure has been provided. There are also significant regulatory gaps in the area of reuse of waste.

## SUMMARY OF FSM INTERVENTIONS

**VIP Programme and LaDePa**

EWS inherited 35,000 Ventilated Improved Pit latrines (VIPs) in the mid to late 1990s. This was the basic level of sanitation service provided to areas that could not be included in the waterborne system, due to high densities, lack of formal cadastrals and difficult topography. After ten years, many of the VIPs were full or overflowing, giving rise to extreme public health hazards. EWS piloted an emptying service that was later refined. Policy was then developed before full rollout took place. Under this policy, toilets would be emptied free of charge every five years. Residents


*Figure 2*

*Figure 3: LaDePa - Decentralised Pelletizer Plant*

would pay for emptying within that period, which would be on request. The sludge removal was carried out by a managing contractor that used local subcontractors who adhered to strict emptying protocol and high levels of health and safety standards. Disposal was burial on site or sludge was processed at a decentralised pelletizer plant called the LaDePa. This machine, developed in partnership with technology partners, first removes solid waste, then dehydrates and pasteurises the VIP sludge and finally produces pellets which can be used as a soil conditioner or fertiliser. The machine uses heat and medium wave infrared technology to destroy the pathogens.

**Urine Diversion Toilet Programme using BSF Processing Plant**

In early 2000, during the cholera epidemic, EWS began exploring other sanitation technologies that could be used in the vast, sparsely populated rural areas as well as the peri-urban areas to replace to the VIP toilet. The cost of emptying the VIP toilet was proving prohibitive due to difficult access to areas and the toilet itself. Following this research and prototype testing, the urine diversion double vault toilet (UDDT) was selected. As the sketch shows, the pedestal separates urine (a male urinal is also provided) from faecal matter. The urine is diverted to a soakaway, while the faecal matter collects in the chamber. When the chamber is full, the pedestal is moved to the second chamber giving time for the contents of the first chamber to decompose and for pathogens to die off. Residents are trained to empty and bury the contents of the chamber once fully decomposed. Access to the chamber is by means of two sliding back panels, which is much easier than breaking into a conventional VIP toilet. The UDDT is provided to the households at no cost but the householder is responsible for emptying.

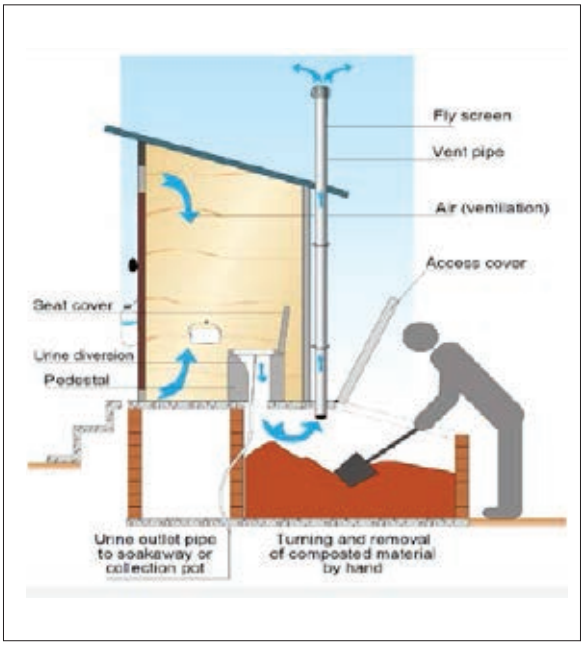



*Figure 4: Urine Diverting Toilet*

*Figure 5*

The delivery programme started in 2005, and some 85,000 toilets have been developed to date.

EWS partner, the University of KwaZulu Natal Pollution Research Group (PRG), have undertaken several research activities linked to the implementation and operation of the UDDT over the past five years. A number of challenges were identified:

- Some households were not emptying full and overflowing chambers
- Households felt that EWS should provide a free emptying service as they did for VIP toilets
- Pathogens were not breaking down during the decomposition process, so households were being exposed to health hazards during uncontrolled emptying
- Some peri-urban areas have densified and there is limited space for burial onsite
- Disposal at hazardous waste sites is prohibitively expensive (USD 65.00/ton)

EWS made a decision in 2014 to provide one free emptying service every two years. The appropriate policy was approved by the council. An opportunity to test and develop an emptying and disposal model through a private sector partnership was made possible through a grant from the Bill and Melinda Gates Foundation (BMGF) that aimed to promote business partnerships in the sanitation sector.

The programme consisted of an emptying programme followed by burial on site or transport to a processing site. The emptying, burial and transport programme is funded by the municipality. The technology selected for the processing plant is Black Soldier Fly (BSF). The plant, which was built at a municipal wastewater treatment works, consists of receiving area, grow-out sheds, nursery and processing equipment. This was funded by BMGF. The end products are oil from larvae, animal feed and biochar. The plant was completed at the end of 2016 and is in the commissioning phase at present. It is being operated privately under a service level agreement (operating contract). The emptying contractor was appointed by tender and will start emptying toilets at the beginning of 2017.

Key institutional and regulatory issues are:

- The development of an innovative service level agreement (SLA) between the municipality and the BSF plant operator
- Use of local labour and local contractor were made mandatory in the emptying tender document
- Detailed health, safety and environmental requirements were included in the emptying contract and in the BSF service level agreement.

**Community Ablution Blocks (CABs)**

A key third sanitation challenge faced by the Municipality is the provision of services to residents

*Figure 6: Black Solider fly treatment plant*

of dense informal settlements while residents wait for provision of new formal housing. Waterborne sewage and urine diversion toilets at a household level are not possible due to densities and topography. EWS piloted and later rolled out community ablution blocks (CABs), which provide services to approximately 75 households within 200 metres of the facility. Housed within a converted shipping container, the CAB provide the following facilities:

- Separate male and female toilets
- Showers
- Laundry areas
- Lighting
- Connections to sewer mains

Each container is allocated a local caretaker who manages the facility. EWS provides consumables such as toilet paper and cleaning material on a regular basis. EWS also attends to faults such as water leaks, toilet blockages and vandalism. Robust, non-valuable materials were used to reduce incidents of theft and vandalism.

Through EWS partner UKZN PRG, a number of research activities on the installation and operation of CABs were undertaken between 2012 and 2016. Key findings from these research activities included:

- High running costs due to slow response by the municipality to leaks and faults
- Inconsistent service provided by caretakers due to low levels of monitoring
- Some pollution challenges due to leaks and blockages
- Access is difficult (in some cases ) due to topography
- Greater acceptance of the technology
- Significant reduction in open defecation
- Greater social cohesion where communities embraced toilet blocks as their own
- Reduction in vandalism

**Other FSM Interventions**

The EWS response to these findings was to develop a social franchising system to manage the CABs. This system involves the appointment of a private managing company (franchisor) that appoints local CAB operator companies (franchisees). The system allows for rapid response to faults, and procurement requirements and cost management would be transferred to the franchise system. However, EWS has not yet been able to obtain approval from municipal management to implement this approach.

EWS is also investigating decentralised waste water treated options including DEWATS for use at new

*Figure 7*

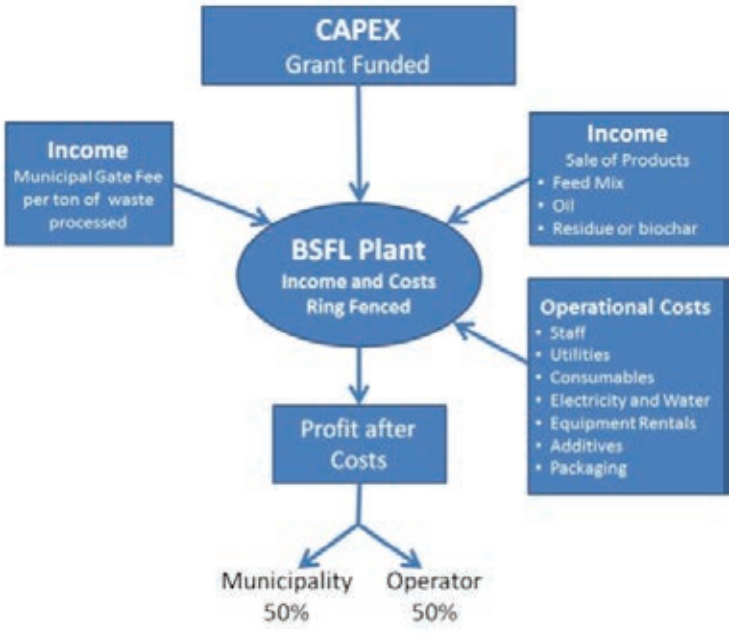



*Figure 8: Business partnerships for the processing of UD waste at the Black Soilder Fly Plant*

housing projects that cannot be connected to the sewer network. DEWATS is an anaerobic baffler reactor, which has been piloted by the municipality but approval for use at new housing projects is still being sought. The approval process, which includes conducting an environmental impact assessment (EIA) and obtaining a water use licence, has proved laborious and resulted in delays.

## FINANCIAL AND ECONOMIC ASPECTS

Both the VIP and the UD toilets were provided to residents free of charge. This was made possible by a municipal infrastructure grant (MIG) given by national government to municipalities. The emptying services (every two years for UDs and every five years for VIPs) is made possible by cross-subsidisation from water and sewerage service charges for in more affluent areas and households. Should households require emptying within the two and five years cycles, they can request this but must pay a removal fee. The cost of emptying a VIP toilet is an estimated USD 69.00–USD 90.00 per toilet. The cost of installing a UD toilet through the MIG is USD 860.

Figure 8 illustrates the agreed business partnerships contained in the SLA for the processing of UD waste at the BSF plant.

The financial costing for the model for removal of UD waste and burial onsite, and transport and processing is shown in Table 2.

The cost to the resident to desludge a septic tank and transport waste is approximately USD 65.00.

## DRIVERS OF CHANGE

The drivers of change in the sanitation sector in eThekwini are summarised in Table 3.

| Processing route | Cost/toilet USD |
|---|---|
| Removal, burial and tree planting | 75.00/toilet |
| Removal, transport and disposal at hazardous waste site(average dist. 20kms) | 97.00/toilet |
| Net cost of removal, transport and BSFL processing (assuming a profit share of USD 11.00 per toilet waste processed and a 100% capital cost subsidy) | 51.00/toilet |

*Table 2: Financial costing for the model for removal of UD waste*

## LESSONS LEARNED

There have been many specific lessons learned from the implementation of the various sanitation technologies for target communities. However, several fundamental lessons have been learned across all programmes.

**First of all there is no 'one size fits all' approach**. Different technologies are suitable for different situations and communities. Secondly, the attitudes and understanding of communities and political structures are critical to the success of any rollout. Without community engagement, support for and understanding of operation and maintenance will be lacking. Technologies need to be tested in laboratories and then piloted in communities before finalisation for rollout. Policy development based on the findings of the pilot must then be developed and approved. During rollout, ongoing research and evaluation must take place. Finally, based on any problems identified, the approach can be re-imagined and new approaches piloted.

The FSM Development Cycle is shown in Figure 9.

A number of other key lessons learned are summarised below:

- Rollout needs to include comprehensive long-term community engagement and education
- Need to shift from infrastructure to a service delivery approach
- Need for safe management of excreta throughout the sanitation chain
- Need for facilitation of progressive realisation built on what is already in place
- It is important to consider operation and maintenance budgets and not focus purely on building toilets
- The role that the private sector plays in bringing in innovation needs to be recognised
- Policy makers and sector leaders need to encourage calculated risk in order to continually improve service delivery

## OUTSTANDING CHALLENGES

Key outstanding challenges and the planned steps to address these challenges are:

**New environmental policy is aimed at reducing or stopping burial of faecal waste on site**. This means more waste from VIPs and UDs will need to be transported to decentralised processing plants. There is a plan to rollout three more LaDePa pelletizes at various locations in the municipality to process waste and derive income from sale of products. This potential income will reduce the costs associated with the transport of the waste.

The operation of the BSF processing plant will be analysed this year. Should the plant be viable in terms of reducing costs through sale of products, additional

| Driver | Change |
|---|---|
| 1994 new democratic dispensation<br>1996 new Unicity – amalgamation of townships and white/Indian council areas<br>Free basic services policy | • Improve sewer network in former townships<br>• Extensive education programmes in communities and schools on correct operation of sewer system<br>• Rollout of VIPs |
| 2000/2001 cholera epidemic<br>2000/2001 White paper – adequate sanitation for all | • Rollout of basic water and UDs in rural and peri-urban areas |
| 2005 VIP – five-year emptying policy | • Rollout of VIP emptying programme and development of LaDePa for processing of waste |
| Rapid urbanisation after 1994 | • Rollout of CABs in informal settlements |
| Political and social pressure for flush toilets in non-sewered areas | • Testing of DEWATS<br>• Pour Flush Testing |
| UD research indicates health hazard when emptying | • Development of UD emptying programme and development of BSF technology for processing plant |
| 2014 Research indicates operation and maintenance challenges at CABs | • Development of social franchise management system |

*Table 3: Drivers of Change*

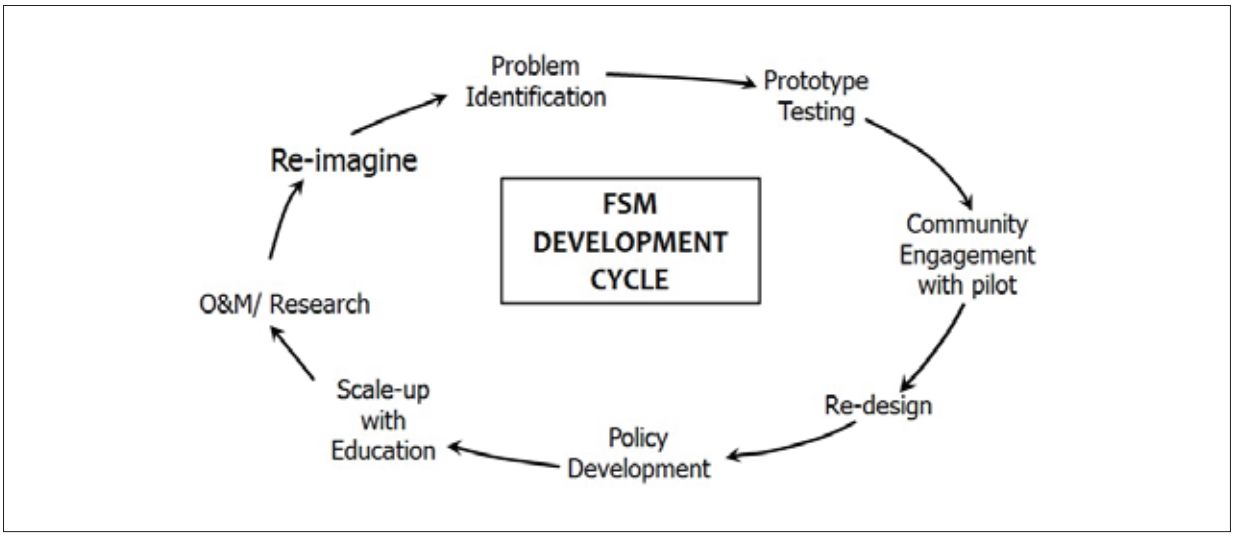



*Figure 9: FSM Development Cycle*

plants will be planned and constructed within the municipality.

**Improving the operational and proactive management of the caretakers in the CAB programme**. The social franchising system (described earlier) aims to achieve more efficient and cost effective management and maintenance of the CABs.

**The provision of flush toilets at new housing projects that cannot be connected to the existing sewer networks.** Residents strongly aspire to owning a flush toilet. Two technologies are being piloted to try to meet this aspiration. First is pour-flush technology, which uses limited water (a scarce resource in the municipality) and waste is disposed of in a pit close to the house. The second is DEWATS or Decentralised Waste Water Treatment System. It is hoped to test this at a new housing project soon.

The **municipal approval processes and delays** experienced during procurement for rollout. Approval by Municipal management and procurement challenges have delayed the CAB franchising system, the rollout of UD waste removal, and the second VIP waste removal programme. New ways to address these challenges need to be sought. The most fundamental step would probably be to build relationships between officials and key politicians (decision makers).

Other challenges needing attention include:

- Creation of sustainable small-scale independent service providers to assist the municipality with improving service delivery efficiencies
- Exploring possible revenue generation from resource recovery and reuse of waste products
- Deepening the understanding of city leaders/ politicians about the value proposition of FSM and that 'it's not all about flushing'
- Changes in procurement processes to allow for more local community involvement in projects
- Relaxation of by-laws and policies for onsite sanitation within urban areas

## NOTES

[1] LaDePa is an acronym for the Latrine Dehydration and Pasteurisation System, developed by eThekwini Water and Sanitation Services in conjunction with the technology partner Particle Separation Systems. The LaDePa converts pit toilet waste into pellets that can be used as a soil conditioner.

[2] The SFD tables and flowcharts were developed by Xanthe Cross of McGill University with UKZN PRG.

[3] Institutional analysis of eThekwini Municipality, Pollution Research Group University of KwaZulu Natal, Durban.

[4] *Ibid*.

## ACKNOWLEDGEMENTS

Research Partner: University of KwaZulu Natal Pollution Research Group (PRG), Water Research Commission (WRC), D Wilson (EWS Consultant), N Macleod (Retired Head – EWS), J Harrison (Retired Engineer – EWS), Xanthe Cross (UKZN PRG and McGill University)

Funding Partners: EThekwini Municipality, Water Research Commission, Bill and Melinda Gates Foundation, Orio Dutch Government

# FSM Means Tackling the Entire Sanitation Chain – Examples from Kampala

J. Rokob

## EXECUTIVE SUMMARY

Over 90 percent of the population of Kampala relies on onsite sanitation, which is mostly unimproved, and about half of the faecal sludge from these onsite facilities is collected and safely disposed or treated. The sanitation market in Kampala is informal except for the treatment of sewerage and faecal sludge, and large parts of the population are unserved. Kampala Capital City Authority, which is in charge of regulating and planning the waste and sanitation sector of the city under its Directorate for Public Health and Environment, has made it a priority to tackle these challenges. Together with the Ugandan German Development Cooperation (GIZ) Water and Sanitation Programme, it has been taking a holistic approach to faecal sludge management since 2015. Its focus is on three main fields of intervention along the sanitation chain: strengthening the legal and institutional framework conditions of the sanitation sector, intensive private sector engagement with a focus on collection and transport of FS, and demand creation for sanitation services. Ultimately, the city authority is working towards a public-private-partnership model in which the city is divided into faecal sludge collection zones that are assigned to specific service providers for emptying through Service Level Agreements. Regulation and monitoring will remain the responsibility of the city authority. Despite being new, the project has already seen considerable results. Amongst others, minimum standards for sanitation technologies have been developed; the private sector is in constant and institutionalised exchange with the city authority; sanitation coordinators are in place in all five divisions of Kampala; streamlined behavioural change communication material has been developed; and a sanitation call centre has been established and been in in operation since mid-November 2016.

## CONTEXT

Kampala, the capital of Uganda, is located on the shores of Lake Victoria. It has a resident population of 1.5 million, which is estimated to double during the day due to commuting flows (2014 census). The city is divided into five administrative divisions: Kawempe, Nakawa, Central, Rubaga and Makindye. The central business district is the economic and industrial hub, however all divisions are characterised by a mix of residential and market areas. They include high-end housing as well as informal settlements for the urban poor. Overall, 60 percent of the people in Kampala live in informal settlements, which are characterised by high population densities, unplanned infrastructure and inadequate access to social services, including sanitation and waste management. The sewerage network is accessible to less than ten percent of the city, mostly in the central division and the Nakivubo catchment area, which drains into Lake Victoria's Inner Murchison Bay, Kampala's main drinking water source (see Figure 1).

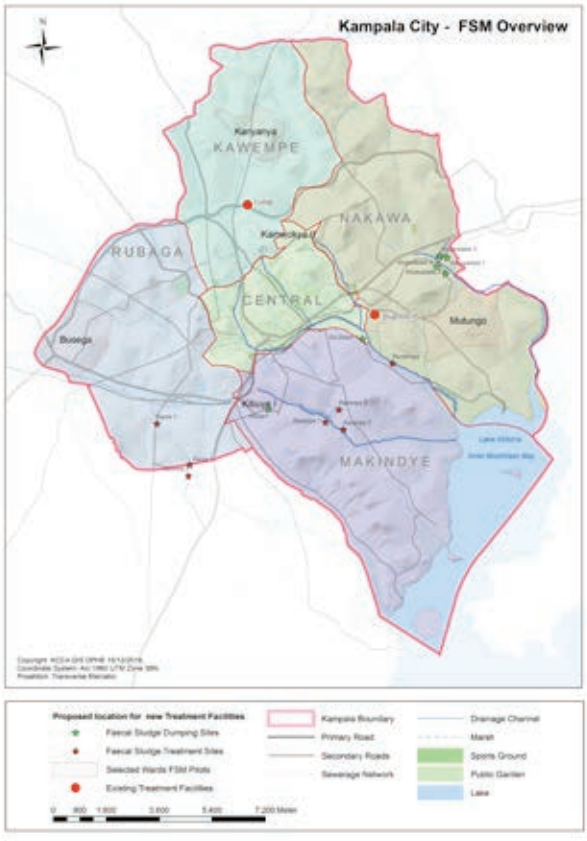



*Figure 1: Map of Kampala, Uganda*

*Figure 2: Typical pit latrine*

Thus, over 90 percent of the population relies on onsite sanitation, most of which is unimproved, causing public health hazards and contaminating the environment. Besides improving personal hygiene and the cleanliness of toilets, a major challenge is the safe handling of faecal sludge from the onsite facilities. It is estimated that only half of the faecal waste generated daily in Kampala is currently emptied from the pit latrines and safely disposed. Sanitation facilities that are emptied during heavy rains and those connected directly to open drains and channels contaminate the wetlands and Lake Victoria's Inner Murchison Bay. Furthermore, abandoned and unlined latrines pose significant health hazards due to the high groundwater tables, leading to a situation where, according to the city's administration, all natural springs of Kampala are contaminated with E. coli bacteria.

## FSM SERVICES

As 90 percent of Kampala's population relies on onsite sanitation systems, sustainable faecal sludge management (FSM) is critical to the city's sanitation services and to maintain public and environmental health. Currently, this is a challenge due to a lack of access to improved sanitation facilities, the long distances to the treatment plants, the unregulated service provision for emptying, and a lack of public awareness. According to the latest census (2014), 30 percent of Kampala's households have access to improved toilet facilities that include flush toilets, VIP latrines, covered pit latrines with a slab, and compost toilets. The city has two treatment plants (see figure 1). Bugolobi Sewage Treatment Work is designed to treat only domestic and industrial effluents, and has a capacity of 14.500 $m^3$/day, which is currently being expanded. Lubigi Sewage and Faecal Sludge Treatment Plant, commissioned in 2014, has a sewage treatment capacity of 5,000 $m^3$, which is to be expanded to 12,500 $m^3$, and faecal sludge treatment capacity of 400 $m^3$. The latter is currently receiving around 600 $m^3$ of faecal sludge per day, so is already overloaded. Furthermore, Bugolobi is also receiving FS on a daily basis, even though it is not designed to treat sludge and sludge should be directed to the Lubigi

*Figure 3: Sludge Drying at Lubigi Treatment Plant*

plant. There is no official data on the amount of FS received per day at Bugolobi.

There is a vibrant private sector for FS emptying services in Kampala, however it is still largely informal and unregulated. Two associations are to some extent organising the private cesspool truck operators, but this does not give them legal status. Most of the cesspool operators work informally without a certificate of incorporation, trading license, environmental license, or a formal office. The objectives of the two associations are to strengthen the operators' market power, set minimum industry standards, and provide pricing guidelines. There are 88 cesspool emptying trucks active in Kampala with sizes varying from 2 $m^3$ to 10 $m^3$. As the operators are not accountable in any way to the authorities, it is hard to keep track of the ownership of the trucks. Only one company has a licence from the National Environment Management Authority (NEMA) to transport FS legally.

There are also ten gulper operators in Kampala. A gulper is a mechanical sludge emptying device similar to a borehole pump that has been designed for pit emptying in densely populated, informal areas that are not accessible by the larger cesspool trucks. The emptying charges range from USD 7.00 to USD 11.00 per 200-litre barrel. With an average daily income of USD 2.00 in poor urban households of Kampala, this service is considered expensive. Cesspool trucks are proportionally cheaper, charging from USD 20.00 for 2.5 $m^3$ to USD 50.00 for 10 $m^3$ of FS. Manual emptiers also exist, but as their work is illegal, there is no record of their number. In addition, Kampala Capital City Authority (KCCA) owns six 5 $m^3$ cesspool trucks for emptying public and institutional toilets, such as in public schools and health centres.

As the FSM market is currently not regulated, competition stems from the customers being free to choose a supplier when they need their sanitation facility emptied. As there are only non-binding guidelines for tariffs, operators negotiate their charges with individual households. Only the dumping fees at the treatment plants are fixed.

There are no geographical boundaries, and operators can offer their services anywhere in the city. This leads to "cherry picking" of customers who are easy to access, close to the treatment plants and/ or who can afford to pay higher charges, leaving large numbers of customers and geographical areas of Kampala unserved (Figure 7). The gulper operators are expected to solve the access issue, however since their charges are relatively high for the volume of FS emptied, they are not considered a pro-poor alternative for low-income areas.

*Figure 4: A tanker discharging at the sludge treatment plant*


*Figure 5: Typical vacumm truck*

*Figure 6: Using a Gulper to empty a pit latrine*

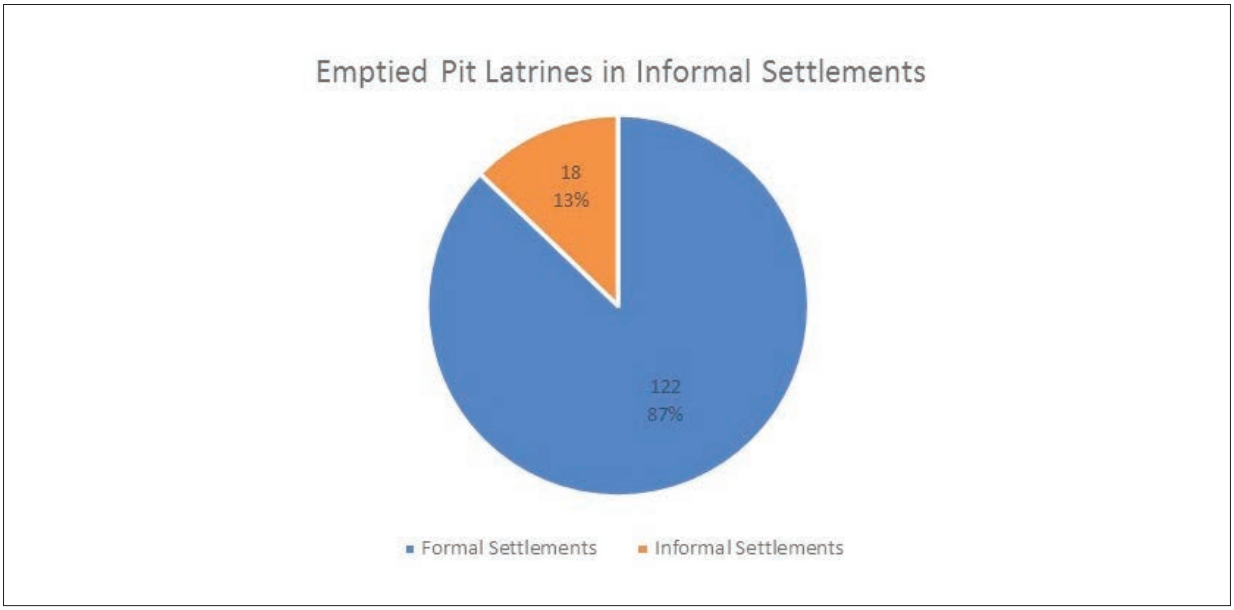



*Figure 7: Preliminary results of a tracking exercise of cesspool emptiers in Kampala. The majority of emptying takes place in formal settlements.*

## FSM STAKEHOLDERS

Following decades of inefficient city management, including poor infrastructure and public services such as waste management, the Government of Uganda decided to drive policy and institutional reforms. KCCA was established by parliament in 2011 to administer Kampala on behalf of the government. Since then, KCCA has been responsible for the city, including but not limited to physical planning, education, social and public health services. KCCA therefore has the mandate for regulating and planning the waste and sanitation sector of the city under its Directorate for Public Health and Environment. In the first years since its inception, the authority has focused on improving the regulation of solid waste management. It has developed a public-private-partnership (PPP) framework, in which KCCA remains the regulator but the private sector is the implementer. This system, though quite new, is proving to be successful. Recently, KCCA made it a priority to also improve FSM in Kampala, envisaging a similar PPP model, with KCCA as regulator and the private sector taking over collection, transportation and treatment of FS.

While collection and transportation of FS is currently carried out by the informal private sector, responsibility for treatment officially lies with the National Water and Sewerage Corporation (NWSC), a government parastatal that has the role of developing, operating and maintaining water supply and sewerage services in urban areas. The NWSC falls under the Ministry of Water and Environment and operates in Kampala and 174 other towns. Using internal funds and donor funding, the NWSC is working to improve and expand the sewerage system

| Stakeholder | Key Features |
|---|---|
| Kampala Capital City Authority (KCCA) | • Responsible for operations of the capital<br>• Regulation of sanitation services incl. solid waste and FSM<br>• Monitoring and enforcement of service provision<br>• Planning of sanitation sector<br>• Can enter into Public Private Partnership |
| National Water and Sewerage Corporation (NWSC) | • Semi-autonomous government institution<br>• Water supply and sewerage services in Uganda<br>• Treatment of faecal sludge<br>• Runs two treatment plants in Kampala<br>• Attracts funding for large infrastructure development |

*Table 1: Two main stakeholders for FSM in Kampala – KCCA and NWSC*

in Kampala, and is also increasingly engaged in pro-poor onsite sanitation projects. For the latter, three FS micro sludge treatment plants, each with a capacity of 5 $m^3$ per day, and three FS disposal points with a capacity of 100 $m^3$ per day in total, are planned (see Figure 1).

## FSM INTERVENTIONS

KCCA appreciates that onsite sanitation will be the reality in Kampala in the mid or long-term. Therefore, since 2015, together with the GIZ Water and Sanitation Programme in Uganda, it has taken a holistic approach to tackling the sanitation challenges in Kampala. It was clear to everyone involved that the approach to FSM should consider the entire sanitation chain (containment, collection, transport and disposal, treatment and reuse), as well as improved coordination of stakeholders. Including all stages and processes along the sanitation chain helped to avoid spending resources on small-scale interventions with short-term impacts. It also helped to improve the understanding of what is currently happening on the ground, what the gaps are and where. The main principles that were followed include:

- Strong legal and institutional framework conditions with clear roles and responsibilities for sector players,
- Private sector engagement,
- Capacity building and coordination of stakeholders,
- Awareness and demand creation among user groups.

Against this backdrop, the vision for improved FSM in Kampala was developed by KCCA and partners. It divides the city into several FS collection zones that

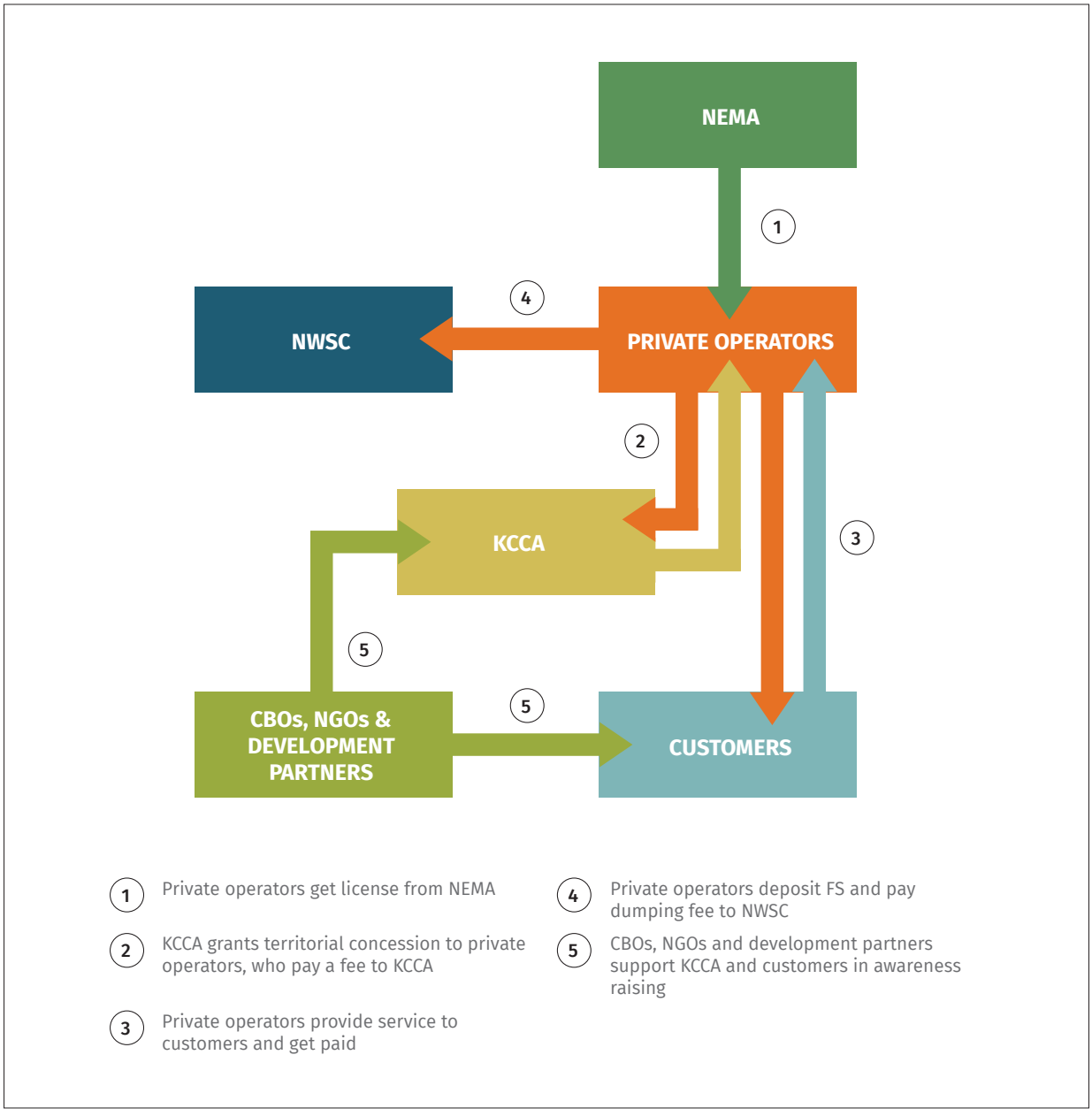



*Figure 8: Suggested business model for FSM in Kampala.*

are assigned to different private operators through a tender process, to make sure that all areas of Kampala are served. The selected private sector players work under service level agreements and in return pay a designated monthly fee to KCCA. A basic requirement would be to have all necessary licenses from the NEMA at hand in order to obtain legal status (see figure 8).

For this business model to work, several preparatory interventions are needed. GIZ together with KCCA entered into this preparatory phase one and a half years ago, and based on the four key principles mentioned above, the following main activities were identified.

**Framework Conditions:** to enable and facilitate better planning and coordination at the decision-making level in the sector, a high-level steering committee for sanitation projects in Kampala was established. This steering committee was established to bring the discussions from a larger group of stakeholders to a streamlined planning and implementation board. At project start, minimum standards for sanitation technologies and minimum health standards for sanitation-related processes were missing. Both documents have since been developed using a consultative and integrative approach.

Furthermore, it was apparent that KCCA did not have enough sanitation designated staff. Sanitation coordination offices have now been established by KCCA. They are providing technical support to the communities and local leaders within their administrative boundaries and improving enforcement.

Lastly, KCCA and other relevant stakeholders agreed that sanitation safety planning (SSP) will be adopted as a future planning and monitoring tool for the sanitation sector.

**Private Sector Engagement:** One criteria identified for a successful reform process was having the private sector involved from the start. Similar to solid waste, a handholding and cooperation process was initiated to overcome the private sector's mistrust and fear of the regulators, and to develop trust and collaboration. This helped them to work closely together and to identify champions with whom certain pilot activities could be tested. Amongst others, the zoning and the establishment of SLA with selected private operators in five pilot areas of Kampala is being tested. Each ward has two designated operators who are working under a memorandum of understanding with the objective of identifying the challenges of working in one specific area. Currently, private operators are being tracked with GPS-capable smartphones to identify which areas of the city are served and which are not. The findings of these exercises will inform the city's zoning process. Furthermore, since the treatment capacities are already exceeded and infrastructure projects take time, KCCA is looking into resource recovery and safe reuse (RRR) of human waste by supporting six entrepreneurs that are interested in turning FS into marketable products.

**Demand Creation and Awareness Raising:** Baseline studies revealed that awareness of the correlation between sanitation and hygiene is low among the communities, especially in the low-income areas. For example, in five of Kampala's lowest income wards, 42 percent of water sources are within thirty metres of a latrine and only 18 percent of household toilets have hand washing facilities. The project identified two interventions. The first is to streamline the awareness raising and behaviour change messages for the whole city, resulting in a set of messages addressing three key behaviours KCCA would like to target, which are: 1) safe pit emptying, 2) improved, and therefore emptiable toilets, and 3) toilet hygiene. The second is to strengthen the link between customers and service providers. To this end, KCCA has been supported by GIZ to establish a sanitation call centre. Through a toll-free number, the centre offers customers a platform for inquiries and complaints, as well as a point of contact for emptying service providers should they want their sanitation facilities emptied. The centre makes follow-up calls to ensure that the customers received the services to their satisfaction. Introduced just ten weeks ago, this service is already a huge success as it is in high demand and receives very positive feedback.

## RESULTS SO FAR

The project is designed to be a long-term partnership between GIZ and KCCA to provide enough time for the reform process. It is appreciated that this is a learning process with several feedback loops that constantly inform the planned structure and regulation of the sector. Despite the project being new, it has already seen considerable results:

- **Minimum standards for sanitation technologies have been developed** and are currently in their final stage before the official approval process within KCCA. They include drawings and types of household, public and school sanitation facilities, such as lined VIP latrines, cistern squatting flush toilets and biogas latrines.
- **Minimum standards for environmental, public and occupational health in FSM** are also in their final stages.

- **Sanitation coordinators on KCCA's payroll are in place in all five divisions of Kampala**; they support information exchange, technical advisory services and enforcement within the communities.
- **A high-level steering committee with decision-making power** for ongoing sanitation projects in Kampala has been established to create synergies and increase impact. Biannual meetings have taken place since early 2016.
- **Sanitation Safety Planning (SSP) has been adopted as a planning and monitoring** tool by KCCA. As well as a high-level sensitisation workshop, SSP capacity building for thirty environmental and health inspectors from KCCA has taken place. Their inspection now include the SSP risk assessment aspects.
- **Eighty-eight private emptying operators through their two associations are in a constant and productive exchange with the city authority, KCCA**. They are part of the planning process and have provided input into a memorandum of understanding with KCCA, which serves as a model for future SLSA. Sixty-four private operators have agreed to being tracked as part of an assessment to inform the zoning process. This exercise is ongoing and first results will be presented at the FSM4 Conference.
- **Six resource recovery and safe reuse** (RRR) **entrepreneurs** have been identified, trained and are currently supported in getting their licenses from the Authorities; amongst others they are producing briquettes, compost and biogas from FS.
- **Streamlined behavioural change communication material** has been developed and is already in use. This includes messages on improved toilets that can be emptied, safe pit emptying and toilet hygiene.
- **A sanitation call centre has been in operation since mid-November 2016** to create a link between users and service providers. Even though the awareness raising campaigns have not yet started and the telephone number has not yet been shared except with sanitation coordination offices, the centre already receives 15 calls per week on average. Of the 60 calls in two months, 58 callers have received emptying services.

## DRIVERS OF CHANGE

**KCCA has a commitment to reform the sector** and the willingness to apply a stepwise approach, which includes a learning and revision process. Also, being able to build on the successful solid waste management reforms, has motivated the authority to improve the FSM situation too. GIZ has supported KCCA since its inception and has strengthened its leading role in the sanitation sector through sector coordination and capacity building. KCCA has gained a momentum of ownership and focused strategy where activities were streamlined and additional funds could be generated thanks to confidence and a shared vision.

**Close collaboration with the private sector is critical**. Their trust in and collaboration with KCCA has brought the project forward in an efficient way. The implication that less enforcement saves time and resources holds true; however the more striking fact is that the private sector brings valuable and significant inputs into the planning process. This way, failures can be avoided when strategies are implemented on the ground.

**Finally, creation and dissemination of information**. The project has not only produced a number of publications to inform the sector, such as an inventory of all private players in FSM and RRR and an analysis of the framework conditions for private sector participation in FSM, GIZ has constantly supported KCCA in widening and improving its databases. For example, the exhaustive database of the state of sanitation in all public schools in Kampala and the maps of all public and community toilets including information on their sanitation, ownership and O&M status, have informed project designs and proposals for funding.

## LESSONS LEARNED

- **Coordination of stakeholders and activities is key** to avoid duplication, create synergies, and pool funding. Fora and steering committees that meet on a regular basis can support this, however they need to have clear descriptions of roles and responsibilities, such as terms of reference, and the outputs, outcomes and agreements of meetings need to be put on paper and circulated. A lead agency that invites and does the follow up is needed; and it should not be a donor or NGO but a local partner.
- **Learn from good experience**, if possible from the same geographical and political context. Practical examples including failures and success stories can motivate and guide people.
- **Having enough time is crucial** because usually everything takes much longer than anticipated. Avoid tight, unrealistic schedules only to please donors. This will support better planning and provide flexibility when activities get delayed. In this project, all activities are typically delayed by six months to one year.
- **Public-private-partnerships need close cooperation right from the start**. Regular meetings are not enough; the public sector needs to genuinely consider the concerns of and inputs from the private sector.

## NEXT STEPS AND PLANS FOR GOING TO SCALE UP

In terms of next steps, the streamlined behavioural change communication material will be used in an intensive awareness raising campaign in the five pilot wards in February 2017. Afterwards, when feedback is fed in, KCCA will roll out a city-wide campaign. Stakeholders are expected to start using this "communication toolkit", thereby enhancing the overall impact of behaviour change and awareness-raising campaigns in the city. The minimum standards will be finalized and approved by KCCA management. After that, both documents will have to be widely disseminated among the user groups through the sanitation coordinators and awareness raising campaigns. GIZ plans to provide training at the private sector level (e.g. for masons and FS emptiers) in order to enable people to implement the standards.

A challenge that is foreseen in this regard is the fact that even simple lined VIP latrines are very expensive in Kampala if built according to the minimum standards (approx. USD 900) due to high cost of materials. A subsidy system like the one implemented by GIZ and the Water Services Trust Fund in Kenya would encourage people to start constructing improved sanitation facilities. Subsidies would only be paid for new toilets that meet the minimum standards when construction is complete. Funds to implement this subsidy program are currently missing, and it remains to be seen how quickly the 70 percent of Kampala's population using unimproved sanitation facilities can make the switch to improved sanitation. The overall success of the sanitation reform also largely depends on improving the containment part of the sanitation chain.

## REFERENCES


Government of Uganda (2010): The Kampala Capital City Act 2010.

Government of Uganda – Kampala Capital City Authority (2014): Analytical Report. Improving Faecal Sludge Management (FSM) for Onsite Sanitation in Kampala City, Uganda. Supported by: BMGF and DFID.

Government of Uganda – National Water and Sewerage Corporation (2014): Lake Victoria WATSAN Project Package 5a. Draft Feasibility Study Report. Volume I: Report. Co-financed by: GoU, EIB, EU-AITF, KFW, afd.

Government of Uganda – National Water and Sewerage Corporation (2016): Kampala Water, Lake Victoria WATSAN Project Package 5a. Inception Report. Volume I: Main Report. Co-financed by: GoU, EIB, EU-AITF, KFW, afd.

Kampala Capital City Authority (2016): Presentation at Kampala Water and Sanitation Forum May 2016.

Kampala Capital City Authority (2016): Report. Framework Conditions for Private Service Delivery in Faecal Sludge Management in Kampala. Supported by: SDC and GDC implemented by GIZ.

Kampala Capital City Authority (2016): Report. Inventory for Formal and Informal Faecal Sludge Emptiers and the Resource Recovery and Reuse (RRR) Private Sector in Kampala. Supported by: SDC and GDC implemented by GIZ.

Kampala Capital City Authority (2017): http://www.kcca.go.ug

Musabe, K. & Nsubuga, S. (2016): Sanitation Status in 5 Pilot Wards of Kampala Under the RRR Phase II Project. Supported by KCCA and SDC and GDC implemented by GIZ.

National Water and Sewerage Corporation (2017): https://www.nwsc.co.ug

Schoebitz, L. et al. Eawag/Sandec (2016): GIS Analysis and Optimization of Faecal Sludge Logistics at City-wide Scale in Kampala, Uganda. Supplementary Information.

The Republic Of Uganda (2014): National Population and Housing Census 2014 – Main Report.


## ACKNOWLEDGMENTS


Kampala Capital City Authority (KCCA) for their continued cooperation and commitment. Bill & Melinda Gates Foundation (BMGF) and Swiss Development Cooperation (SDC) for providing funding to KCCA and GIZ respectively to implement the FSM project in Kampala. KfW for supporting NWSC to improve its treatment capacities and pro-poor portfolio in Kampala. Susanne Bieker from the GIZ for input into this paper.

# Forever Sanitation: An Emerging FSM Service in Kampala, Uganda

J. Businge

## EXECUTIVE SUMMARY

Faecal sludge management is a huge problem in Kampala, Uganda. Most of the city's ever-growing population relies on on-site sanitation, for the most part, pit latrines. Growing migration from rural to urban areas, and the lack of proper housing and expanding urban slums will only add to this problem. FSM provision in the city is largely unregulated and unaffordable to most of the city's poor. Most rely on manual emptying, which is done very unhygienically. Forever Sanitation is a small-scale manual emptying service that emphasises the health and safety of its workers and reducing the risk of water-borne disease outbreaks in the city's informal settlements.

## CONTEXT AND BACKGROUND

According to UNHabitat Reports (1998–2000) and to a 2015 Ministry of Health report, there is a clear lack of housing units in Uganda. The reports highlight a shortfall of close to 1.5 million housing units, highlighting the failure to keep pace with the rapid urban development of growing cities like Kampala in Uganda, where the annual population growth is about 5.6 percent.

For Kampala, this problem is compounded by poorly designed housing infrastructure in the city, where there are no road networks or properly planned drainage systems. Improper waste disposal has caused an increase in water-based and diarrheal diseases in Kampala, especially in the rainy season. According to a 2014 BMFG/DFID report, in this city of 1.9 million people (rising to around 4 million during the day), around 90 percent of the urban poor rely on on-site sanitation, mainly pit latrines. This report goes on to say that 87.4 percent households use pit latrines, 7.6 percent use VIPs, 3.2 percent use flush toilets (septic tank or sewered) and 1.8 percent have no toilet. Furthermore, 45 percent of these sanitation

*Figure 1: Urban residential environment*

*Figure 2: Peri-urban areas*

facilities are reportedly abandoned after five years when they are full or out of order. Growing migration from rural to urban areas, and the lack of proper housing and expanding slums in urban areas will only add to this problem.

## FSM SERVICES

Faecal sludge management (FSM) in Kampala is characterised by unregulated service provision, lack of access to proper sanitation facilities, and poor public awareness. In many cases, faecal sludge has to be transported up to 17 km to the city's only disposal/treatment plant. The emptying charge is an average USD 9.00/$m^3$ by truck and USD 60/$m^3$ by gulper; hardly affordable to most urban poor, who earn just USD 2.00 a day.

In 2011, a rapid market analysis of Kampala's sanitation sector commissioned by Water for Africa found that households who empty their toilet pits – rather than fully covering the pits and building new toilets – use cesspool emptiers or manual emptiers. Manual emptying is usually done very unhygienically, using a broken jerry can and a rope and in most instances at night. This is also labour-intensive and time consuming.

## FOREVER SANITATION'S INTERVENTION

Forever Sanitation Limited was established as a pit-emptying business, with the help of the NGO Water for People. Since starting operations in March 2013, Forever Sanitation Limited have emptied the pits of more than 1,250 customers, removing 2,500,000 litres of sludge in 12,500 barrels, enabling more than 30,000 people to continue using their pit latrines.

Forever Sanitation Limited was started by me after receiving business training and support from the NGO Water for People. They advertised a new business opportunity called Gold Harvest through their sanitation marketers and on the radio. It turned out that Gold Harvest was about using gulpers to empty latrine pits in low-income areas that are not generally accessible to larger waste removal services or where other methods of waste removal are not affordable. By using the gulper to remove sludge, latrine pits can be re-used, rather than being abandoned when full.

The gulper reduces the content of full pits, but it cannot empty them completely. The longest gulpers (three metres) are too short to remove all the sludge from our customers' pits, which are typically 4-6 metres deep, but are often up to 10 metres deep. In Uganda, it is common practice to dig a pit as deep as possible, reasoning that a deep pit will take a long time to fill up. However, this means that the sludge in the bottom of pit is as hard as rock and almost impossible to remove. Even gulpers can only remove the first couple of metres from the top of the pit.

When Sanitation Forever services a pit, we begin by adding up to two drums of water to the pit to soften the sludge. We then break up the hard sludge as best we can using wooden poles, and remove solid waste with rakes and spades. We then scoop the sludge out using a three-litre jerry can with part of the top cut away, suspended on rope. Using this method, we can scoop to a depth of up to six metres. On average the process takes about three hours, but can take up to ten hours for difficult pits. We typically empty two pits a day. It

is a tedious way of doing the work, but most of our customers live in places that vacuum trucks cannot access, and this is the only affordable emptying option.

Our teams, which usually consist of two people – one to empty the sludge and the other to transfer it to our roadside truck – have been trained to be very careful about health and safety. They wear gumboots, gloves and protective clothing, and to prevent splashes, clean all surfaces frequently as they work. We also practice safe disposal. The National Water and Sewerage Corporation sludge dumping sites in Kampala are designed for vacuum tanks with hoses, and cannot accept sludge in barrels. To address this problem, we designed a funnel with hosing at one end and a cage screen in the middle to screen out rubbish.

A key component of our business is the commitment of our well-trained and organised team. Initially we focused our business on slums in Kampala, but later we identified demand in other parts of, and outside, the city. We are emptying everywhere now and provide our service to anyone who requires it. This can mean travelling long distances; up to four hours to reach customers up country.

As well as filling a gap in the FSM market, we aim to employ unemployed youth in the city. Initially, young people were reluctant to work in faecal sludge management, but now we are never short of new workers. Our growing business has gone from 20 barrels and two gulpers, to renting a truck (in 2014) and buying our own truck from savings in 2015. In 2016, we removed sludge from 305 pits, and by the end of January this year, we had serviced 11 pits.

## BUSINESS STRATEGY

Customers pay Forever Sanitation UGX 30,000 (USD 8.60) per 200-litre barrel removed and transported to the treatment plant. This translates as UGX 150,000 (USD 43.00) per 1,000 litres, compared with a minimum of UGX 250,000 (USD 71.50) for removal of the same volume by vacuum truck,

*Figure 3: Pit latrine emptying process*

assuming access is possible. Also, our customers are free to decide how many barrels they can afford to have removed.

We do not charge for the water used to soften the sludge, and bring our own water in reserve barrels in a pick-up truck that can carry up to ten barrels. Each trip generates average revenue of UGX 300,000 (USD 85.70). We pay for labour, dumping fee, fuel and disinfectants, which cost a total of UGX 122,000 (USD34.80). After all these expenses, Forever Sanitation makes a profit of UGX 178,000 (USD50.85) per trip on average, and we do two trips a day.

Many of our customers also buy a chemical fluid to manage pit odour. We add good quality, locally made chemical fluid to the pits we service, and we are interested in learning about other additives that can manage the odour.

## FUTURE PLANS

The company has started saving for a cesspool truck, because we have identified high demand for this service. Existing cesspool service providers tend to be informal and have no training in emptying latrines. Eventually, we would like to construct a treatment plant for our company so we can empty sludge safety after the National Water and Sewerage Company's treatment plant closes at six p.m. We also plan to construct transfer tanks, which will help to us to avoid traffic jam problems in the city. Our dream is to extend emptying services to neighbouring countries like Kenya, Congo, Rwanda and Tanzania.

## CHALLENGES

Technical

- Available dumping sites available are designed to cater for cesspool emptier trucks only, and close early
- The trucks are designed for sludge burrows
- We lack modern equipment, and the gulpers we use are too short to completely empty pits

Community

- Lack of enforcement of legislation that requires people to have latrines
- People do not have the money to pay for emptying even if they would like to use our services
- The process of manual emptying is time-consuming and tedious
- Some latrines collapse when emptying
- The water table is high in many low-lying parts of Kampala city
- We are shunned in the communities we serve due to the nature of the work we do

Financial

- External funding to cover around 75 percent of costs is needed to make our service affordable to most slum dwellers and help to tackle disease outbreaks in informal settlements.
- Our workers are essentially volunteers, who have been working in return for food and transport, but realise we need to pay wages to keep our trained teams.
- The equipment we use needs upgrading and we need to buy more modern equipment (if it exists) to match demand.

## POSSIBLE SOLUTIONS

Short-term

- Creating a networking platform with local, regional and international stakeholders to generate support and funding for our work
- Having better protective equipment, and motorised tricycles to better serve our customers
- Developing a funded wage structure to retain our dedicated staff
- Putting 'foot soldiers' on the ground to raise awareness and sensitisation.

Medium-term

- Acquiring land to develop private dumping sites, to cut the cost of dumping sludge at the municipal disposal site
- Linking up with other international organizations we can work with to make by-products from faecal sludge, such as manure
- Providing insurance for our staff
- Acquiring mini-trucks and motor cycles to help with transportation.

Long-term

- Developing local, institutional, academic and international collaborations to drive to work forward with expertise
- Acquiring sewage lagoons and transfer trucks.

## REFERENCE

*Improving Faecal Sludge Management (FSM) for On-Site Sanitation in Kampala City, Uganda* (2014). Government of Uganda, Kampala City Authority supported by Bill & Melinda Gates Foundation (BUMF) and Department for International Development (DFID)

# Lessons Learned from 50 Years of Providing Septic and Plumbing Services, Puyallup, USA

J.R. Inman and T. Ramsay

## EXECUTIVE SUMMARY

In the last fifty years, FloHawks Plumbing and Septic has grown from a small installer of septic systems and side sewers to a large, diversified provider of plumbing and septic services. The company operates in a five-county area of Washington State in the United States, servicing more than 27,000 residences and businesses annually. In the mid-1990s, the company decided to place a strong focus on growth, and grew from a USD 4.5 million business to one with more than USD 15 million in revenue annually. The keys to achieving this growth trajectory were: broadening service offerings, emphasizing operational efficiency, investing in training employees, keeping employees safe, and investing in marketing.

## BACKGROUND AND CONTEXT

FloHawks Plumbing and Septic is a large provider of plumbing and septic services in the state of Washington in the United States. The company was founded in 1967 as Cascade Septic Service; an installer of septic systems, side sewers and other underground utilities. Now a division of Northwest Cascade, Inc., FloHawks has grown to serve 27,500 households and businesses annually. Today, FloHawks' primary business includes septic and grease tank pumping, pump repair, plumbing and drain cleaning, vault cleaning, and portable restrooms. Other divisions of Northwest Cascade manufacture and install septic tanks, sewers, and other plumbing, as well as offering portable toilets and restrooms.

FloHawks' primary service area is the counties of Pierce, King, Thurston, Mason, and Kitsap in Washington State (excluding downtown, urban Seattle). Per the United States Census Bureau, these counties were home to approximately 2.8 million people in 2015, and had more than 1.1 million housing units. The 2015, median household income for the area was approximately USD 62,000 per year. The poverty rate for the area, as measured by the US Census Bureau, was 12.4 percent.

## FECAL SLUDGE MANAGEMENT SERVICES IN WASHINGTON STATE

Since 2011, The World Bank has reported that 100 percent of the United States population has access to improved sanitation facilities. The US Census Bureau's American Housing Survey reported


*Image 1: Several FloHawks employees following a breakfast meeting in 2014*

| Primary Disposal Location | Waste Type | Capacity (avg. gallons/day) |
|---|---|---|
| City of Tacoma WWTP | Municipal | 27 million |
| LOTT WWTP | Municipal | 12.5 million |
| Seattle King County Metro South Plant | Municipal | 66 million |
| Bio Recycling (Centralia) | Septic | 93,000 |
| Bio Recycling (Shelton) | Septic | unknown |
| FloHawks Private Plant | Septic & Portable Toilet | 36,000 |
| Baker Commodity, Seattle | Grease only | N/A |
| Darling Recycling, Tacoma | Grease only | N/A |
| FPE Renewables, Enumclaw | Grease only | N/A |

*Table 1: FloHawks' Common Disposal Locations*

that in 2015 approximately 20 percent of households nationwide used a septic tank or cesspool as their sewage system, with a standard septic tank and subsurface leach field being the most common by a wide margin. In the Pacific Census Division (the states of Washington, Oregon, and California), use of septic systems is slightly lower, at approximately 12 percent.

The Washington State Department of Health regulates handling and treatment of sludge and wastewater in the state. The department sets guidelines for the location, installation, and inspection of systems before operation and when a property is sold. Anyone wishing to install a septic system must hire a septic system designer, obtain a construction permit from their municipality and provide a site survey and soil testing results. Service companies must obtain a license from each municipality (usually a county) in which they operate. Each agency has slightly different forms and requirements.

Private companies are responsible for installation, maintenance, and pumping of septic systems. The typical cost to the consumer for septic tank emptying is USD 500- USD 800 each time, depending on number of tanks and additional services. The pumping company then transports the waste to the optimal wastewater treatment plant for disposal, considering proximity, disposal cost, and other jobs in the area. Municipalities or private operators may operate the treatment plants. Companies are required to report every job performed, usually within days of completion. In addition, monthly and yearly reporting disclosing where each liter of waste was taken for disposal is required. Reporting must be punctual and accurate for the operator to maintain their license. Most municipalities have reporting windows of between ten and thirty days. The penalty for failing to accurately report disposal may be USD 250–USD 500, plus other civil penalties up to and including loss of license. Trucks and equipment are inspected by regulatory agencies annually for public health and the safety of workers.

Most of the fecal sludge collected by FloHawks is disposed of at one of nine wastewater treatment plants in the region. A summary of plants, types, and capacities can be found in Table 1.

## FLOHAWKS' PATH TO GROWTH

In the mid-1990s, FloHawks' business in plumbing and septic services was good, generating almost USD 4.5 million in revenue annually, but not seeing strong growth. There were more than one hundred providers of similar services in the area, and the company lacked differentiation. The Northwest Cascade leadership faced a strategic decision: either invest and grow the FloHawks business or divest. They chose to invest, and through focus and willingness to change, the business gained customers and market share.

As the company grew, they differentiated by investing in their operations, sales and customer service, and employees. They broadened service offerings from septic pumping to pump service and general plumbing. They hired full-time sales, customer service and dispatch staff, and offered their employees fair pay and opportunities for training and advancement.

Today, FloHawks has more than doubled their annual revenue and grown to a business that services 27,500 households and businesses annually, averaging 110 services per day. They operate a fleet of 38 vacuum

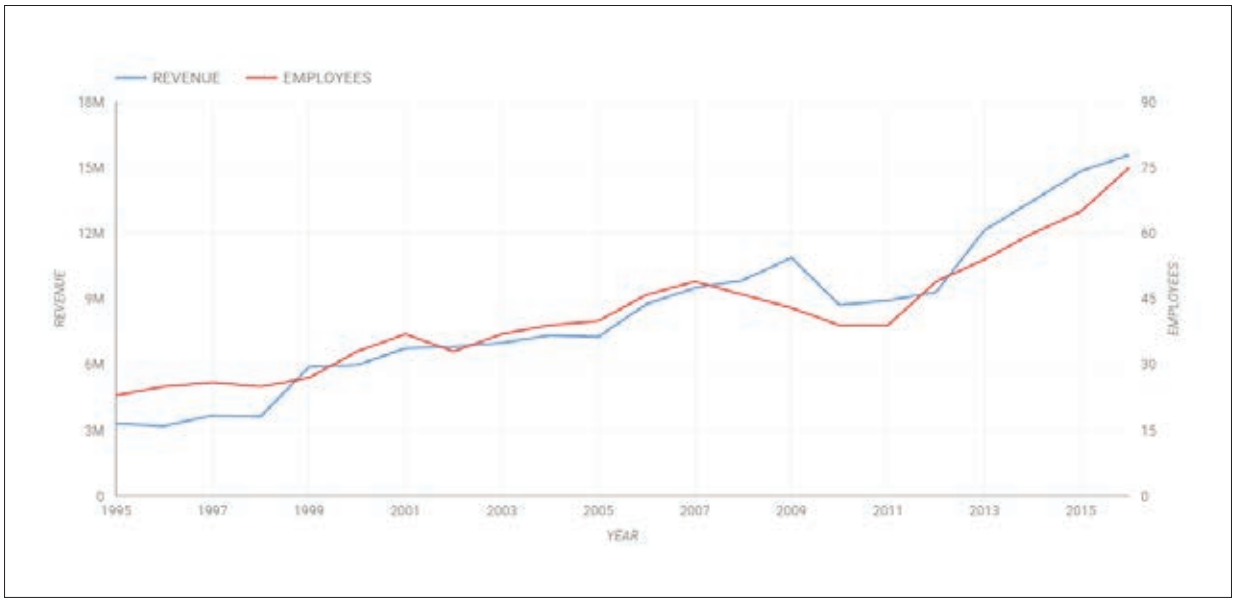



*Image 2 FloHawks growth 1995–2015*

trucks and vans, and currently employ more than 75 employees. Customer service representatives answer calls 24 hours a day, 7 days a week. The company transports 1-2 million gallons (3.8–7.6 million liters) of waste per month. Each material needs to go to a different treatment facility so the company maintains five storage yards with capacity for almost 250,000 gallons (one million liters) of waste, to be transported to treatment plants in large loads, after hours when traffic is at a minimum.

## FINANCIAL & ECONOMIC ASPECTS

As operations expanded, financial success has followed and FloHawks' annual gross revenue has grown to more than USD 15 million. Approximately 40 percent of company revenue comes from pumping (slightly over USD 6 million in 2016), and the rest from drain cleaning and support services. Pumping work is commoditized, but it is still a key activity for the business. Pumping work is often the entry point for customers and leads to higher-margin services such as replacing or repairing baffles, fixing bottoms in tanks, installing surface risers, repairing pumps, and jetting of clogged drain fields. The company's margin on these other service activities is at least 10 percent higher than the margin on pumping services alone.

The average residential job for FloHawks is USD 500–USD 800 (cost to the customer). This typically includes septic tank pumping and associated activities such as locating the tank, digging, or minor repairs to risers or the drainage field. Small residential tanks or minor repairs are lower cost, sometimes as low as USD 200. Larger residential tanks or jobs that require more extensive repair can be up to USD 1,500. Commercial contracts can be slightly larger because tanks tend to be large, with the average job being between USD 500 and USD 1,500. Commercial jobs are priced on a per gallon basis, while residential customers are charged at a flat rate. No subsidies or other assistance from the municipalities is provided; customers bear the full cost of septic service.

When a septic tank must be replaced, customers typically pay USD 2,000–USD 3,000 for a 1,000-gallon or 1,200-gallon (approximately 3.8 $m^3$) tank. The average cost to the customer to install a new septic system is approximately USD 10,000, with large or specialized systems costing as much as to USD 30,000.

*Image 3: FloHawks' employees fixing a pump for a residential customer.*

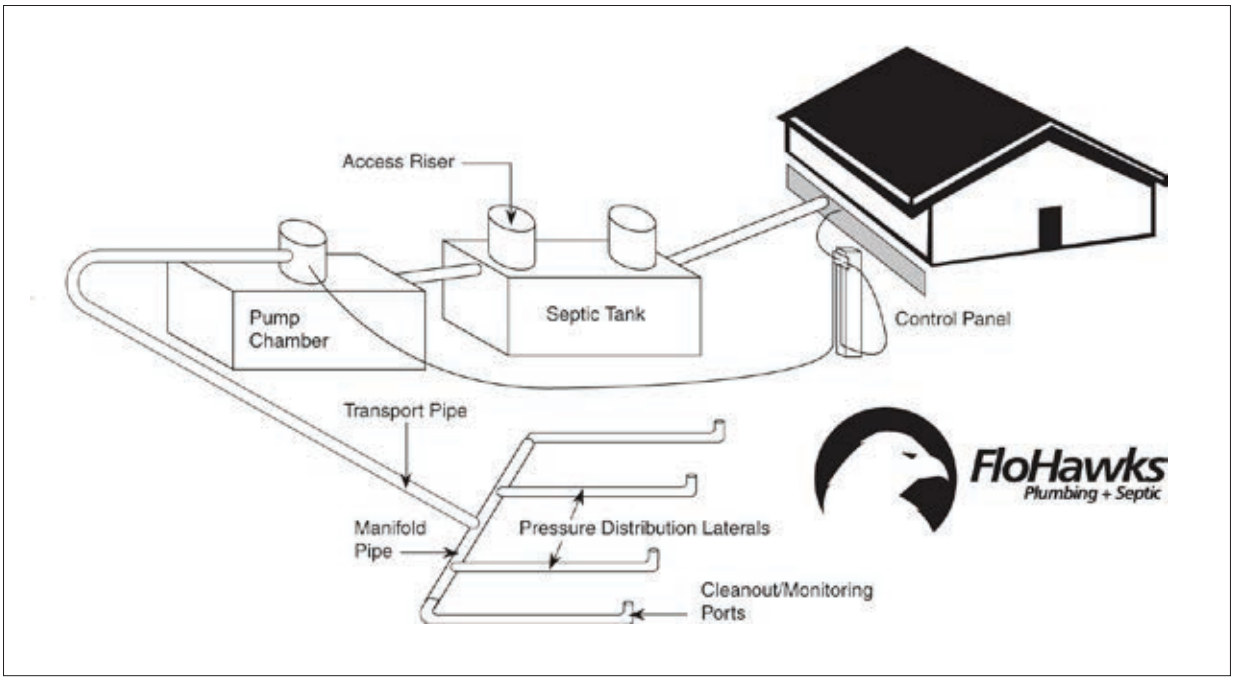



*Image 4: The typical layout of a septic tank in the United States.*

The company sets up contracts with several thousand customers each year to inspect or service a system on a regular basis. A small holding tank or a septic tank that is not working well may be pumped every few weeks, bringing in around USD 200 per job, while annual service on large commercial tanks can be up to USD 50,000–USD60,000 per job.

Most of FloHawks' costs are directly associated with job activities, with administrative costs (sales, customer service, billing, and dispatch), representing approximately 20 percent of total costs. Capital costs for FloHawks' trucks range from USD 85,000 for the smaller vehicles up to USD 200,000 for specialized or larger trucks (up to 4,600 gallons or 17.5 $m^3$ capacity). The company also uses tow-behind trailers, with capacity from 2,000 gallons (7.5$m^3$) to more than 4,000 gallons (15 $m^3$), at a cost of USD 20,000–USD 60,000 each. Several service trucks are well over 20 years old, with the oldest having driven around 1.5 million miles (2.4 million kilometers), though some vehicles are retired much sooner.

Disposal costs vary by location and sludge type. Approximately 60 percent of the septic and portable toilet waste collected by FloHawks is processed at their private treatment facility, at an approximate cost of USD 0.13 per gallon (USD 34 per cubic meter). Disposal costs for other facilities and sludge types are outlined in Table 2.

FloHawks have chosen to allow organized labor in their workforce, and the company believes in the strengths and advantages of a strong labor union. The company's non-union employees are paid hourly and not on commission, unlike most plumbers in the United States. Pay for a service technician ranges from USD 50,000 to USD 75,000 per year depending on overtime and specialized skills, with supervisors making around USD 90,000 per year with benefits. Total compensation for hourly technicians is around USD 32 per hour, and for office staff around USD 17-18 per hour. The company also offers healthcare, dental, vision, and retirement benefits, which account for approximately USD 8.50 of total compensation per hour. In addition, the company offers profit sharing, with most employees receiving an annual bonus of at least USD 1,000.

## KEYS TO SUCCESS AND LESSONS LEARNED

The primary growth driver for FloHawks has been clear business focus and a willingness to adapt their service offerings and operations to benefit their customers. Important factors have included the company's:

- **broadening their service offerings.** This is a key point of differentiation from their competitors. By offering not just septic tank pumping but all types of clean water and waste water plumbing repair, plus specialized services such as pump repair, the company has increased margins and created more touchpoints with customers. They place great emphasis on enabling their technicians to solve the customer's whole problem (clearing drains back to the house, servicing pumps, etc.), and not just servicing their tanks.

- **focusing on efficiency in their operations**. Full-time customer service representatives receive the same training as technicians, so they begin troubleshooting problems as soon as they contact the customer. The company's maintenance shop has 15 mechanics who work after hours to ensure all vehicles are repaired and ready for service the next day, minimizing downtime. Dispatch operations have real-time GPS location for all the company's service trucks, redirecting them as needed and providing customer with updates on arrival time and progress. Operating 24/7 enables the company to keep equipment utilization high, lowering costs.
- **investing in training employees through its FloHawks University program**. The program takes around three weeks and includes class time, practice on a working septic system in the company's mock home, and service calls with more experienced technicians. After graduating, employees spend a month riding with an experienced employee to learn customer service. When new technicians start taking calls on their own, the quality assurance supervisor rides along for several more weeks to ensure they are ready. FloHawks offers full educational reimbursement to all employees, even if the classes do not relate directly to their current position.
- **believing in keeping their employees safe**. The company maintains an Experience Modification Rate (EMR) of less than 1.0, and this low incident rating is required by some clients. The company holds weekly meetings to review safety procedures, and monthly meetings to review any past incidents and learn from them. FloHawks has a full-time safety director who is available at any time to address safety issues, monitor risk factors, train employees, and oversee the company's safety program and government reporting. Employees are trained in the proper use of safety gear and confined space procedures for tank entry, and supervisors and colleagues check their proficiency regularly. The company has its own certification training for everything from vehicle to equipment operation. In addition, all technicians complete 12–18 hours of continuing education each year, which can include commercial driver's license certification, first aid and cardiopulmonary resuscitation (CPR), confined space entry training, and other professional classes.
- **investing in marketing, especially online.** Customers can submit service requests by phone or through the internet or email. The company has an active Facebook profile and regularly creates written and video content to educate customers about septic systems. Content is crafted to optimize use of the keywords most commonly used in web searches, improving the company's hit rate in search engines. Billboards have also been found to be an effective source of new customer inquiries. The company also runs septic system courses for real estate professionals, who then recommend FloHawks to their clients. For commercial contracts, the company has a staff of sales people who regularly call on businesses (e.g. restaurants, apartments, hotels) to develop relationships and win service contracts.

## NEXT STEPS

Flohawks regularly has 13–26 billboards in the general working area. This empty box van acts as an additional billboard that can be moved as needed for fairs and trade shows. Many customers comment on the funny slogans and often look forward to seeing new ones.

Moving forward, FloHawks intends to continue their growth by optimizing operations and broadening relationships with customers. Over the next year,

| Facility | Ownership | Waste Type | Disposal Cost (USD per gallon) |
|---|---|---|---|
| City of Tacoma WWTP | Government | Municipal | 0.1482 |
| LOTT WWTP | Government | Municipal | 0.1563 |
| Seattle King County Metro South Plant | Government | Municipal | 0.1329 |
| Bio Recycling (Centralia) | Private | Septic | 0.1382 |
| Bio Recycling (Shelton) | Private | Septic | 0.1219 |
| FloHawks | Private | Septic & Portable Toilet | 0.1300 |
| Baker Commodity, Seattle | Private | Grease | 0.1400 |
| Darling Recycling, Tacoma | Private | Grease | 0.1600 |
| FPE Renewables, Enumclaw | Private | Grease | 0.1000 |

*Table 2: Disposal Costs*

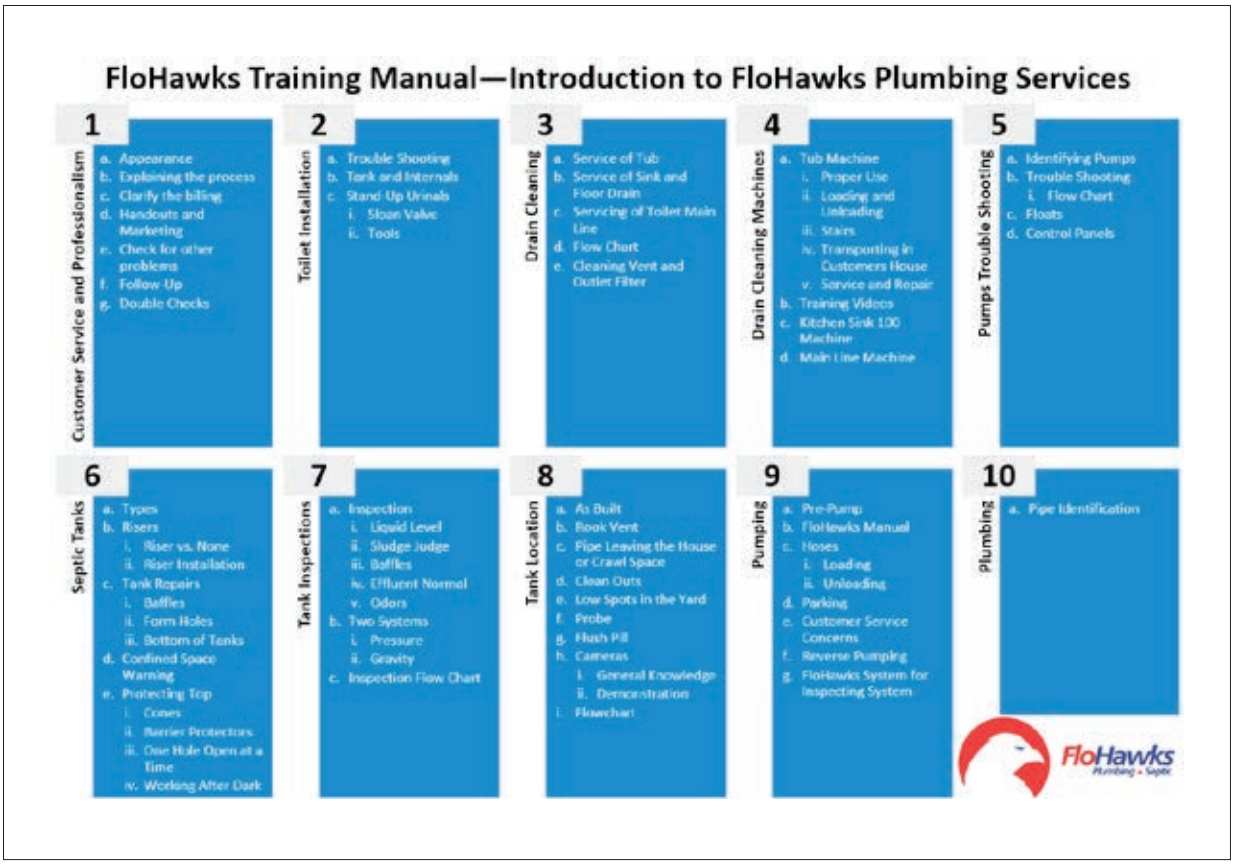



*Image 5: The table of contents from a FloHawks University training manual.*

they are working towards two-way, real-time synchronization of dispatch and in-car computer systems. They are also moving towards real-time communication with customers: providing updates on arrival, pictures and updates during the job, and sending invoices by email immediately upon completion. The company is focusing on educating customers about the breadth of services they provide to encourage repeat business and larger jobs. Each time a technician recommends additional services to a customer, the customer must either agree to the work, or sign-off that they decline the work. This helps FloHawks ensure that employees are communicating with the customer about additional services during each job.


*Image 6: Funny or catchy billboards are part of FloHawks' marketing campaign.*


## ACKNOWLEDGEMENTS

FloHawks would like to thank all current and former team members who have played a role in their success, and the customers, families, and communities that have trusted FloHawks with their septic service needs.

# Building Successful Sludge Enterprises in Norton, Zimbabwe

Alana Potter, Joseph DeGabriele, Jeffrey Msamala, Mark Harper and Humphrey Mapuranga

## EXECUTIVE SUMMARY

In Zimbabwe, high population growth and limited space in peri-urban centres, coupled with fiscal constraints on the provision of reticulated sewerage systems, mean that existing pit latrines must be desludged. However, the country currently has no appropriate technology for emptying latrines in dense settlements.

A Research into Sludge Enterprise (RISE) initiative is trialling the viability and applicability of mobile desludging units (MDU), in a pilot location including Norton, a township near Harare. Overall, reports from households that had received the service said the MDU service was a quick, hygienic and efficient way to desludge tanks and pits, despite concerns about cost and capacity.

Lessons from the pilot include the need for the service to focus on its niche market, although commercial customers are crucial for business viability. Customer feedback is important, as in ongoing, targeted marketing and regulatory support.

FSM is a more than a technology, and while the MDU has all the hallmarks of contextual and market fit, viable business models, marketing, drive and alliances and partnerships are crucial.

## CONTEXT AND BACKGROUND

Zimbabwe is a landlocked country in Southern Africa with a population of around 13 million people. The country's economy is agriculture based and GDP growth declined from 3.8% in 2014 to an estimated 1.5% in 2015.

About a third of Zimbabweans live in urban areas, where annual population growth is around four percent a year. According to the 2015 country poverty atlas, poverty is widespread in rural wards and lower in urban districts. Poverty is highest in districts with low rainfall and is generally low in cities and some towns.

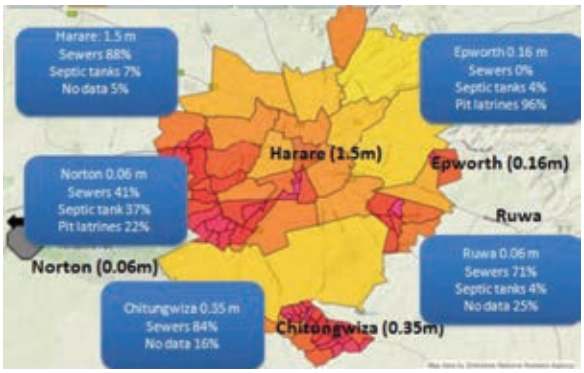



*Figure 1: Sanitation facilities in Greater Harare*

A well-defined legislative and institutional framework is in place. Water, sanitation and hygiene (WASH) issues are governed by the ministry responsible for water and coordinated by the National Action Committee (NAC), a multi-ministerial body established under the National Master Plan of 1985. The NAC comprises three sub-committees: rural WASH, urban WASH, and water resources management.

Despite state and non-state efforts, Zimbabwe did not meet the MDG target for sanitation. At the end of 2014 overall sanitation access to improved unshared facilities was 35 percent (47 percent in rural areas and 30 percent in urban areas). About 2.1 million people (2012 census) live in Greater Harare (the city of Harare and the four surrounding towns of Chitungwiza, Epworth, Ruwa and Norton). At Zimbabwe's economic low point in 2008/9, water and sanitation service delivery collapsed as a result of chronic power shortages, an inability to procure essential inputs such as chemicals to treat water, and disruptions in pumping and treatment of water and wastewater. This resulted in an outbreak of waterborne diseases. Greater Harare accounted for 26 percent of the 4,300 reported cholera deaths. Handwashing facilities and soap were found to be available in only 0.3% of households.

### Faecal Sludge Management

Options for desludging latrines in Zimbabwe are limited. Although vacuum trucks (honeysuckers) are

*Figure 2: Sludge illegally disposed by manual emptiers*

available in some urban centres, they are unsuitable for the types of toilets found in dense settlements because they are too large to access the pits, and have inadequate suction to desludge the thick sludge from Blair toilets and small septic tanks. In addition, the investment and operating costs of vacuum trucks are significant.

By-laws make Blair toilets and other pit latrines illegal in urban areas, so acknowledging their existence and providing an emptying service is a significant hurdle for local authorities. Most households and institutions are unaware that latrines can be emptied by mechanical means, and instead build new latrines when pits fill up or engage manual labourers to empty full pits and septic tanks. As a result household and institutional toilets with good infrastructure are often abandoned due to full pits.

Currently, Zimbabwe does not have an appropriate technology for emptying latrines in dense settlements, especially where these latrines have high solid content and contain the rubbish such as nappies and plastic bags that is often disposed of in pits. High population growth and limited space in peri-urban centres, coupled with fiscal constraints on the provision of reticulated sewerage systems, mean that existing pit latrines must be desludged.

The Research into Sludge Enterprise (RISE) initiative is trialling the viability and applicability of mobile desludging units (MDU) in small urban centres in Zimbabwe. The mobile desludging unit is designed to empty pit latrines, Blair Ventilated Improved Pit Latrines (BVIPs), and septic tanks with high solid content. The MDU was developed and up-scaled in Malawi by WASTE through small-scale private providers in peri-urban sites. The RISE initiative aims to assess the potential contribution of this technology to improving sanitation services in Zimbabwe.

By trialling, researching and demonstrating a viable model for mobile desludging in urban centres in Zimbabwe, we aim to benefit: (i) local authorities, by providing a new technology for sanitation services; (ii) private operators, by providing a viable business option; (iii) institutions, by extending the life of existing latrines; (iv) households, by providing an affordable, locally available emptying service; and (v) local authorities and the Environmental Management Agency, by enabling them to regulate the activities of licensed operators to ensure that faecal sludge is adequately collected, transported, treated and disposed.

The MDU project is active in Zvimba and in Norton, a township near Harare, that has a population of approximately 68,000. WASH services are provided and administered by the Norton Town Council (NTC), which is also mandated to enact and enforce the by-laws and regulations that govern WASH provision. Norton has a sewage treatment plant with a design capacity of 30 megalitres/day that currently processes around ten megalitres/day. The majority (50–60 percent) of households living in high density settlements are not connected to the sewerage system, which is constrained by water shortages. Pit latrines and septic tanks (standard and non-standard) are the most common sanitation systems. The residential stands are small (200–400 $m^2$) and dense and therefore cannot be easily accessed by honeysuckers. This

| MDU Fee (USD) | NTC Honeysucker Fee (USD) – high density areas | Private Honeysucker Fee (USD) | Manual Emptiers (USD) |
|---|---|---|---|
| 35.00/trip or $m^3$ | 23.00/5$m^3$ | 60.00/pit or septic tank | Range from 5.00/20-litre bucket to 100 USD per pit |

*Table 1: Current Emptying Costs in Norton*

| Perspective / Sustainability Dimension | User / buyer | Producer / provider | Regulator investor facilitator |
|---|---|---|---|
| Social | (1) Demand for the technology | (2) Need for promotion and market research | (3) Need for behavioural change and social marketing |
| Economic | (4) Affordability | (5) Profitability | (6) Supportive Financial Mechanisms |
| Environmental | (7) Potential for benefits or negative impacts for user | (8) Potential for local production of product or spares | (9) Potential for negative impacts or benefits for natural resources on a larger scale |
| Legal, institutional, organisational | (10) Legal structures for management of technology and accountability | (11) Legal regulation and requirements for registration of producers | (12) Alignment with national strategies and validation procedures |
| Skill and knowledge | (13) Skill set of user or operator to manage technology including O&M | (14) Level of technical and business skills needed | (15) Sector capacity for validation, introduction of technologies and follow up |
| Technological | (16) Reliability of technology and user satisfaction | (17) Viable supply chains for product, spares and services | (18) Support mechanisms for upscaling technology |

*Figure 3: The 18 Technology Action Framework (TAF) indicators*

leaves households with the option of manual emptying to extend the lifespan of their latrines, a practice that poses public health and environmental risks.

Although the local authority has by-laws against manual emptying and unauthorised disposal, enforcement and regulation are weak and for the most part, unsuccessful. The Environmental Management Agency is mandated to regulate and ensure that faecal sludge is collected, transported, treated and disposed safely, but there is limited coordination between the Environmental Management Agency and the local authority. Like many other local authorities, Norton has no standard operating procedures for disposal of sludge at sewage treatment plants or in areas without treatment works, and there are no clear systems to report illegal emptying or disposal. The draft National Sanitation and Hygiene Policy (2016) makes no reference to faecal waste desludging.

## ACTION RESEARCH METHODOLOGY

The Technology Applicability Framework (TAF), a decision-support tool to assess the applicability, scalability and sustainability of a specific WASH technology to provide lasting services in a specific context, was adapted and applied as a research tool.

The three main stakeholder groups – users, operators and government (local authorities and the national regulator, the Environmental Management Agency) – are engaged as action research participants, applying the TAF:

- (a) at the feasibility stage to inform actions to introduce the MDU;
- (b) at mid-line to strengthen implementation of the MDU services, and
- (c) at end-line to inform scaling up.

Action research participant groups score the indicators from their perspective with reference to a common information base collected through survey data, focus group discussions and key informant interviews, which is presented in an interactive setting. Scores from the perspectives of users, operators and authorities/ regulators can be analysed per sustainability dimension (horizontally) and from the different perspectives (vertically).

By bringing the key actors together to analyse comprehensive institutional, social, environmental, capacity, technical and financial information and develop action plans, the initiative also (a) develops their knowledge on how to design, implement and scale up faecal desludging towards improved sanitation services; (b) uses their knowledge to design, implement and scale up mobile desludging, and (c) builds partnerships for improved sanitation services.

*Figure 4: Mobile Desludging Units (MDU) in Norton*

## SUMMARY OF FSM INTERVENTIONS AND CHANGES

A private company (Green Earth) selected from 16 candidates for MDU operator based on clear actions identified through the first TAF workshop, has introduced the MDUs in Norton and in Zvimba small urban centres. A contract between Welthungerhilfe Zimbabwe (WHH) and Green Earth sets out the terms and conditions of MDU use, including WHH's obligation to support and train the operator in the use of the MDU and the operator's obligation to insure and run the unit and reach agreed targets. As well as households, institutions such as mines have shown interest in the MDU and have been engaging Green Earth to desludge pit latrines for their staff.

The MDU is light-weight, with a tank capacity of 1 cubic metre. The specifications of the MDU are shown in Table 2.

An MoU and operating licence is in place with the local authority (NTC), and a customer feedback mechanism is being introduced. To date, 137 households have received and paid for the service to date. To enable MDU service provision, NTC reduced the fee for sludge disposal (into its sewage treatment works) from USD 100.00 per load to USD 5.00 per load. Despite initial concerns about competition between the MDU and the council honeysucker, NTC is now supportive and acknowledges that the MDU complements their efforts to provide sanitation services and offers a service it cannot offer in the four suburbs of Maridale, Johannesburg, Kingsdale and Marshlands. The Maridale and Johannesburg communities have been more receptive to the MDU service, which has contributed to an anecdotal decline in manual emptying and open sludge disposal sites in these areas. The MoU clearly stipulates that the MDU services will be offered only in hard-to-reach areas that the council's honeysucker cannot access.

## FINANCIAL AND ECONOMIC ASPECTS

A business model canvas was developed, which revealed that the MDU has two main value propositions:

It can remove difficult sludge more effectively and safely than by honeysucker or manual emptying.

It is a cost effective way to rehabilitate household and toilets in institutions such as schools, health centres and industrial sites.

**MDU Specifications**

| | |
|---|---|
| *Manufacturer* | ROM Bv, Netherlands. Developed in partnership with WASTE, Red Cross Netherlands and Malawi. |
| *Description* | Petrol driven vacuum pump with pressure pump for fluidising. 100 litre Steel holding tank with inspection hatch. |
| *Shipment gross weight and volume* | 500kg; L. 200 x W. 140 xH. 160 mm. |
| *Propulsion* | Truck mounted or trailer |
| *Engine type and power* | Honda 6.6 kW; Electric start |
| *Vacuum pump capacity* | 2500l./min, Kevlar vanes (+ spares). Additional oil reservoir |
| *Pressure pump capacity* | 140 bars –maximum pressure - unloader set on 60 bars. No need for pressurised water inlet. 4.1 kW. 15 litres / minute. |
| *Water tank holding capacity* | 400 lts |
| *Suction hose diameter and length* | 3-inch; 30 metres |
| *Hose connectors* | Quick release, Metal |
| *Ball valves* | Metal |

*Table 2: MDU Specifications*

| 20% | 80% |
|---|---|
| Paying households in high density areas should represent around 20 percent of the revenue. Charges are lower, and operating costs higher because customers are dispersed. | Enterprises such as mines, NGOs, etc. while representing a smaller number of clients, typically have more toilets (more than 30) and can pay more. The target should be that they represent 80% of the revenue of the business. |

*Table 3: Customer segments.*

Capital costs for the MDU are covered by RISE for two years. The operating cost per trip is USD 20.00 and households are charged USD 35.00 per trip of 1m$^3$, for a net profit of USD 15.00 per trip. Other costs borne by the operator include fabricating a trailer to mount the MDU and a truck to tow the MDU.

At around USD 20,000 for one imported MDU unit, capital costs are a serious barrier to entry into the business and a barrier to a profitable business. The focus is now on designing and producing quality MDUs locally for around USD 10,000, which offer the additional advantages of increased availability and service capacity.

## DRIVERS OF CHANGE

### Main enablers

**Local partnerships:** Welthungerhilfe's local presence and ongoing work in the Sustainable services for Everyone beyond the Lifetime of the project at Fair price (SELF) project facilitates relationships with NTC and other local actors. The periodic engagement of users, operators and regulators/ authorities (NTC, local councillors and EMA) in TAF workshops helps coordinate, share information, systematically address social, institutional, environmental, capacity, technical and economic questions, and make plans to address bottlenecks.

**Household need and demand:** Sixty-three percent of households in the pilot area have flush toilets connected to 'septic tanks' (which are little more than infiltration pits with large amounts of solid waste), and 31 percent have pit latrines. Only 7 percent have no latrines. Twenty-two percent of these tanks or pits were almost full and 33 percent were half full, of which 59 percent contained wet sludge.

Forty-five percent of households reported using the municipal honeysucker, and 17 percent employed the services of manual desludgers when their tanks/ pits were full and 11 percent built new toilets.

There are no cultural or religious constraints to the uptake of the MDU service, and although manual desludgers are prevalent, households indicated a preference not to use them. Most households use latrines that need to be emptied, so behaviour change is not significant constraint. Many Blair latrines have dry sludge (low water content), and this, coupled with the high household densities, creates a good market for the MDU.

Overall, reports from households that had received the service (97 in September 2016) said the MDU service was a quick, hygienic and efficient way to desludge tanks and pits. However, there were concerns about capacity and cost.

**Local production and spare parts**: Theoretically, small honeysuckers (up to 2m $^3$) can be adapted to MDUs. The MDU can be operated and maintained using off-the-shelf spares. A regional supply chain proposal has been accepted.

**Technology applicability:** The MDU can be equipped with a high pressure nozzle to unblock sewers and deal with thick sludge. Either this is done, or 1 m $^3$of liquid waste is removed from the pit/ tank but the hard sludge is left behind.

**Regulatory arrangements:** Welthungerhilfe brokered an MoU between Green Earth (the operator) and Norton Town Council (NTC) to reduce the disposal fee to USD 5.00. This also segmented the target markets of the NTC honeysucker and the MDU, relieving the initial perception of the MDU as competition to the NTC's honeysucker, and thus revenue collection.

Risks considered during introduction of the MDU, such as overloading the wastewater treatment plant or illegal dumping of sludge, have been addressed, and the Norton treatment plant has been rehabilitated.

Green Earth and the truck are also licensed and MDU operations are legally compliant with national and local standards. The MDU has presented no negative environmental impacts in Norton.

**Skills/know-how:** WASTE and WES are transferring the operation and maintenance and business skills training for the MDU business to Green Earth, through training and mentorship. However, O&M tools need to be developed to ensure proper record-keeping (timesheets, log books, operation and maintenance procedures, etc.).

**Main constraints**

**Cost and capacity:** The MDU is custom made for 1m$^3$ pit latrines in high density areas. Some pit latrines – especially at institutions – are larger than 1m$^3$ and will not be empty after one trip. Septic tanks fill up in the wet season and also because people flush greywater into pits and tanks. This means more than one trip will be needed to empty them, and at a cost of USD 35.00 per trip (1m$^3$), this may become or be unaffordable.

There is need to review the pricing model. Suggestions from users, operators and regulators include charging USD 40.00 to completely or half empty a pit or tank or charge USD 8.00 per m$^3$, or for the council to waiver the USD 5.00 disposal fee since Green Earth pays for the operating licence. Other options are to consider resizing the MDU to a capacity greater than 1 m$^3$, or that the MDU services target pit latrines and small septic tanks.

**Meeting demand:** Customers want their pits/ tanks emptied completely, and they want a quick and reliable service. There are complaints that the MDU is too small and expensive.

Mechanisms to understand user demands and manage expectations for the MDU service must be developed, and Green Earth must have a feedback mechanism in place. A customer feedback form has been developed to be completed after each desludging.

Currently, the truck resides in Harare, so meeting the demand for a quick, responsive service is reduced, as is business viability due to the costs of travel to and from Norton.

**Target markets for business viability:** A commercial business cannot provide affordable yet profitable services in low income high density areas without cross subsidy from corporate clients that can pay the full cost of the service. Different marketing strategies are needed for households and for corporate customers. The Zimbabwean operator has not as yet managed to get significant business from corporate clients despite marketing, meetings and demonstrations. This is currently the major barrier to business viability of the MDU.

In terms of capital costs, the MDU costs USD 16,000–20,000 (without trailer or truck) and a honeysucker costs about USD 75,000. The MDU operator has desludged 137 toilets and has yet to make a profits (due to set up, marketing, trailer, operating, and other costs), but will make USD 15.00 per desludge going forward.

Options to improve business viability include combining the council's honeysucker with Green Earth as a business, identifying a local operator in Norton, and/or keeping the truck in Norton rather than Harare.

**Target market for the MDU:** There are many large septic tanks in the pilot area, and the MDU's ability to liquefy hard sludge and unblock sewers using a high-pressure hose has yet to be fully exploited.

**Competitors:** Presently, the NTC charge of USD 20.00 per desludge undercuts the MDU service. NTC is also not fully enforcing illegal disposal by-laws, leaving the market open to cheaper, illegal manual desludgers. Green Earth also needs to do better marketing and have a regular on-site presence in order to provide the responsive service that most customers want.

**Marketing strategy:** Despite efforts to promote the service through fliers, demonstrations, posters and billboards, a survey in August 2016 revealed that only 25 percent of households surveyed reported knowing about the service.

## LESSONS LEARNED

- There is demand and the service is affordable, but it needs to be offered to its niche market, i.e. latrines/ small septic tanks in high density areas rather than large septic tanks and Blair toilets in institutions such as schools, health centres and mines.
- Commercial customers, NGOs and institutions are crucial for business viability
- Local authorities need to see the value of the service as an extension of their sanitation provision mandate rather than a threat to their service provision or an opportunity for increased income
- Formal agreement is needed between the operators and the local authorities, brokered by an independent agency such as an NGO if needed.
- Customer feedback mechanisms are crucial, as is ongoing, target-oriented marketing.
- Regulatory support is necessary, and enforcement of by-laws to reduce illegal manual emptying and disposal is crucial.
- The use of the TAF to spark and guide discussion between users, operators, authorities and regulators, and to form the basis of action planning is useful. A significant contribution was the non-threatening platform it offered to technical staff at NTC to explain

the benefits of the MDU and help them address the challenges they have with NTC management.
- The role of WHH as an honest broker and mediator between the local authority and the private sector company has been important, primarily in the development of the MoU.
- The accessibility advantage of the MDU has been as important for business, as has its ability to desludge high solid content.
- The local authority and private sector need to synchronise prices. Currently, NTC charges USD 23.00 per load (because overheads such as salaries, depreciation and repairs to equipment, and disposal fees are not factored into the costs), whilst the MDU operator charges USD 35.00 per load.
- Selecting the right operator is crucial. The right combination of demonstrable business skills, social entrepreneurship and business development drive should be considered.
- Household desludging is not sufficiently profitable as a stand-alone enterprise. Corporate clients are needed to meet the commitment to serving low-income households.
- FSM is a more than a technology. While the MDU has all the hallmarks of contextual and market fit, viable business models, marketing, drive and alliances and partnerships are crucial.

## CONSIDERATIONS FOR SCALE UP

**Regulatory provisions:** EMA in consultation with local authorities should develop desludging guidelines and standard procedures for sludge disposal in areas without wastewater treatment plants.

**Marketing strategy:** Marketing requires ongoing investment and effort, and the MDU strategy needs to focus more specifically on the MDU customer niche and target corporate customers, such as institutions, mines, and large development partners and NGO programmes.

**Build public private partnerships:** Regular meetings between the operator and future operators and the council are needed to identify and unlock challenges and ensure quality service delivery. For example, the council needs to operate its honeysucker in lower density areas rather than high density areas (the MDU's niche), and enforce disposal bylaws in order to facilitate the role of the existing operator and future operators in extending the Council's mandate to deliver sanitation services.

**Operational issues:** An operating manual needs to be developed together with a supply chain database for spare parts.

**Skills development:** In the long run, Green Earth should consider cascading the MDU O&M training to other staff members so that the current operator is not overwhelmed with work. Finances permitting, the current operator should have an assistant who will be mentored and eventually be left to operate the MDU in Norton and surrounding areas. In the future, there may be need to identify a local institution that will offer MDU O&M training and mentorship in order to institutionalise the MDU training and skills.

**Meeting customer demand:** To ensure that pits are fully emptied, the operator and WASTE need to develop a cash flow proposal that includes more than one trip per household. A customer feedback and communication mechanism is needed. Customers should complete a feedback form after every visit.

**National level:** There is a need to advocate the technology at national level through national sector meetings, notably the revised National Sanitation and Hygiene Policy. Welthungerhilfe and Green Earth have engaged various relevant structures responsible for national and district support (technical advice, marketing, etc.), but other institutions such as private sector companies and government ministries are still to be engaged.

## SELECTED REFERENCES


WASTE and NL Red Cross Advisers, 2014. Testing and Developing of Desludging Units for Emptying Pit Latrines and Septic Tanks. Summary of findings of field work in Blantyre, Malawi.

M. Jere, A. Dzotizei and M. Munjoma, 1996. Sustainability of Water and Sanitation Systems: Pit latrine using motorised equipment.

Zimbabwe Water Forum Policy Note 4 (2013:3)

Zimbabwe 2016 National Sanitation and Hygiene Policy

Zimbabwe Water Forum Policy Note 4 (2013:4)

Zimstat 2012 Census National Report

http://www.ircwash.org/tools/technology-applicability-framework

http://www.aguasan.ch/downloads/PAPER_Tech4Dev.pdf

https://washtechafrica.wordpress.com/category/project-outputs/technology-applicability-framework/

https://www.unicef.org/zimbabwe/Zimbabwe_Poverty_Atlas_2015.pdf

http://www.ircwash.org/resources/technology-applicability-framework-taf-questions-mobile-desludging-units

http://www.cswashfund.org/our-work/news/self-project-gives-councils-push-start-zimbab

## ACKNOWLEDGEMENTS

This research was funded by Australia's Department of Foreign Affairs and Trade (DFAT) under the Civil Society WASH Fund managed by Palladium. Welthungerhilfe implements the SELF Project in Zimbabwe under this fund.

Norton Town Council and Zvimba Rural District Councils have enabled the mobile desludger to operate in Norton and Zvimba respectively. Green Earth is the private sector company operating the desludger. The research also benefitted from contributions from the residents of Norton and Zvimba.

IRC led the research with the Institute of Water and Sanitation Development (IWSD) as the local research partner. WASTE Malawi transferred the technology from Malawi to Zimbabwe and mentored Green Life on marketing the technology.

Special thanks to Bronwyn Powell and team who have reviewed the project each quarter.


FSM4