Paper 2: Scaling up safely managed on-site sanitation services in Lusaka

Only a small proportion of households in Lusaka are connected to the sewerage network. Even for the 74% of residents that were nonetheless judged to have access to sanitation, very little information existed on the actual facilities, practices and providers they were using. Attempts to trace the flow of the estimated 30,000 tonnes of faecal sludge produced in Lusaka every year were largely based on estimates.[2] The extent to which existing sanitation services could be described as 'safely managed' was unknown.[3] Many had been left with little choice but to resort to informal services, where illegal sludge dumping is commonly practised to save on costs. Some chose to simply abandon overflowing pit latrines. In any case, inadequate treatment facilities meant that large amounts of sludge, whether collected or not, were finding their way into the open environment without any prior treatment. Any available data, uncertain as they were, showed a large gap between national aspirations for universal access to safe sanitation and the daily reality for most city residents, and poor outcomes for society as a whole.

As sanitation had no clear institutional home and attention was generally focused on sewerage rather than on-site sanitation (OSS), solutions to tackle citywide sanitation had not yet been fully explored. Lusaka Water and Sanitation Company (LWSC)[1], through its peri-urban department, had started its OSS and faecal sludge management (FSM) journey in 2012, working with local pit-emptiers on a demonstration site in Kanyama peri-urban areas (PUAs). There, Water and Sanitation for the Urban Poor (WSUP), the Water and Sanitation Association of Zambia (WASAZA) and sanitation specialists from the Bremen Overseas Research & Development Association (BORDA) supported the development of a model for low-cost emptying services, which was then also implemented in Chazanga. Water Trusts, with technical backstopping and oversight provided by LWSC, are sub-contracted to manage the entire FSM chain. Sludge collected from household latrines is taken to decentralised transfer stations, where it receives partial treatment in anaerobic digesters before the remaining solids are taken to drying beds[4] for further treatment. Through this project LWSC piloted two faecal sludge treatment plants (FSTPs) as part of the effort to provide affordable and financially viable pit-emptying services.

For the utility, even this small step represented a significant departure from its usual business. LWSC gained some insight into how a utility could deliver an OSS service and the challenges that they were likely to encounter. The advent of the Lusaka Sanitation Programme (LSP) brought significant funding, and crucially, some of this was reserved for OSS/FSM activities. The LSP started off with a one-woman 'team' to take on the difficult task of designing and implementing this project component. However, the tide was beginning to turn on the national approach and attitudes towards sanitation. LWSC was going to enter the OSS market. To succeed, it had to start looking for answers to questions few had previously thought to ask.

Activities and interventions

Comprehensive baseline studies focused on low-income households have long been promoted by various develop-

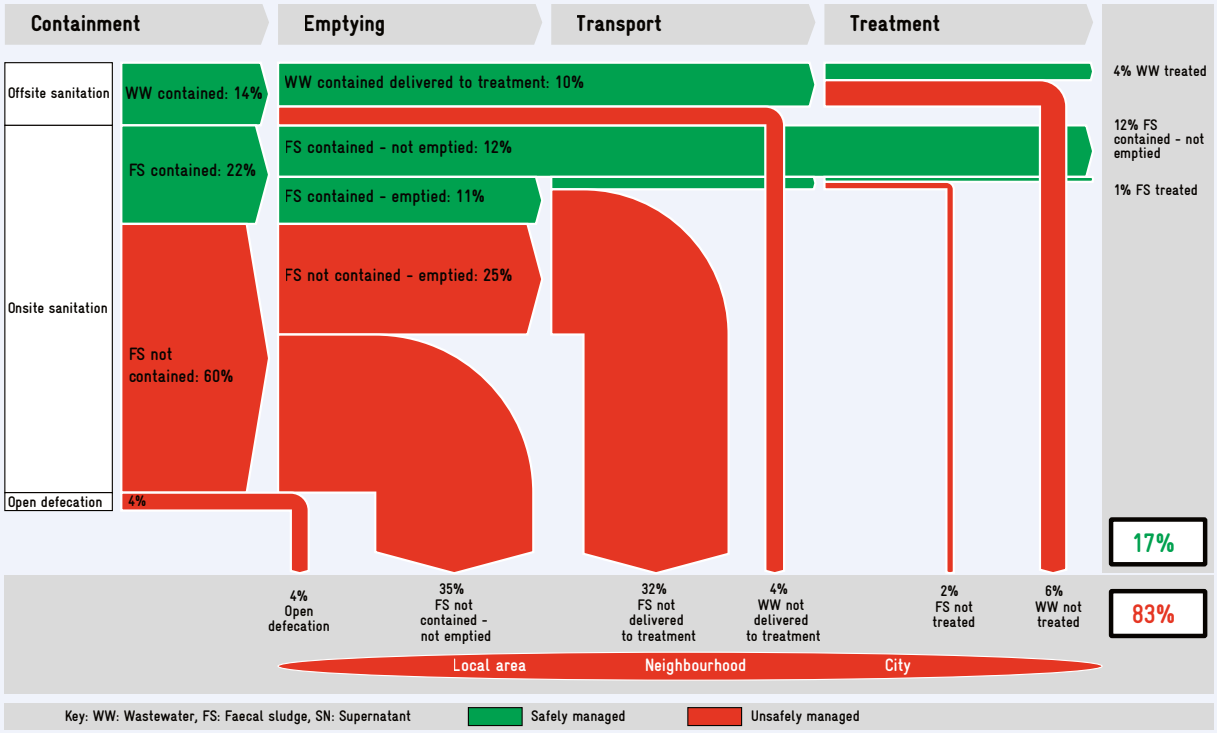
1) All commercial utilities in Zambia were officially renamed 'Water Supply and Sanitation Companies' in 2019
2) The 30,000 t/year figure is quoted in Renouf, R. 2018. Towards citywide sanitation in Lusaka: The next phase of non-sewered sanitation. Topic Brief. WSUP. An 'SFD lite' rapid assessment was done in 2015 to identify priority intervention areas for LWSC under LSP. Still, estimates for the prevalence of different types of OSS facilities ranged between 10 – 20% for septic tanks and 55 – 70% for pit latrines (mostly simple, unlined versions), the latter rising to around 90% in PUAs. Open defecation was thought to be around 1%.
3) Mutale, P. 2019. Framework for Service Provision and Regulation in Zambia. Urban Onsite Sanitation and Faecal Sludge Management. Presentation to Knowledge Exchange Lusaka, 8 May 2019.
4) on-site in Chazanga, off-site in the case of Kayama, where transport is provided by private tankers.

Published by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

LUSAKA CITY COUNCIL

LUSAKA WATER AND SEWERAGE COMPANY LIMITED



SFD Level 3: Comprehensive city-wide Shit-Flow-Diagram

Lusaka 2018

Produced with support from the SFD Promotion Initiative with funding from the Bill & Melinda Gates Foundation.
The SFD Promotion Initiative recommends that this graphic is read in conjunction with the city's SFD Report, which is available at: sfd.susana.org

ment partners including GIZ as essential to develop an accurate understanding of current contexts in order to facilitate targeted interventions, especially for disadvantaged and vulnerable people.[5] A database of all prospective customers and existing infrastructure as a reference for future monitoring of FSM services was an important first step towards formalising OSS and FSM as part of 'normal' LWSC services. Detailed spatial mapping surveys of all on-site sanitation facilities and users were commissioned by CFS-Lusaka for four PUAs that had been identified as priority intervention areas for the LSP': Kanyama was mapped in early 2017, followed by Chawama, Chazanga and George a year later covering an overall total population of approximately 650,000 people.

The first phase was able to build on WSUP's ongoing involvement in Kanyama. In addition to mapping every pit latrine, septic tank and other type of toilet facility, it referenced water points (kiosk, shallow well, yard tap, borehole, water tank) and solid waste disposal sites as other sanitation-relevant features to generate a more complete thematic map of the sanitation situation in the area. During the second phase, the census of facilities was complemented by a household survey to gauge the local residents' knowledge, attitudes and practices (KAP) with regard to sanitation and hygiene. On request of (and financed by) the World Bank, questions were included that probed willingness to pay and other stated household preferences. Field enumerators were trained to record GIS-referenced data on mobile devices, and to conduct the KAP surveys as well as key informant interviews with selected respondents for data triangulation purposes. Open-source tools and applications used for the mapping exercises included OpenStreetMap and Open Data Kit, as well as the purpose-built software TruField.[6] CFS-Lusaka assisted with the initial training and pilot testing and participated in the data review process.

5) The tool was first used to furnish NWASCO's information system with water services data about peri-urban areas in Zambia, and baselines were later replicated in other GIZ partner countries

6) OpenStreetMap is a free, editable world map, created and updated by users. www.openstreetmap.org
In a similar vein, the 'Open Data Kit community produces free and open-source software for collecting, managing, and using data in resource-constrained environments' www.opendatakit.org 'TruField [owned by OpenStreetMap Zambia] was developed specifically to address the challenge of mapping features in densely populated shanty compounds of Africa. It eliminates positional errors by combining GPS positioning capabilities with visual observation of the feature being mapped (on a satellite image) so that the mapped feature is placed at the exact location.' Fibonacci Engineering. 2018. Facilities mapping and KAP study report: CFS-Lusaka Mapping of sanitation in three peri-urban areas of Lusaka – Chawama, Chazanga and George. p.27.

At the same time, CFS-Lusaka sought a better understanding of excreta management in the entire city of Lusaka. A relatively novel way of visualising excreta flows and tracking their ultimate destination was the 'shit flow diagram' (SFD): a simple graphic shows the status of safely managed urban sanitation services, and its accompanying report describes the service delivery context, data sources and any assumptions made during the assessment. CFS-Lusaka supported the GIZ Sector Programme Sustainable Sanitation in revisiting the 'SFD lite' prepared in 2015; an update was commissioned with a view to arrive at a more thorough citywide SFD. Drawing on new reports and study findings and adding further details gathered through key informant interviews, focus group discussions and field observations, the consultants produced a comprehensive 2018 version.[7] Data for the SFD were provided by LWSC staff, who were also involved in reviewing assumptions and outputs.

> *"Visualisation of data is key to building consensus and awareness. Shit-flow diagrams revealed the 'more real' sanitation situation in Lusaka and were discussed passionately!"*

Building on the mapping surveys of Kanyama, Chawama, Chazanga and George, CFS-Lusaka also produced specific baseline neighbourhood SFDs for these locations. Members of the local communities were amongst the key stakeholders who provided vital inputs at the data collection stage. Researchers also visited treatment facilities and accompanied pit-emptiers to form a first-hand impression of local faecal sludge management practices. Secondary sources were consulted to make informed judgements regarding the risk posed to underlying groundwater resources by different containment systems. Feedback received at validation workshops was then used to revise the SFD graphics and ensure that they reflected a general stakeholder consensus around the 'true' sanitation situation in each locality. Finally, three further 'Scenario' SFDs were developed to illustrate the potential impact of different interventions in the LSP target areas.

Fieldwork for the mapping and SFD exercises had offered some insight into the techniques and 'technologies' used by pit-emptiers in peri-urban areas of Lusaka, as well as a fairly accurate understanding of the environment they had to work in. Small spaces usually prevented access for vacuum tankers, leaving messy and dangerous conditions for manual emptiers with their modified garden tools. Driven by the desire to limit exposure to environmental and health risks and give more dignity to this line of work, CFS-Lusaka was keen to introduce low-cost technologies that would also allow services to be scaled up. For this reason, CFS-Lusaka started searching the market for emptying technologies and solutions being used, or designed for use, in other African cities that might transfer well to the Lusaka context.

Three technologies were chosen, and teams of operators from Chazanga and Kanyama invited to conduct field trials of pit-emptying devices to test their suitability in Lusaka's PUAs: the 'Gulper', a manual device from Uganda, and two mechanised versions, the 'Flexcravator' first invented by American research engineers, and the 'eVac' from South Africa.[8] All are more or less compact, robust and portable machines designed to empty pit latrines by pumping ('sucking') out sludge of relatively wet consistency. Each trial consisted of testing sludge removal from a selection of containments (dry pit to septic tank). The Technology Applicability Framework (TAF)[9] was used to assess the likely fit of each device with local conditions. After each trial, field observations were discussed at a review workshop facilitated by CFS-Lusaka, where stakeholders would score the various sustainability dimensions (e.g. technical performance/suitability, local procurement/manufacture, business potential).[10]

Progress and impact

The mapping surveys provided insight into the reality and perceptions of sanitation in the PUAs. A total of 13,324 sanitation facilities were mapped in Kanyama and another 23,125 in the other three areas, all with an additional descriptive layer of information: plot type, users, type of toilet and containment, including ownership, structural characteristics, access restrictions and emptying history.[11] The mapping had already confirmed some suspected behaviours

7) The graphic and its report are available from https://sfd.susana.org/about/worldwide-projects/city/46-lusaka
8) A newer version of the eVac is now used in Chambeshi Water and Sanitation Company.
9) TAF has been developed as a decision support tool for the introduction of WASH Technologies. https://technologyapplicability.wordpress.com/
10) TAF also considers the sector readiness to take up a new technology. The technology testing exercise included case studies of the technology in its 'home context' as well as evaluating best practices regarding sustainable FSM business models, with specific recommendations for measures that would improve the situation in Lusaka. These aspects are considered in focus area 4 of this report.
11) Zambia OpenStreetMap. 2017. Kanyama Open Street Mapping Report. Fibonacci Engineering Ltd. 2018. Facilities Mapping and KAP Study Report. Unpublished internal reports.

From left to right: The Flexcravator, the eVac, and the Gulper being tested in Lusaka

(for example, about a quarter of respondents confirmed a pit latrine had been buried on their property, and less than 10% of households had had their pit latrine emptied in the past[12]). The updated city SFD then painted an overall picture of the sanitation situation in Lusaka, revising the proportion of safely managed faecal sludge from 25% down to just 17%.[13]

This low level of safely managed excreta was reflected in localised SFDs from the four low-income areas. With almost no access to a connection to a sewer line, poor quality on-site facilities, and limited emptying and treatment services in place, most of the excreta in these areas are unsafely managed. In Chazanga, the practice of abandoning and covering full pits with sand produced a slightly improved picture compared to the citywide SFD, though this is also due to its lower groundwater vulnerability relative to the Lusaka average. A notable finding of all four of the localised SFDs was the high open defecation (OD) rate, in the form of flying toilets, that in turn led to a higher assumption of the citywide OD rate in the citywide SFD.[14]

The SFDs gave LWSC a much better understanding of current and expected service needs, allowing for better investment planning in the future. At the same time, the SFDs gave renewed focus and purpose to discussions amongst decision makers and expert advisers at all levels. Information and knowledge gained from all studies have been integral to designing steps to implement the OSS/FSM component of the LSP. LWSC recognises mapping of sanitation facilities and KAPs as important tools without which the company is unable to design the right services. LWSC being involved in these exercises has had the beneficial effect of integrating other departments (beyond the newly-created FSM unit) in OSS, starting with the CU's GIS department, which manages the database. LWSC has recently secured funding from the Bill and Melinda Gates Foundation to extend the mapping to every sanitation facility in the entire city. There is also some interest within the FSM team to look into creating further SFDs. Mapping has been recognised as a means of mobilising funds for much-needed investments in OSS.

The technology testing has given LWSC the opportunity to explore other possible approaches to operationalising OSS. All of the three tested devices were an improvement on manual pit-emptying in terms of minimising workers' exposure to raw sludge, whilst offering a small-scale and cheaper alternative to vacuum trucks that can reach facilities inaccessible for larger vehicles. Testing did highlight a number of issues, notably the poor construction of toilets and containments, many of which were never built with future emptying in mind. Low roof heights and partially collapsed walls, as well as small doors and small latrine drop holes restricted access for sludge removal, which in some cases had to be forced by breaking into the pit – adding the risk of further weakening already fragile structures. Another major hindrance to service delivery revealed by the testing was the fact that pits are frequently used to dispose of non-biodegradable solid waste. Emptying is significantly slowed (and workers' safety potentially compromised) when waste items that easily clog up sensitive parts of the device need to be manually removed in order to prevent damage to

12) Fibonacci Engineering Ltd. 2018. Facilities Mapping and KAP Study Report. Unpublished.
13) Kappauf, L., Heyer, A., Makuwa, T. and Titova, Y. 2018. SFD Report Lusaka, Zambia, 2018. GFA.
14) GIZ, LWSC, LCC. 2019. The development and use of SFDs for better sanitation investment planning – A case story from Lusaka (Zambia). Lusaka Water and Sewerage Company (LWSC).

the machine. The Gulper and the Flexcravator in particular struggled to cope with the drier, dense sludge often found in unlined pits. The two technologies that require electrical power were unable to function in areas that either had no connection to electricity, or were experiencing a power cut.

Remaining challenges

LWSC has also considered introducing mobile desludging units (MDUs)[15]. However, further exploration is needed as to whether the MDU is suitable for the Lusaka context. It is worth noting that it had been suggested that the fairly flat terrain found in Lusaka would favour the use of modified tricycles as another cost-effective option for transporting sludge.[16] This could be a particularly attractive proposition from a climate perspective, as it saves on fuel and therefore emissions.

The testing and the reports submitted by the teams have offered valuable suggestions regarding OSS management beyond the emptying technology itself. Attention has been drawn towards some key prerequisites for successful OSS, notably the need to formulate and enforce improved toilet construction standards. Testing results strongly suggest that in PUAs it may not be possible to address sanitation and solid waste management separately, at least in the short to medium term.[17] In any case, there is a need to work with residents to stop the misuse of pits for non-biodegradable waste disposal. However, targeted sensitisation activities will need to be implemented in conjunction with effective solid waste strategies and reliable collection services. This task will rest with Lusaka City Council (LCC) and other regulators to create the enabling framework needed for OSS sanitation businesses to thrive.[18] LWSC as the overall responsible service provider has been urged to consider further elements of the sanitation chain with a view to building a strong and sustainable business model for FSM.[19]

Extending the mapping to create a reliable sanitation information system for the entire city of Lusaka holds the promise of much more proactive sanitation management. Any sanitation database will need be updated regularly to offer maximum capability for FSM providers. Ideally, LWSC and LCC would like to move towards scheduled emptying, which requires knowledge of the size and number of users of each facility to track and predict demand. The development of a citywide database is in progress; applications for health inspectors, a customer call centre and OSS-FSM customer management system are under consideration. Within LCC, geo-referenced property data could also be used for planning and overseeing other services. While the mapping to date has been comprehensive, some gaps do remain with respect to the sludge itself: the composition of sludge is not monitored, though the CFS-Lusaka team has carried out a 'quantities and qualities' study. Knowing the composition of the sludge being collected is crucial to inform the design of new FSTPs.

As for the LSP, whilst there is unanimous agreement on the positive impact and publicity its OSS activities are bringing, there is still some work to be done to move Lusaka closer to its goal of being a safe, green city for all its residents. For all the interest and know-how the LSP has generated, it is a project – and projects have defined boundaries and an end date. With this in mind, LWSC has begun to think beyond the project and its intervention areas and activities, preparing for how business will continue once the LSP has been completed. Measures for sustainability after LSP should continue to drive the expansion of OSS /FSM services within the city. The formal name change from Lusaka Water and Sewerage Company to Lusaka Water Supply and Sanitation Company (in 2019), which echoes the emphasis on on-site services on the part of the regulator, is a positive step in this direction. Continued internal capacity development and bridging the human resource gap must be a priority across the company. The fact that a new FSM unit was created within the company, which clearly enjoys management buy-in, (as well as the FSM team within the LSP having grown to four full-time staff) signals a new level of commitment towards enhanced services in underserved and marginalised areas.

15) MDUs are designed as a simple, reliable and economical desludging technology for sanitation services in emergency situation and 'difficult' developing country settings.
16) Sanitation Solutions. 2017. Testing of Pit Emptying Technologies – The Gulper in Lusaka, Zambia. Final Report. p.27
17) Emptiers delivering FS to the treatment plant are having to pay extra for dumping solid waste, as this then needs to be transported/collected to be moved to a dumping site at a cost that is absorbed by LWSC. Some emptiers have expressed the desire to be able to pass on these costs, effectively charging households for solid waste collected from pits and discouraging their misuse.
18) See focus area 1 for a discussion of current and planned activities.
19) The suggestions pertaining to the business model are considered in focus area 4..

Lessons learnt: insights and recommendations

- Operationalising OSS and integrating it not only into the LSP but the changing mandate and business model of the LWSC was a primary concern for GIZ: CFS-Lusaka was designed around the LSP, to complement rather than duplicate activities. Two secondments from CFS provided a much-needed and well-received boost to the project's FSM 'team'.

- The baseline mapping and SFD activities were perceived as helpful because their outputs were needed, yet these needs had not been anticipated and budgeted for. CFS not only filled important gaps relating to 'soft' components of the LSP, but also focused on ensuring continuity beyond the LSP project horizon by empowering LWSC to become a strong OSS partner.

- Stakeholders in Lusaka recognise the value of SFDs for prioritising interventions. The instant appeal of an SFD lies in its compelling simplicity. It translates a complex situation into a clear picture by condensing large amounts of data into an easily accessible format. The process of weighing assumptions and uncertainty itself stimulates discussion to influence decision-making.

- Pit-emptying testing activities carried out in Lusaka have meant that both LWSC and LCC recognise the need for standardised, emptiable toilet facilities, which is an important part of efforts to protect groundwater and safeguard public health.

- The key to scaling up sustainable OSS and FSM lies with LWSC, which needs to adapt its organisational structure and undertake the necessary capacity development across all departments to fulfil its sanitation mandate. A proactive, well-resourced and supported FSM unit can ensure that OSS activities are sustained well beyond the LSP project horizon, and become less reliant on external support. Further exploration of pit-emptying technologies and business models is strongly recommended.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15
E info@giz.de
I www.giz.de

Programme/project description:
Climate Friendly Sanitation Services in peri-urban areas of Lusaka
& Sector Programme "Sustainable Sanitation"

Author/Responsible/Editor:
Esther Gerlach
Co-authors: Amanda Mallaghan, Doreen Mbalo, Mintje Büürma,
Trevor Surridge

Design/layout:
Stefan Mümpfer, grafic works

URL links:
Responsibility for the content of external websites linked in this publication always lies with their respective publishers. GIZ expressly dissociates itself from such content.

GIZ is responsible for the content of this publication.

On behalf of
German Federal Ministry for Economic Cooperation and Development (BMZ)
Stresemannstraße 94
10963 Berlin, Germany

Eschborn, March 2020

On behalf of

Federal Ministry
for Economic Cooperation
and Development