

FSM

INNOVATION

Emerging Lessons on FSM from
Maputo, Mozambique

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EXECUTIVE SUMMARY

This case study describes the process of establishing faecal sludge management (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 a systematic sanitation diagnostic, the problem-based approach of the municipal council, 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 development 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.

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 35 percent use a septic tank (though many are quite crude) and 55 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, 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 (figure 1). 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.

Although sanitation is the responsibility of the municipal councils in Mozambique, on-site systems,

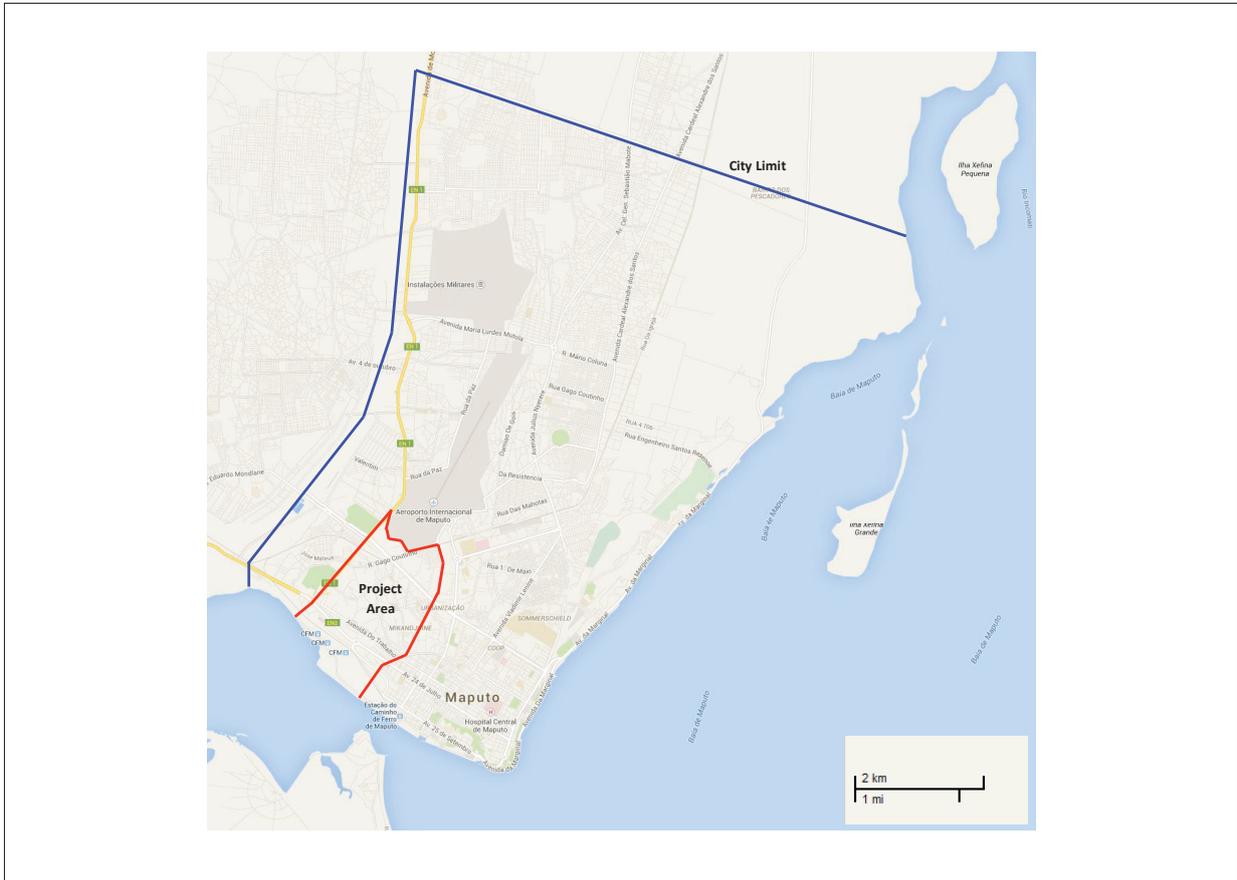


Figure 1: Map of Maputo and the Nhlamankulo project area

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.

NATIONAL AND CITY LEVEL POLICY

Following the promulgation of a national water sector policy in 2007, and a subsequent wide-ranging stakeholder consultation process, in 2011 the Government of Mozambique approved the National Urban Water and Sanitation Strategy (NUWSS), laying out the general principles for urban water and sanitation services planning and delivery. However, the development of implementation tools and plans for sanitation was limited by a lack of investment in the subsector, although investment and expansion of water supply services in urban areas continued.

In a related process, a new sector institution, the Water and Sanitation Infrastructure Board (AIAS, by its Portuguese acronym) was established in 2009 to lead investment and planning for water supply in secondary towns and public sanitation systems in all urban areas, and the remit of the water supply regulator (CRA) was expanded to include public urban sanitation systems.

However, the legal mandate for onsite sanitation remains with the municipal councils.

THE DEPUTY MINISTER FOR WORKS AND HOUSING INITIATED A PROCESS WHICH RESULTED IN AN INTEGRATED PLAN FOR URBAN SANITATION

In parallel, following the AfricaSan-3 conference in 2011, the Deputy Minister for Works and Housing became aware of the growing problem of urban sanitation, and initiated a process involving 12 ministries and agencies with an interest in sanitation, which resulted in an integrated plan for urban sanitation. Importantly, this was supported by the Planning Ministry, which enabled the establishment of a specific line for sanitation in the national budget and thus the tracking of expenditure on sanitation, as well as triggering the much-delayed promulgation of the NUWSS.

The NUWSS charges municipal councils with managing all parts of the sanitation service chain

under a comprehensive approach covering both planned and unplanned areas. It envisages the establishment of autonomous sanitation agencies in the larger cities, funded by a surcharge on water bills. However, general legislation allowing local governments to set up such entities is yet to be enacted and would also fall foul of government guidelines on municipal financial management. The situation is further complicated by the fact that CRA regulates the water tariff – and, by extension, water bills – but, having been designed to regulate independent utilities, does not have legal standing to regulate municipal councils. This led to an impasse whereby the surcharge could not be implemented. After much discussion at a high political level it was agreed that a modest surcharge could be collected as an interim measure.

Following considerable preparatory work collecting information on the sanitation situation and defining the scope of basic sanitation services, MMC decided to pilot improved FSM services at the level of a Municipal District, as a first step towards developing a city-wide approach. In support of this, MMC developed a Municipal Sanitation By-law (the first of its kind in the country)¹, which recognizes and regulates FSM service provision in peri-urban areas, based on the lessons learnt from this pilot. The by-law creates incentives for the private sector to expand services in peri-urban areas, and for residents to be more vigilant in protecting their health and environment. It also allows for MMC to develop service models and payment mechanisms to facilitate the access of poor households to FSM services.

The pilot and municipal capacity development activities were shared with other municipal councils during a National Urban Sanitation Workshop in 2014. This brought together senior national, provincial and municipal leaders with technical specialists from line ministries and agencies and development partners and brought urban sanitation into the political frame.



Figure 2: National urban sanitation workshop

Subsequently, Beira Municipal Council (the second largest city in Mozambique) decided to regulate sanitation services and expand service provision (previously monopolized by the Municipal Council) to the private sector². Other cities are also embracing the initiative, engaging the private sector and developing municipal sanitation byelaws.

MOST OF THE EXISTING INSTITUTIONS ARE NOT DISCHARGING THEIR RESPONSIBILITIES EFFECTIVELY, AND SERVICE PROVISION IS HIGHLY FRAGMENTED AND POORLY COORDINATED

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. AIAS (under the Ministry of Public Works and Housing) is the national agency in charge of sanitation in urban areas, whilst CRA regulates sanitation services. 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

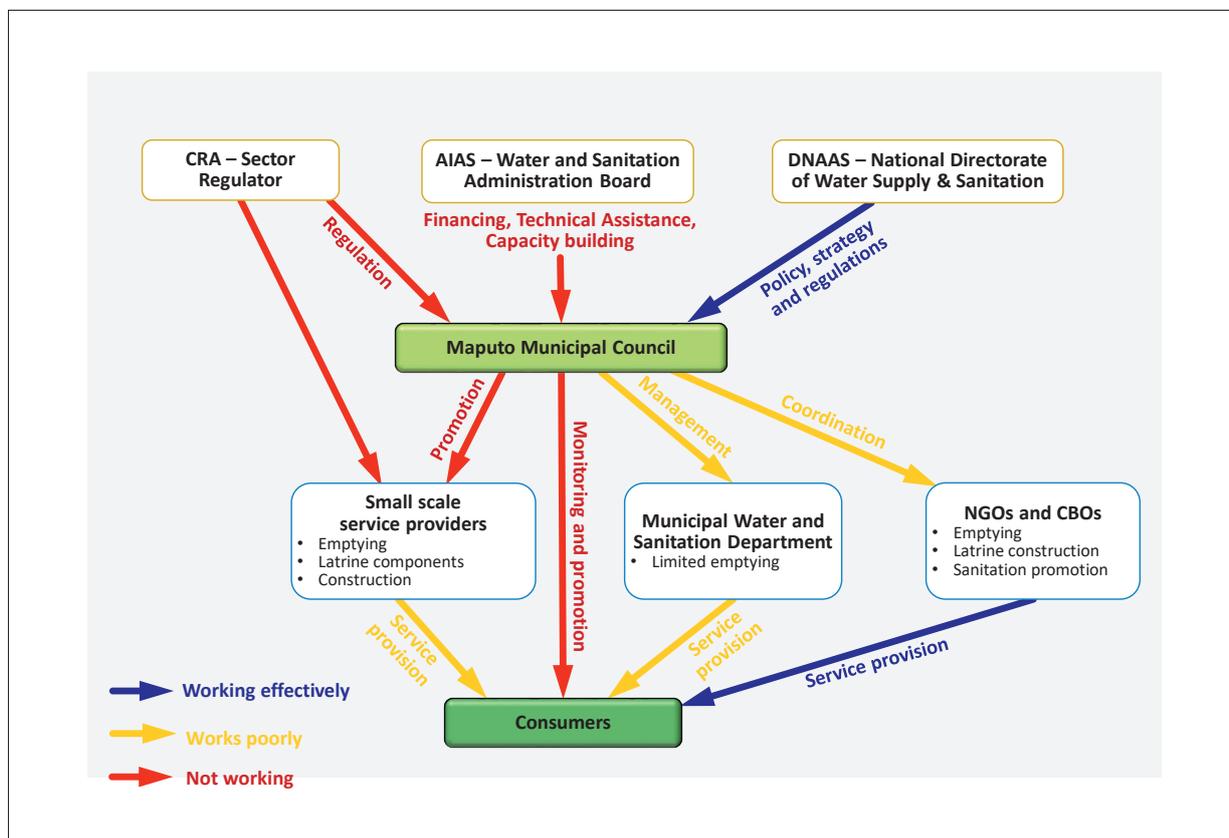


Figure 3: Institutional framework for urban sanitation

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 of FSM service provision by private operators across the rest of the city.

- Based on an analysis of the situation, principal FSM needs emerged as:
- Recognising and regulating FSM services;
- Phasing out (or displacing) unhygienic manual emptying practices;

- Upgrading the treatment facility; and
- Developing services capable of emptying on-site sanitation facilities that are difficult to empty or inaccessible by road.

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, following major water supply improvements in the area.

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



Figure 4: Operator and pump

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 0.5m³ plastic tank mounted on a handcart. Three “secondary” operators additionally received a 2m³ 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 6m³ 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 2m³ 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 2m³ tanks for delivery to the treatment facility. A further reason for the abandonment of the 0.5m³ handcarts was the large-scale shift away from pit latrines to septic tanks, which greatly reduced the number of emptyings of less than 2m³ (Figure 5).

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.

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

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

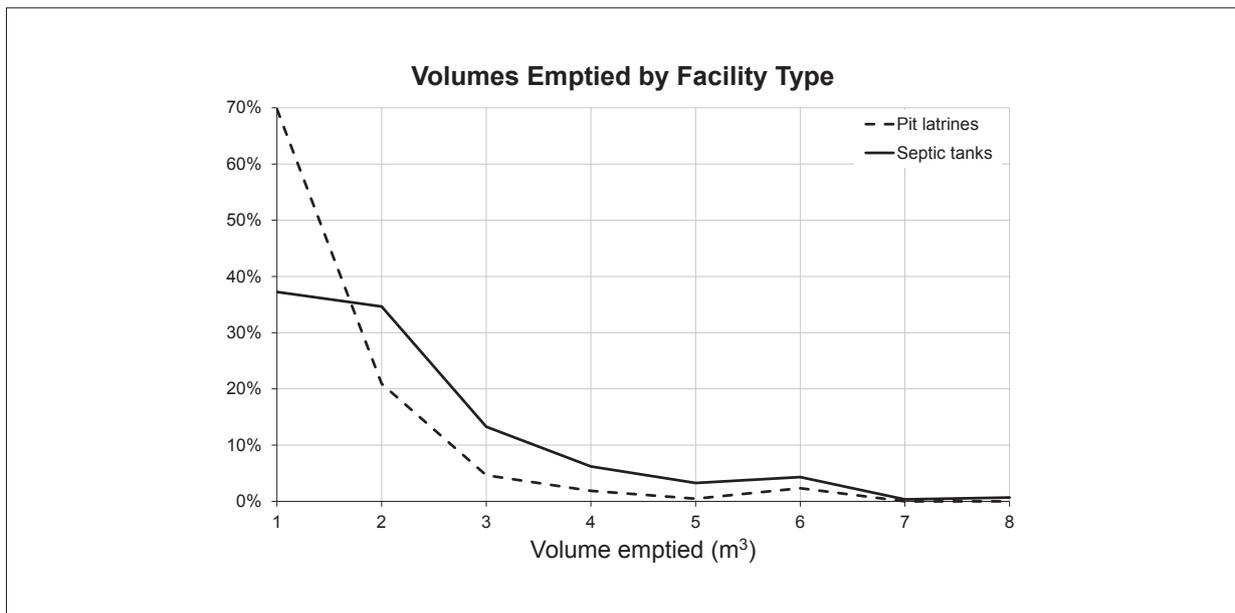


Figure 5: Volumes emptied by facility type

| Operator | No. of emptyings: | | Revenue (USD) | Cost (USD) | Operating profit (USD) | Depre- ciation (USD) | Net profit (loss) (USD) |
|----------------------------|-------------------|--------------|------------------|---------------|------------------------------|----------------------------|-------------------------------|
| | Pits | Septic tanks | | | | | |
| 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) |
| Siema | 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) |

* ceased operating

Table 1: FSM operating costs and revenues for pilot operators

was still under development. The pilot operators were originally charged three 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 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.

FINANCIAL ASPECTS

It should be noted that because the operators were paying three 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 (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.

THESE FACTS CLEARLY SHOW THAT THE BUSINESS IS PROFITABLE AT THE PRICES THEY ARE CHARGING

By comparison, vacuum trucks charge USD 30.00–USD 80.00 per service (average USD 53.00), whilst the informal 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.

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.

BUSINESS MODELS

One of the factors leading to the high survival rate of these new FSM businesses was that all of them were already established in the solid waste business, under contract to the municipal council. As mentioned above, this made it easier for them to manage the highly variable demand for FSM services, and it also meant that they were already connected to their customer base and knew many of their future FSM clients. Given the linkages between sanitation and solid waste management, there are also technical advantages in having a single operator provide both services.

Some of the operators were formally established as businesses, whilst others were registered community organizations (CBOs). In the latter case, this gave them extra credibility and linkages to their clients, but two of the CBOs registered themselves as companies in order

to be able to borrow money for investing in equipment to expand their businesses. This strong degree of orientation of the operators as businesses despite their respective histories suggests that it could also have been a factor in ensuring their survival.

SESSIONS TO INTRODUCE SANITATION MONITORING TO LOCAL COMMUNITY LEADERS HAD THE UNEXPECTED EFFECT OF DYNAMIZING THE LOCAL LEADERSHIP

The operators' association, AMMEPS, was instrumental in setting up the pilot in the first place. They approached the World Bank (which had supported the establishment of primary solid waste collection by micro-enterprises in Maputo) looking for ways to boost their income. In the ensuing discussion, FSM emerged as a promising business area, which formed the basis for the pilot project. 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.

CAPACITY DEVELOPMENT

Capacity building was an important factor in building commitment to improved FSM, and sanitation in general, amongst many of the stakeholders. The active involvement of the municipal sanitation department was an important result of their on-going partnership with the World Bank's Water and Sanitation Program (WSP), which focused on the development and implementation of the new decentralized service structure for sanitation services, and revitalizing the department itself, which had been rather neglected. WSP also facilitated several tightly designed knowledge exchange events for the municipal team to learn from other experiences at national, regional and international level.

At community level, sessions to introduce sanitation monitoring to local community leaders on the lowest tier of the municipal administration had the

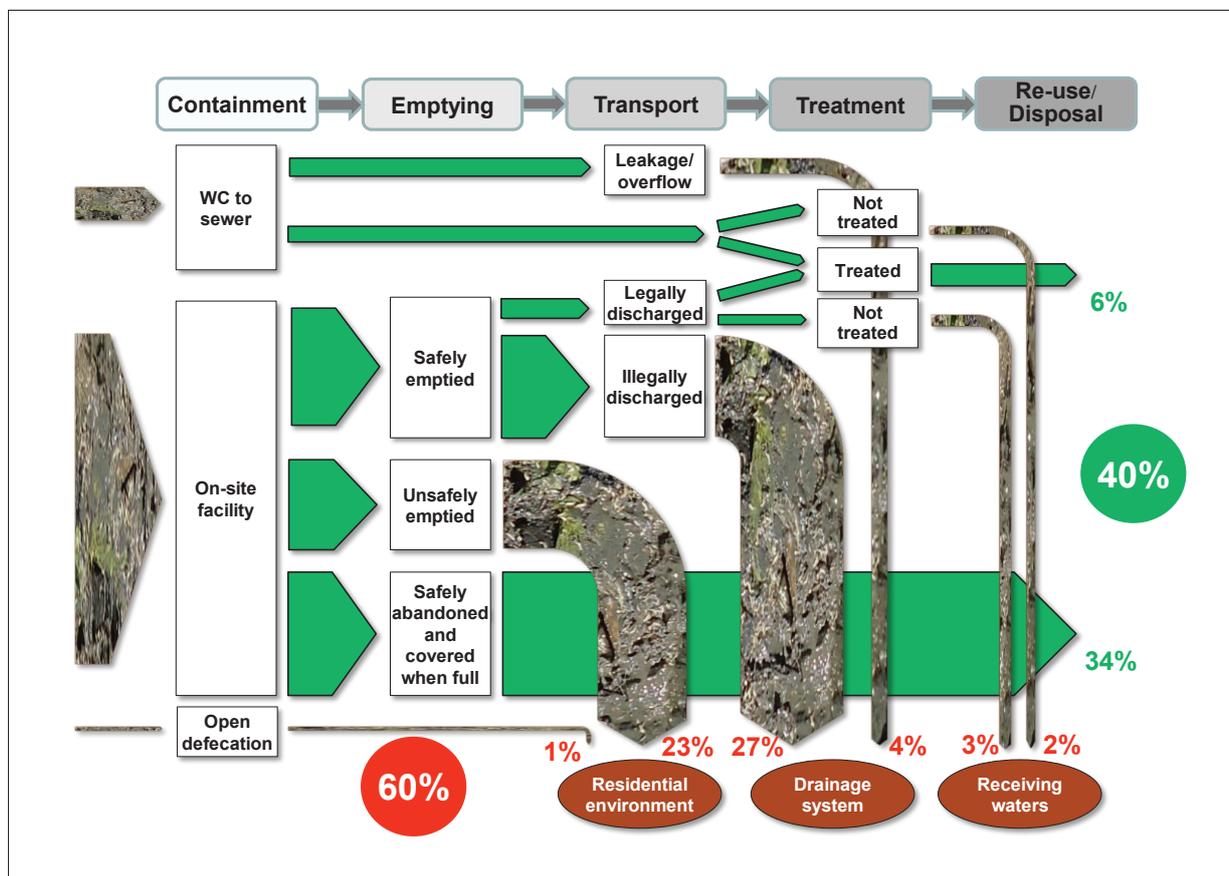


Figure 6: Faecal waste flow diagram for Maputo

unexpected effect of dynamizing the local leadership, when they were forced to confront the reality of the poor sanitation conditions prevailing in their neighborhoods. This followed on into continued support for the FSM improvement program.

An intensive program of technical assistance was provided to the FSM operators involved in the pilot, with three specialists each working about half time providing support on technical, business development and communication aspects respectively. AMMEPS provided the platform for this support, and it is expected to continue playing a key role in building its members' capacity. The operators only repaid a small part of the full costs of the equipment they received, but the equipment has proved adequate as seed capital and they are now able to invest for themselves.

DRIVERS OF CHANGE

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 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 WSP. From this it became clear that faecal sludge management in the peri-urban areas was the most pressing sanitation issue (see figure 6), 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 study, 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

The enabling environment

As the chart below shows, progress in the enabling environment was critical in moving FSM improvement forward. In 2011, a senior politician was convinced through advocacy efforts of the need for improvement, and this led directly into the preparation of a national strategy and a plan. In parallel, at city level, advocacy by the WSP was instrumental in convincing the Mayor and his closest advisors of the importance of improving sanitation in the densely inhabited informal areas. The subsequent diagnostic studies formed the basis for a preliminary intervention in 2014, feeding back into further advocacy and the establishment of a legal framework for FSM in Maputo and the start of a city-wide roll-out of the approach developed. This demonstrates how policy and practice reinforce each other, facilitated by advocacy and the collection, analysis and presentation of evidence as progress is made.

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.

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.

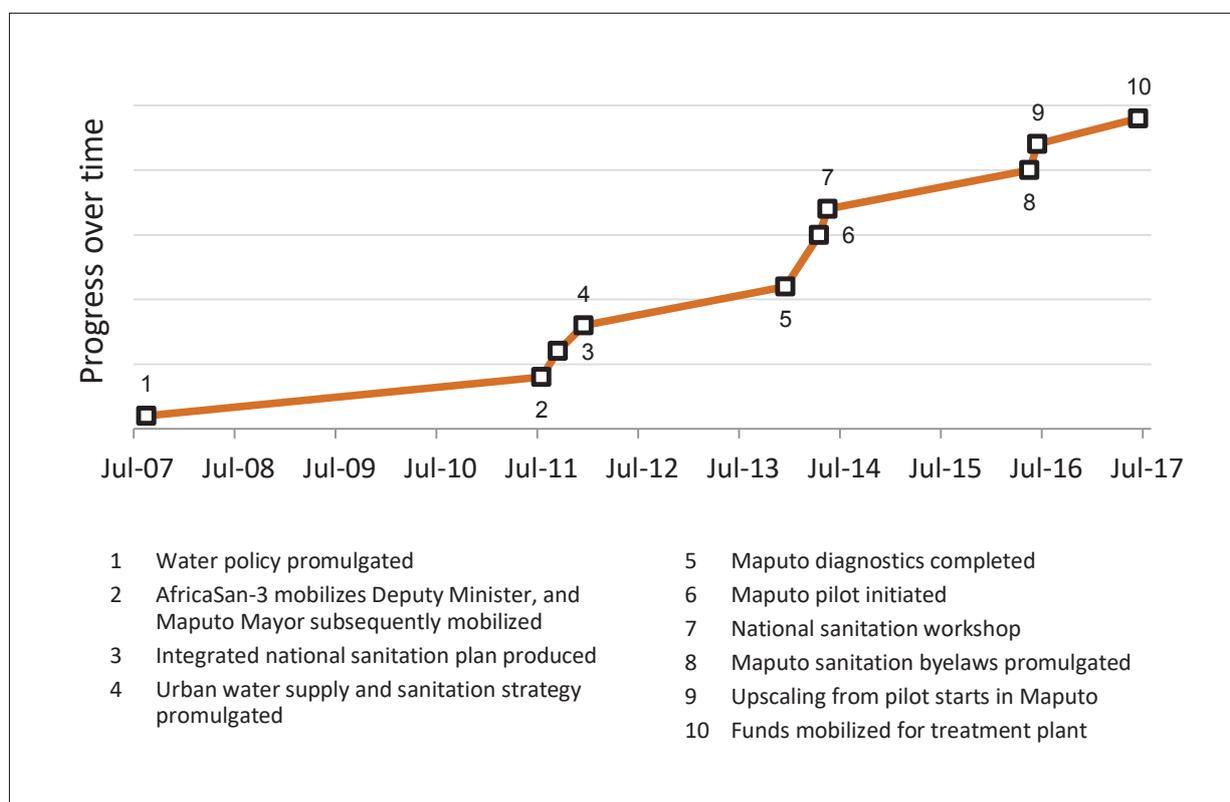


Figure 7: Progress towards improved FSM in Maputo

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.

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.

NOTES

¹ Maputo Municipal Assembly. Resolution No. 68/AMM/2016

² Beira Municipal Assembly, Resolution No. 33/AMB/2016

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ACRONYMS AND ABBREVIATIONS

| | |
|--------|---|
| AIAS | [Mozambique National] Water and Sanitation Infrastructure Board |
| AMMEPS | Mozambican Association of Small-scale Service Providers |
| CBO | Community-based organization |
| CRA | Water Regulatory Council |
| FSM | Faecal sludge management |
| GDP | Gross domestic product |
| MMC | Maputo Municipal Council |
| NGO | Non-governmental organization |
| NUWSS | National Urban Water and Sanitation Strategy |
| USD | United States Dollars |
| WSP | The World Bank Water and Sanitation Program |
| WSUP | Water and Sanitation for the Urban Poor |

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