FSM INNOVATION

OVERVIEW AND ANALYSIS

Implementing FSM Services: Emerging Examples of Success

PETER HAWKINS AND ISABEL BLACKETT

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Peter Hawkins and Isabel Blackett

INTRODUCTION

With the growing acceptance that city-wide inclusive sanitation is essential in this rapidly urbanizing world, there has been a major growth of interest in faecal sludge management (FSM). The variety and continuously changing characteristics of neighbourhoods in any given city create the need for a range of sanitation services, both sewered and non-sewered, working side by side. Non-sewered sanitation is a rapid and flexible means of providing cost-effective sanitation in a wide variety of urban settings, including both poor and better-off communities, and has an essential role to play in delivering city-wide, inclusive sanitation. FSM services are a major component of non-sewered sanitation, and are essential to deal with the ever-increasing quantities of faecal sludge generated by the range of sanitation options from well-built septic tanks and improved latrines to simple self-built sanitation facilities, where there is no longer any space to cover and relocate pits when they are full.

The 2017 JMP report estimates that worldwide 43% of the faecal waste generated by urban dwellers is safely managed, by sewerage systems, on-site sanitation and faecal sludge management.[1] Non-sewered sanitation is reported to be the principal form of improved sanitation in the urban areas of Central Asia and Southern Asia, Oceania and sub-Saharan Africa, but only 13% of this is estimated to be safely managed.[2] This is due in large part to the lack of FSM systems to deal with the septage and pit latrine sludge from on-site sanitation facilities. Faecal waste is often dumped directly into the immediate residential, neighbourhood or downstream environment, with significant public health and environmental implications. The establishment of publicly available FSM services and infrastructure to keep faecal sludge out of the environment and protect public health, is a major new challenge for achieving universal sanitation access, and is incorporated in the Sustainable Development Goals adopted by the United Nations General Assembly on September 25, 2015.

Conventional approaches to urban sanitation, often reflected in policies and legislation, are strongly focused on sewerage (sewers and wastewater treatment plants), and non-sewered sanitation has generally been left to individual households and

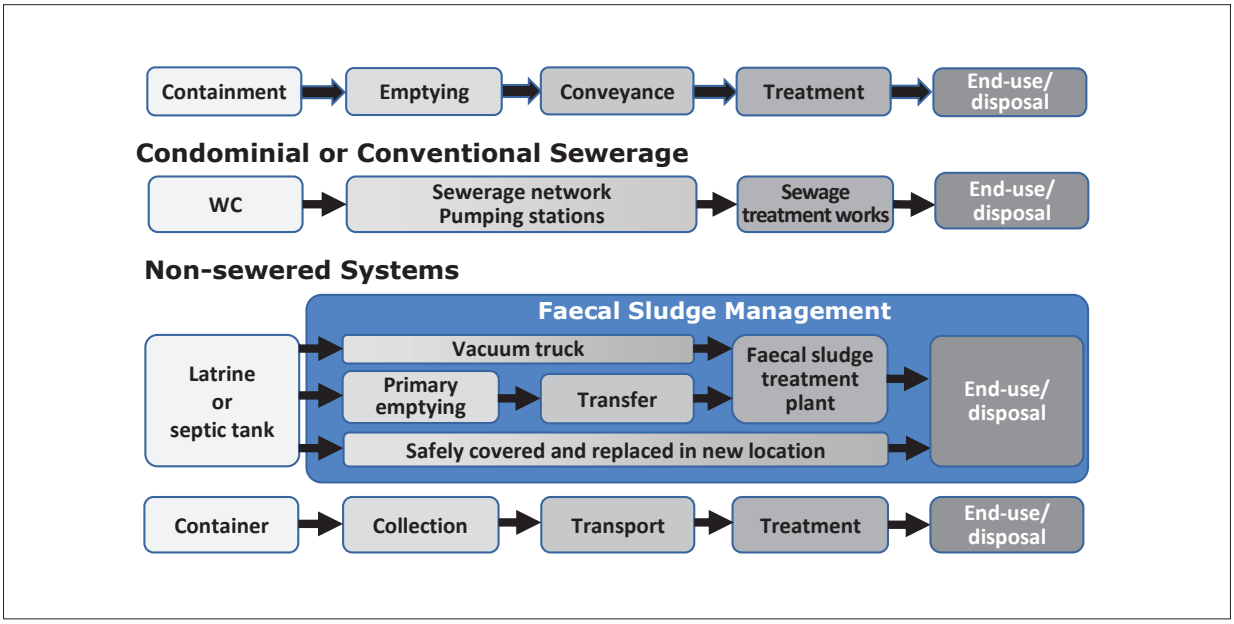

Figure 1: Urban sanitation service chains

unregulated service providers. This is now changing, and over recent years a growing number of cities have been developing more systematic FSM services, as reflected in the case studies in this document. FSM comprises the emptying, collection and treatment of faecal sludge from pit latrines and septic tanks, and is a major part of the city-wide system of sanitation, which may include all or some of the elements set out in Figure 1. This document sets out an initial analysis of the evidence, and draws out learning about common factors promoting or hindering improvements in FSM services, and how and why these vary between local contexts. The aim is to assist practitioners (national and city planners, project managers, technical staff, utilities, consultants, etc.) in making informed decisions for their own situation, and to highlight pitfalls to avoid.

The lessons and analysis are divided into three broad areas:

- **The institutional and policy environment** – the critical elements required to legitimise and support the use of non-sewered sanitation, including FSM;
- **Business models and service delivery** – how to manage the sustainable delivery of FSM services; and
- **Technical aspects** – which require resolution to enable effective FSM service delivery.

This overview chapter is based on the seventeen FSM case studies published for the FSM4 bi-annual conference held in Chennai, India in February 2017. It includes additional and updated cases, published in a second edition; supplementary information provided by the Bill & Melinda Gates Foundation (BMGF); the authors' own experience (mainly from Botswana, Ethiopia, Ghana, Indonesia, Lesotho, Mozambique, South Africa and Tanzania) and documents on FSM published by the World Bank in recent years. Some of the references are to case studies for a single city, while others cover a number of cities in the same country, hence some refer to cities and others to countries.

POLICY AND INSTITUTIONAL ENVIRONMENT

Sanitation services provide both private (household) and public benefits, and are therefore (at least in part) a public responsibility. FSM has failed in the past because it has been left almost entirely to the uncoordinated and unregulated actions of individual customers and informal service providers, due to weak, unclear or non-existent institutional mandates for FSM. However, the case studies show that meaningful change can occur at scale with appropriate advocacy, political support and partnerships. This must be solidified and supported by appropriate legislative, policy and planning instruments, based on an appreciation of the technical issues. In particular, attention must be given to structuring the relationship between the responsible public authorities and the private sector, which in many cases provides most of the services.

POLICY AND INSTITUTIONAL DO'S AND DON'TS

Essential

- Recognize and include FSM as an integral component of national sanitation policy
- Leadership and strong ownership by local government, as part of urban management
- Sustained advocacy
- Involve a diverse set of stakeholders, including different levels of government, city officials, utilities, private operators, CSOs, etc. in developing policies and regulations
- Strong national level commitment and accountability for city-wide inclusive sanitation
- Clear institutional mandates, roles and responsibilities for FSM with associated budgets
- Ensure adequate staffing levels, continuity and training
- Adopt a gradual and incremental approach
- Develop and put in place regulations, standards and guidelines
- License and monitor FSM operators

Seriously Consider

- Adapt planning to a mix of sanitation types
- Lease the treatment/processing plant
- Use practical experience as a basis for developing or refining policy

Avoid

- Expecting major changes overnight – or even in the first few years
- Expecting that policy alone will drive effective and sustainable action
- Setting regulations unilaterally
- Adopting overly ambitious standards
- Assuming that the private sector will want to be involved without incentives

Ensure Leadership and Commitment

The case studies identified high profile leadership at the city level by the Mayor and other high-ranking officials as a key factor in ensuring the adoption of appropriate institutional responsibilities, regulations and budgets for FSM. Political support at both national and local government levels was explicitly identified as an important enabling factor in the at-scale examples from Malaysia, Philippines and South Africa. The emerging examples from Bangladesh, India, Indonesia, Mozambique, South Africa, and Uganda also identified the role for both national and local political support. In Warangal, Balikpapan, Maputo and Kampala, advocacy was an important factor in achieving this support.

Local commitment is also critical where infrastructure is constructed by an external actor, e.g. central government or a donor agency. Without strong local ownership and an agreement on management arrangements and recurrent financing, as happened with sludge treatment facilities in Indonesia in the 1990s, such facilities may be abandoned or fall into disrepair.

Clarify Roles and Responsibilities

The case studies from eThekwini, Malaysia, Dumaguete, Indonesia, Kenya and Kampala show that clear institutional mandates and well-defined responsibilities are essential if sanitation (and within that, FSM) is to be effectively managed, and the same is implicit in many of the others. Given that sanitation is an urban management issue, it is not surprising to find that progress is being made where local government has well-defined responsibilities with respect to sanitation and a commitment to improving FSM, often articulated initially by statements from the Mayor or other high-profile officials. Responsibilities may be shared with a water and sanitation utility (as in Balikpapan, Dumaguete, Kenya and Lusaka) but ultimately still fall under municipal supervision and, in principle, are fully integrated into urban management.

While overall authority will almost always lie with local government, effective FSM requires the development of structured partnerships and coordination between the stakeholders, and a corresponding understanding of formal and informal community and political structures – the political economy. This was an explicit consideration in Indonesia, Maputo and Lusaka. As in any such undertaking, priority should be given to building on existing structures rather than starting completely new ones. Experience in Balikpapan, Bekasi, Lusaka, Kenya and Maputo shows that careful consideration should be given to developing adequate staffing levels, staff continuity and training, to ensure the sustainability of the improved sanitation regime.

Apply Realistic Time Frames

It is apparent that to ensure full local ownership of sanitation services, time is needed for decision-making and the internal processes which are essential to negotiate, align and embed responsibilities for sanitation with other aspects of governance, and to develop and formulate the associated regulations. The need to allow time for developing institutional roles and to work with all stakeholders was identified in Bangladesh, Kenya, Indonesia, Mozambique and Uganda, and the experience shows that this may often take 5 years or more. This means that development partners wishing to support the process need to ensure continuity beyond typical 3–5 year project horizons.

Tackle the FSM Policy Agenda

Progress depends on continuous political support from the highest level of the local government, so a sustained advocacy effort is required at multiple levels, both to convince politicians who typically see little political advantage to be gained from improved sanitation, and to address the inevitable turnover of national and local government officials. In Warangal, the need for advocacy to be evidence-based was noted, and instruments such as shit flow diagrams (as in eThekwini, Lusaka, Maputo, Indonesia and Sakhipur), clean city indices or environmental reports can all be effective ways of presenting the evidence. In Indonesia, almost 25 percent of all cities will develop shit flow diagrams in 2017. Epidemics of cholera or other faecally transmitted diseases can be particularly persuasive (and were significant in eThekwini, Lusaka and Maputo) as they bring sanitation onto the visible public agenda. Concerns about the effects of poor sanitation on the attractiveness of the city for tourism and investment (for example, in Dumaguete) can also be powerful drivers of change.

Politicians are usually pragmatists, and experience in Bangladesh, Kenya and elsewhere shows that tried and tested concepts, backed by practical evidence that a given type of intervention will work, can help in giving them the confidence to enact effective policies. Thus, the case studies from Warangal, Kenya and eThekwini all recommend that policy should be based on evidence, piloting and local practice. Conversely, experience from Malaysia, Zimbabwe and Rwanda shows that a lack of progress, or even chaos, can be caused by well-meaning, but poorly formulated or impractical policy based on a theoretically ideal scenario rather than practical experience. This has implications for the work of NGOs and development agencies, which often target the development of national policies. Their contribution can be invaluable when they work together to support local and national authorities, and base policy on project trials,

local experience and insights. However, importing international or developed country standards and guidelines in an unmodified form and without a suitably phased introduction or trial period can have negative effects by setting unattainable and costly goals, leading to 'high standards for the few', or discouragement and neglect instead of incremental improvement. As mentioned above, effective support requires a willingness to enter into medium to long-term partnerships with a strong commitment to inclusive dialogue.

Policy support from national government for the systematic inclusion of non-sewered sanitation is highly desirable, and was a key driver in India, Malaysia and Philippines. However, the evidence from Bangladesh, Indonesia, Mozambique, South Africa, and Uganda shows that progressive city authorities can make good progress, prior to the development relevant of national policy. National policy on non-sewered sanitation can therefore be developed in parallel with effective action at city level. This may even be advantageous, as it allows for the generation of evidence and experience to support sound policy formulation.

Develop Regulations, Standards and Guidelines

Nearly all the case studies identify that regulations, standards and guidelines which recognize and codify FSM are essential to underpin the delivery of improved services. In extreme cases, on-site sanitation in urban areas may be illegal (for example in Zimbabwe and Rwanda), although it may still account for most of the sanitation in a city. Elsewhere, the ambiguity resulting from a lack of regulation can discourage potential service providers, and force residents to obtain the services they need from the informal sector. Explicit legislation and standards for FSM are essential if unhygienic manual emptying is to be phased out and replaced by safe, regulated services. However, the legislation must be practical and acceptable to stakeholders if it is to function effectively, which means that customers and service providers must be involved in its development, as demonstrated in Dakar, Dumaguete, Durban, Kampala, Malaysia, Manila and Warangal. Service providers are often supportive of this, despite the regulatory burden it imposes on them, because it creates a legal space within which they can operate and expand their businesses, and confers improved status on them – as seen in Bangladesh with the formalization of the Khutibari Cleaners Co-operative, in Dakar with the tanker operators' association, and in Maputo and Lusaka with the small-scale non-mechanized emptying teams.

A second area of regulatory intervention is the need to ensure the quality of on-site sanitation facilities, so that they are emptiable. Some positive results have been obtained in Indonesia, Kenya, Malaysia, Philippines and Kampala, although they are often constrained by the practicalities of enforcement, especially in illegal or unplanned settlements, or in challenging environments (high water table, flood plains, rocky land etc.) In such situations, the regulated solutions may not be suitable.

Include FSM as a Recognized and Necessary Component of Sanitation

Legal provision for FSM must implicitly or explicitly recognize that sanitation services can and should be provided by a mix of the available options, according

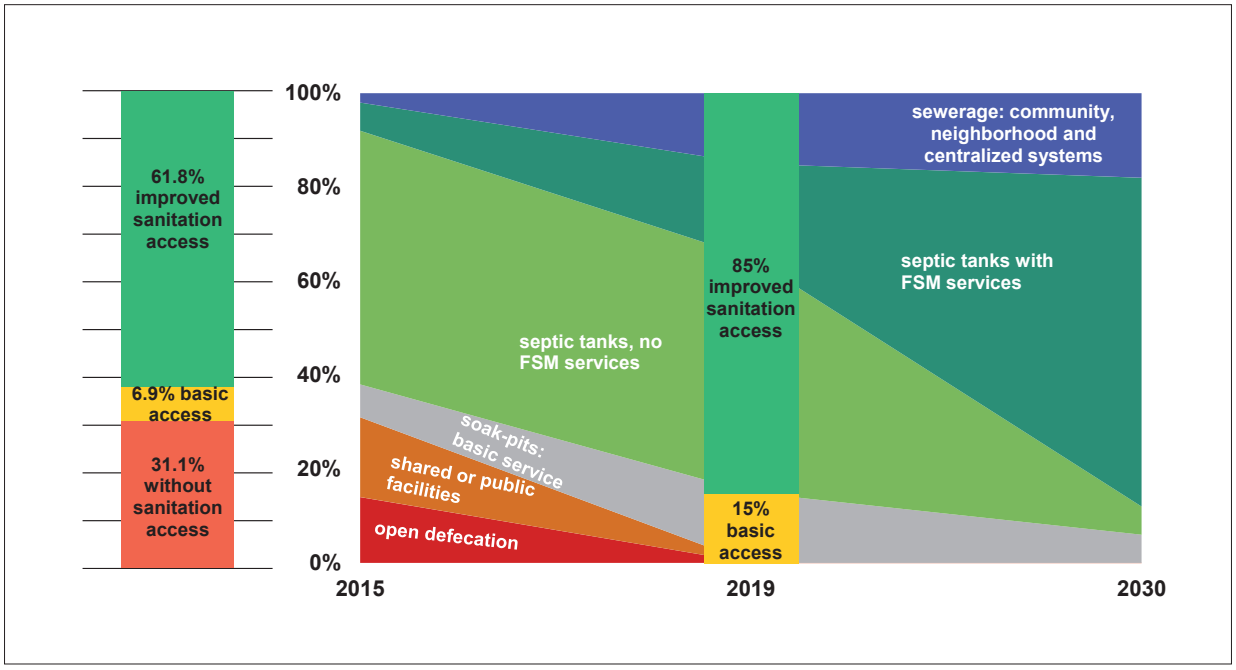

Figure 2: A changing technology mix to achieve national targets in Indonesia

to what is appropriate in each area at any given time. This can have profound implications for urban planning systems based on the common assumption that all improved sanitation is by means of sewerage. Employing a mix of sanitation options opens the way for a more incremental approach, a focus on services and how to deliver them, rather than infrastructure, and the acceptance that sanitation modalities will change over time in any given location. Integral to such an approach is a trajectory for improving sanitation, that explicitly considers how the mix of options will change over time, rather than focusing exclusively on the gradual introduction of sewerage while neglecting all other options. This will almost certainly require modifications to planning guidelines and procedures, with perhaps the most notable example being Indonesia.

Develop Local Public-private Partnerships

In most cases, the private sector will provide the bulk of faecal sludge collection and transport services, and may also undertake treatment and production of materials for sale. Based on the case studies, it is clear that much remains to be learned about sustainable and appropriate partnership arrangements with the local authorities, which will, in any case, vary widely from place to place. However, evidence of arrangements that work at scale, is outlined in the case studies for Philippines, Dakar and Malaysia, and is emerging from Warangal, Kenya, Indonesia and Kampala. Approaches that have been effective in different places range from a regulated market of emptiers, to more formal service level agreements and/or zoning, to subcontracting under a utility. The private sector may already be active in the sector and eager to become more formally involved, as seen in Maputo, Balikpapan, eThekwini and Malaysia. In other cases, they may not want to be involved initially, as observed in Sakhipur, Faridpur, Norton, Kenya and elsewhere. However, this initial reluctance can be overcome by advocacy, building up new business models and ensuring that convenient sludge disposal facilities are available. The development of partnership arrangements should in any case include a wide-ranging and inclusive dialogue with existing service providers, which must include manual emptiers where they exist, such as happened in Faridpur, Lusaka and Maputo.

Whatever arrangements are decided upon, licensing, reporting, monitoring and data management systems will be required. As operators also need management information for their own purposes, there may be scope for including an obligation in licensing agreements to share certain data with the local authorities.

Faecal sludge collection and transport is highly suited to the private sector, but treatment and the sale of end products can also work well in the private sector, as demonstrated in Sakhipur and Kigali. Collection and processing may or may not be combined under the same operator, but the available examples tend to the combined approach, with the treatment plant under a lease agreement (i.e. the treatment plant belongs to the utility or local government) as in Dakar and Kigali.

BUSINESS MODELS AND SERVICE DELIVERY

The demands of urban life mean that an accessible toilet is a basic need for all residents, and that all toilets must be connected to a sanitation service chain that ensures the separation of people from faecal material, all the way to its final treatment and disposal or reuse. The service chain may be sewered or non-sewered. Non-sewered sanitation is based on using an on-site excreta containment facility (a pit latrine or septic tank) and is the more widely used option in many countries, including those in the case studies. Where housing density is such that the faecal waste generated cannot be retained or infiltrated on site, the containment facility will need to be periodically emptied and/or continuously discharge faecal sludge to the environment.

Emptying of fecal sludge can be managed safely and hygienically, however, in many cases emptying is carried out manually with burial or open dumping nearby, or by vacuum tankers, which may or may not discharge the sludge at a designated site. Vacuum tankers typically focus on higher-income areas, where water based toilet systems with septic tanks predominate and road access is adequate. As the case studies on Kampala, Kigali and Maputo observe, manual emptying is more usual in densely settled, unplanned areas, where pit latrines are common and access to them is often difficult. As noted in the same studies, the heavier, drier sludges from pit latrines are often difficult or impossible to remove using vacuum tankers – and even when they might be possible to remove, the cost or the potential damage to a poorly-constructed pit latrine discourages the use of vacuum tankers.

Improved FSM is always developed in the context of, and often in competition with existing services, however insanitary they may be. In effect, the improved service needs to replace existing, usually cheaper, but lower-quality services. A tried and tested approach to that is to focus on the four P's of marketing – Product, Price, Place, Promotion – and this is reflected in the successful examples from many of the case studies.

SERVICE DELIVERY DO'S AND DON'TS

Essential

- Develop services across the full FSM value chain, not only infrastructure
- Build the technical capacity and business skills of service providers
- Implement a sustained campaign of community engagement and FSM marketing

Seriously Consider

- Encourage and support the private sector to become service providers
- Use public funds to develop FSM services
- Cross-subsidies from water, sewerage or septic tank emptying services in better-off areas
- Establish a call centre for FSM services
- Combine FSM with other related services
- Systematic enforcement of relevant public health regulations
- Establish partnerships for undertaking applied action research
- Research and development on the reuse of treated faecal wastes
- Show improved value to customers before attempting cost recovery

Avoid

- Using old tankers or other equipment beyond its economic life
- Abandoning the FSM awareness raising and marketing campaign

Product

An improved FSM service must be perceived by customers as offering something that is superior to existing options. This means adopting a service-oriented approach – improved infrastructure and technology are part of it, but they are only effective in the context of a service package appreciated by customers. These improvements typically include easy access to service providers, a quicker response time, less disruption, the ability to access hard-to-reach pits, and cleaner operating practices. In general, the private sector – with its flexibility, ability to innovate and the commercial incentive to improve efficiency – is better at delivering this than the public sector. Even where there is a dynamic public utility, for example in Dumaguete in the Philippines or eThekwini in South Africa, the private sector has still proven to be an effective partner in providing faecal sludge collection and transport services.

The case studies indicate that faecal sludge collection and transportation can be a viable business, but that if it is to compete effectively with long-standing unregulated services, a subsidy or cross-subsidy of some kind may be necessary (see also the discussion below on price) to reach the poorest customers. This is reported from countries as diverse as Bangladesh and South Africa, India and Kenya. Therefore, it may not always be possible to depend entirely on the private sector to make the necessary up-front investments to an adequate standard. However, leasing arrangements (as in Dhaka, Bangladesh and Dumaguete) or the judicious use of seed capital (as in Maputo in Mozambique) to buy basic equipment have resulted in viable businesses able subsequently to expand from their own resources. At-scale technical capacity building and business skills development of local companies are also consistently necessary components of FSM services development, as explained in the case studies from Dakar, Dhaka, Faridpur, Kampala, Maputo, Norton and Warangal.

Linked to this, and given the current limited knowledge base on FSM, partnerships with NGOs, research institutes and universities for applied research in developing, testing and piloting improved techniques have proven useful – as well demonstrated in the case studies from Bangladesh, India, Madagascar, South Africa, Uganda and Zimbabwe.

A number of studies (the BMGF study of 30 cities, Maputo, Kampala) suggest that the typical one-truck or one-team emptying operation is less viable than a larger one. This is perhaps not surprising given the wide range of containers and contents to be emptied, thus requiring a range or combination of equipment. Operators in Dakar also reported that a larger size (or at least a joint venture) is essential to gain large and lucrative commercial contracts – which could in principle cross-subsidize emptying in low-income residential areas. In the case of simplified mechanical and improved manual operations in Maputo and Lusaka, initial attempts to work with handcarts failed due to the distances involved, and the shift to motorized transport demands several emptying teams working simultaneously to justify the costs this incurs.

Most FSM services operate in response to customer requests, which is adequate in many situations, and in particular where households use dry or wet pit latrines rather than septic tanks. Regular or scheduled emptying is an alternative system that has been

tried in various places, including Indonesia, Malaysia and Philippines. It delivers better performance for septic tanks, simplifies payment by customers, as they pay monthly through the water bill, and provides a predictable income stream to the service provider. However, it has proven to be challenging to implement in practice. It also requires a high degree of organization and communication with customers, easy access to the septic tanks and a comprehensive database of onsite facilities. A door-to-door system worked quite well initially in Dumaguete, but the rate of emptying dropped dramatically when the system changed and owners had to make their own arrangements with approved emptiers. Malaysia had similar problems getting households to accept service, but is reintroducing scheduled emptying with improved customer awareness creation and more stringent enforcement. The lesson seems to be that even where people have paid regularly for desludging, they do not necessarily take up the services to which they are entitled. It also shows that on-demand emptying tends to operate at a much lower frequency than the ideal 3–5 years, and is usually triggered by septic tank failure rather than maintaining optimum performance.

Price

As transport is usually the largest cost element in FSM, traditional services that remove faecal sludge from the immediate vicinity of the customer but frequently fail to take it to an effective treatment facility (if one exists), are generally cheaper for the operator, and sometimes also for the customer. In comparison, the cost of hygienic collection, transport and treatment will usually be greater. This is to be expected, as an improved service including sludge treatment has a public good component in the form of improved public health, a cleaner more attractive environment, reduced pollution of water resources etc. In Mozambique, although customers preferred the improved service because it was more hygienic, 40 percent of them reverted to manual emptying because it was more affordable. It is therefore crucial to offer improved FSM services with a price and payment regime that is easily affordable to customers.

An affordable price means getting the technology and operational procedures right, and this is discussed below in the section on technical issues. The other part is the establishment of viable financial arrangements to ensure a sustainable service at a price that customers are willing to pay.

As already mentioned, FSM has a substantial public good component, so it is important to ensure that specific and focused funding arrangements are in place, which could reasonably include a component of public funds. Where sewerage is used to provide a sanitation service, public funding usually covers at least part (if not all) of the investment costs, and is rarely questioned. This can be used as an argument to support public financial support for FSM services, usually at a much lower cost per capita. It is the low-income segments of the market that are particularly important to capture, since it is these customers who depend the most on manual emptiers and are least able to pay for the public benefits delivered by improved FSM.

Various forms of cross subsidy have been developed and applied in a number of different ways: on an area basis, as in Dhaka; from septic tank emptying to pit latrines (Norton); and from institutional to residential services (Malaysia, although eventually somewhat reduced due to protests from commercial customers). In eThekwini, emptying services for urine diversion toilets (every two years) and ventilated improved pit latrines (every five years) are funded by cross-subsidies from water and sewerage service charges in more affluent areas. Should households require emptying in between scheduled services, they can request this but must pay a fee. Payment through the water bill may also help low-income customers to spread payments in small regular instalments, instead of dealing with a major expense every few years. Under such a system or by applying an explicitly pro-poor tariff (Dumaguete), capital cost recovery may even be achievable – if the capital costs have been kept low, as demonstrated in Dumaguete. The sale of safe processed faecal sludge products such as solid fuel or fertilizer can partially cover treatment costs, and this is already the case in Dakar, Faridpur and Kigali. However, in many places, such as Dhaka, Antananarivo, Malaysia, Philippines, and eThekwini, research and development is still in progress and a significant return has not yet been achieved. Such solutions require careful adaptation to local conditions, such as the range of sludge composition encountered, the seasonal availability of sludge, the balance of supply and demand for potential products in local markets, and transportation costs to the point of use.

It is important that the financial models cater explicitly for adequate maintenance and replacement of all equipment. Thus, in Kenya the business model for the decentralised sludge treatment facilities takes into account affordability for customers, while covering the capital investment, operation and maintenance costs. This also includes ensuring that tankers operate at optimum cost-effectiveness, which means avoiding the false economy of keeping old equipment running when it should have been replaced. A guarantee fund has

been successfully used to mobilize bank loans for this purpose in Dakar.

Place

Septic tank and pit emptying is a seasonal business, with peaks in the wet season in many, if not most countries. It therefore makes sense for operators to provide other related services that keep them in business throughout the year, or add value to their FSM business. Thus, in Maputo, FSM services are being provided by some of the micro-enterprises already undertaking primary solid waste collection (using different equipment), while in Kampala one of the FSM operators also sells and installs Sato pans to improve pit latrines.

In Balikpapan, Bekasi, Dakar, Kampala, Santa Cruz (Bolivia), and Warangal, a call centre or 'hotline' number has been (or is being) established to help customers make contact with a service provider, and in some cases to make the market more efficient by providing a platform for operators to bid for jobs. These can also provide a financial win-win by reducing the costs of job acquisition for operators and the cost of service for customers. In some cases, they have been used in conjunction with a database of on-site facilities, to assist in longer term planning for operators and the responsible authorities.

Promotion

In nearly all cases, a programme of long term community engagement, awareness raising and marketing was identified as essential to promote and maintain demand for improved FSM services. Examples include Dhaka, Faridpur, Warangal, Indonesia, Kenya, Dumaguete, Maputo, eThekwini, and Kampala. In the absence of such activities, demand was weak, and where they were abandoned after some time, the take-up of services decreased greatly, for instance in Dumaguete and Malaysia.

There is some evidence (for example in Dumaguete, Maputo and Balikpapan) that customers do appreciate the indirect benefits to public health and the environment as well as the direct benefits of improved FSM, and are prepared to pay at least something for them, if not the full extra cost. If this is promoted, it also helps to raise the status of FSM service providers, which may attract them into the market. This improved status allows them to operate during the day instead of at night (which is common amongst traditional manual emptiers), and their new-found visibility may become a marketing tool in itself, as reported by operators in Lusaka and Maputo. The status and attractiveness of the services to both providers and customers is further improved by the use of clean uniforms, personal protective equipment and more "formal" pit emptying equipment (pumps, covered plastic drums etc. as opposed to the simple tools and scoops used by traditional emptiers).

The availability of improved FSM services allows for more effective application of public health regulations on emptying, since customers now have the option of using a more hygienic service. The same regulations can also be used to discourage traditional emptiers – as, for example, in Kampala or Lusaka. Related regulations can be used to persuade users to upgrade their on-site facilities, making them more hygienic and also easier to empty.

TECHNICAL ASPECTS

Due to the previous focus on sewered sanitation there has been a widespread neglect of non-sewered sanitation by city managers and the engineering profession. However, that is now changing, and the case studies demonstrate how FSM technology is under development, testing and piloting. While, this is still work in progress, there is now sufficient experience to serve as a basis for developing the often very location-specific solutions needed, in collaboration with private sector service providers, engineering companies and academic institutions.

Looking beyond FSM services themselves, the on-site containment facilities often constitute a major obstacle to service provision, because the well-established principles of septic tank and pit latrine design are often flouted, misapplied or simply not understood under a weak or non-existent regulatory regime. This is especially the case in unplanned and illegal settlements, where policy and building regulations hardly apply. Furthermore, in challenging environments such as areas of high ground water, flood plains or rocky land, most established sanitation options are likely to be unsuitable.

There is thus a need both for ongoing research and development of FSM technology and for the development of approaches to the large-scale upgrading of on-site facilities. Below is a set of remaining challenges and constraints which would benefit from further study and additional case studies to illustrate good practice to mitigate these concerns.

Improving Containment

One of the major constraints to efficient FSM, noted in many case studies, is the type and poor quality of on-site containment structures. This 'containment' aspect of FSM is being addressed in eThekwini, Indonesia, Kenya, Madagascar, Warangal and Uganda. In South Africa and India, subsidies are available from national Government, and in Indonesia a performance-

TECHNICAL DO'S AND DON'TS

Essential

- Ensure dumping facilities are open from early morning to evening
- Develop adequate faecal sludge treatment capacity
- Use and upgrade or improve existing infrastructure
- Incremental approach starting with robust low-cost, low-tech solutions

Seriously Consider

- Pilot at-scale latrine upgrading
- Applied research on pit emptying
- Assessing the feasibility of fixed and/or mobile faecal sludge transfer stations
- Co-location and partial co-treatment of FS at sewage treatment facilities
- Build dedicated faecal sludge treatment facilities, where none currently exist
- Vehicle tracking devices and other digital applications to increase efficiency

Avoid

- Overloading sewage treatment facilities with faecal sludge

and output-based program for upgrading onsite sanitation was launched in 2015. In India and in Kenya masons are being trained to build improved standard septic tanks.

The containment challenges which are being, or need to be, addressed include:

- **Direct discharge of septic (or conservancy) tank effluent** and pit latrine overflows to storm drains, rivers, and canals. These need to be directed to soak pits, planted (evapotranspiration) beds or to off-site treatment in decentralised or centralised sewage treatment. Direct discharge is especially common in Asia, where wet systems are used, but also occurs widely in Africa.
- **Lack of a removable cover** to access a pit or tank for emptying:
  - In the case of pit latrines, this may mean that emptiers need to break the slab or the side wall of the pit, or work through the drop-hole within the confined space of the superstructure,
  - In the case of indoor water-seal toilets, the seepage pit or septic tank may be situated under the house and only accessible by breaking the floor, at considerable inconvenience and expense to the house owner. This is especially common in East Asia, where houses are often extended over the back yard where the septic tank was originally placed;
- **Poorly constructed latrine pits** unable to be emptied mechanically, for fear of collapse.

Although the problems are widely recognized, and many pilots are underway, work is still in progress on how to achieve effective interventions at scale, particularly in reaching the poorest residents, who bear the major burden of these problems. A number of cities have started to collect and manage data on existing on-site facilities (see above under 'place'), but have been able to make only a limited impression on the millions of existing on-site sanitation structures. While many responsible authorities recognise the need to apply resources to this area, the sheer scale of the problem demands that this be a partnership with users and the private sector, involving both incentives and sanctions.

Making Emptying More Efficient

Thick sludge from pit latrines with a low water content can be difficult to empty, especially when there is also solid waste in the pit – as commonly found in Rwanda, Mozambique, Ethiopia, Uganda and Zambia. In such situations, there is often little alternative to scooping it out with a range of buckets and hand tools. In the long run, the solution lies partly in improving the containment structures and reducing the solid waste content (by improving solid waste management and/or introducing a water seal, requiring small amounts of water). However, for the existing millions of pit latrines, quicker and more hygienic methods of pit emptying, coupled with more efficient sludge fluidisation, could make a huge and more immediate impact.

The development and production at scale of effective, low-maintenance and low-cost equipment could transform this blockage in the sanitation chain. This could be realised through applied research and pilots, in partnership with the private sector, and with the full collaboration of the respective local authorities. Experience already gained on this subject, and new knowledge as it emerges, should be shared internationally as widely as possible.

Improved equipment that enables the removal of faecal sludge to a treatment facility instead of local burial or open dumping will also increase the amount

available for processing and reuse. For instance, in Kigali the private operator of a facility processing faecal sludge into solid fuel has branched out into pit emptying in order to increase the volume of sludge available for processing.

Reducing Transport Time and Cost

As cities grow and become ever more congested, there is a corresponding need to limit tanker travel times, and hence cost. One solution proposed is the use of sludge transfer stations or decentralized faecal sludge treatment facilities, but experience to date is limited and poorly documented. There have been several cases where it was tried, but failed for various reasons: in Accra, due to unclear responsibility for managing them; in Freetown, due to community mistrust of those assigned to manage them; and in Maputo, due to lack of community acceptance for a faecal waste facility near their homes. This limited experience does not, however, rule out such solutions, but does make clear the need for effective planning, strong management and systematic engagement with the communities concerned. Experience in Maputo and Kampala also suggests that mobile transfer stations may have a role to play.

The dumping of faecal sludge into sewers to reduce tanker travel times and congestion has also been tried, with mixed results. Sludge with high faecal solids and/or solid waste content, typically from pit latrines, is likely to block and damage the sewerage system, and its disposal into sewers should be strongly discouraged. However, the discharge into sewers of septic tank sludges with a high water content may be feasible in some instances, and is allowed in Bandung, Indonesia, and Dhaka, for example. Faecal sludges are highly variable, so caution needs to be applied to avoid the dumping of sludge with an excessive solids content or industrial sludges that could be toxic to the treatment system. Even where neither of these conditions apply, care would need to be taken to avoid overloading wastewater treatment facilities.

Significant cost savings and a reduction in open and illegal dumping could also be made by longer opening hours at existing faecal sludge disposal sites. This makes better use of the investment in infrastructure, allows the tankers a longer working day and enables them to travel in the evening and at night when there is less traffic congestion.

The use of the cheap vehicle tracking devices now available and being used in Warangal, Kampala, Balikpapan and other cities, can contribute to improved fleet management and better control of illegal dumping.

A related issue is limited road access to on-site sanitation facilities, necessitating the use of small, portable equipment for emptying combined with a separate means of transport to reach disposal sites, and several case studies (including eThekwini, Indonesia, Kenya, Kigali, Lusaka and Maputo) report the use of specially developed machinery. This is often best developed locally, both to ensure that it can be maintained, and to enable its progressive adaptation to specific local conditions.

Specific Options for Faecal Sludge Treatment

Where dedicated faecal sludge treatment plants exist, they are frequently in bad condition or completely unserviceable, and are often poorly located as well. If they are in a suitable location (within 30 minutes' travel time from the premises they serve), they should be rehabilitated and put under sustainable management arrangements, possibly involving the private sector. Indonesia is promoting the use of an incremental approach to developing sludge treatment plants, aiming to expand them in a modular way as the customer base grows.

The conversion of faecal sludge into saleable products such as organic fertilizer or solid fuel may provide extra revenue opportunities for a private operator if they can be well matched to the local market.

Where there are no dedicated faecal sludge treatment facilities, the use of operational sewage treatment plants with spare capacity may be considered for the treatment of septage with a high water content, but loadings should be carefully controlled to avoid damage to the treatment process by excessive solids or nutrients. Alternatively, and ideally, if land is available, a solids-liquids separation facility for faecal sludge should be installed, with the liquid fraction co-treated with sewage and the solid fraction undergoing further treatment in new facilities, such as drying beds. If no space is available for solids-liquids separation at sewage treatment plants, then dedicated stand-alone faecal sludge treatment facilities must be considered, as in Sakhipur, Faridpur, Kampala and Lusaka.

CONCLUSION

The following eleven case studies provide practical examples and deeper insight into the material presented above. They present a growing and solid base of experience to build on, and some common lessons are emerging, although issues remain to be resolved.

It is notable that many of the lessons learned in the emerging case studies are similar to the ones reported

by examples that have already gone to scale. This strongly suggests that emerging practice is on the right track. It may also imply that there is an element of 'reinventing the wheel' going on – although each city is different and is likely to require different solutions and the learning of lessons in its own specific context. Five lessons that come out clearly from both the well-established and emerging programmes are that:

- **Well formulated and practical policy, rules and regulation** are essential – but always need to be supported by complementary factors such as those below;
- **Local leadership and clearly mandated and resourced institutions** are essential to manage services, even where actual services are delivered by the private sector;
- **Partnership between stakeholders** will contribute to developing services at scale, building community confidence and achieving sustainability;
- **A sustained program of community engagement, marketing and awareness raising** is as essential to FSM as sludge treatment – but is frequently under-valued, under-budgeted and sometimes abandoned after an initial period;
- **Capacity-building for FSM service providers** will be required so as to ensure that they can effectively meet all segments of demand and achieve long-term viability. This may include training in both technical matters and business management, and the facilitation of capital formation through grants, equipment leasing, loan guarantees and other financial instruments.

Improving FSM alone is only one component of improving sanitation. Complementary and well-coordinated programs will be required in the closely related areas of improving:

- solid waste management;
- surface drainage, and grey water management in residential zones;
- the quality of on-site sanitation facilities, especially in densely occupied areas and challenging environments;
- the reliability, quantity and quality of water supplies, and
- reducing – and eventually eliminating – urban open defecation.

Ultimately, FSM – and urban sanitation in general – is only one component of the basic services that are essential to make cities liveable. It is vital to give it the attention it deserves which it has often lacked in the past, but it is unlikely to be delivered effectively without taking other equally essential services into account. Sanitation affects, and is affected by, many other aspects of urban activity. Due to its cross-cutting nature, sanitation must be considered at the level of governance and political management as well as in terms of a technical service. The growing base of experience summarized here and in the following case studies has an important role to play in persuading and guiding city managers towards clean, healthy liveable cities.

The following case studies are available in 'FSM Innovation' the second edition of the FSM case studies published by BMGF in August 2017. They can be read as one document or used individually as reference material about specific approaches to FSM in different country and city contexts. The following table provides short descriptions and page numbers in the main document to help navigate the case study content. The case studies are also available as separate documents, and all are available on www.susana.org.

PAGE	COUNTRY/CITY, TITLE	SELECTED FOCUS OF CASE STUDY
16	**Bangladesh** Tackling the Second-Generation Sanitation Challenge at Scale: Business Solutions for Inclusive Faecal Sludge Management in Bangladesh	National policy and institutional framework Whole sanitation chain Treatment and reuse of sludge Working with the private sector
33	**India** Towards a Model Sanitation City: Operationalizing FSM Regulations in Warangal	Evidence based advocacy FSM regulations Licencing desludging operators Use of information technology Capacity development and training

47	**Indonesia** Moving Towards Improved Urban Septage Management at Scale in Indonesia	National sanitation program and plans Advocacy, leadership and planning processes City sanitation surveys and census Scheduled and non-scheduled emptying Use of information technology
59	**Kenya** Scaling up Faecal Sludge Management in Kenya's Urban Areas	FSM services in small and medium towns Decentralised sludge treatment Improved on-site sanitation Working with public and private sector services Capacity development
70	**Malaysia** Sanitation and Sewerage Management: The Malaysian Experience	Utility managed services National policy and management Decentralized services Scheduled and non-scheduled emptying Lessons learned over 40+ years
84	**Maputo, Mozambique** Emerging Lessons on FSM from Maputo, Mozambique	Evidence based advocacy Working with the Municipal Council on byelaws FSM by small scale solid waste entrepreneurs Usefulness of seed funding and technical assistance Impact of TV advertising
95	**Philippines** City-Wide Fecal Sludge Management Programs in the Philippines	National law and regulation FSM city-wide services Working with the private sector Scheduled and non-scheduled emptying
109	**Dakar, Senegal** Dakar: Organising the Faecal Sludge Market	Market interventions FSM call centre and information technology Guarantee fund for FSM equipment purchase Management of treatment plants by private sector
119	**Ethekwini, South Africa** Sustainable FSM Services through Integrated Use of Resources and Innovative Technologies: A Case Study of the eThekwini Municipality (Durban) South Africa	Utility based services Evidence based policy Technical innovation and testing Services for all including the most vulnerable Working with partnerships
132	**Kampala, Uganda** Leveraging FSM to Close the Urban Sanitation Loop in Kampala	City authority managed FSM services Stakeholder collaboration Working with the informal private sector FSM call centre and information technology City wide mapping and mobilization for scaling-up
145	**Lusaka, Zambia** Approaches to Faecal Sludge Management in Peri-Urban Areas: A Case Study in the City of Lusaka	Trialling different business models Working with informal service providers Developing sludge treatment Financial sustainability challenges

NOTES

[1] JMP 2017

[2] ibid

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