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Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas

Summary Report

Final

6 May 2016

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Water

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water and
sanitation program

Preface / Acknowledgements

This 'Summary Report' is the main output of a World Bank Economic and Sector Work, on *Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas* (P146128). The task team leaders were Isabel Blackett and Peter Hawkins and the task team members were Zael Sanz Uriarte, Ravikumar Joseph, Chris Heymans and Guy Hutton.

This report is based on work conducted under a consultancy between January 2014 and February 2016, led by Oxford Policy Management (OPM) in partnership with the Water, Engineering and Development Centre (WEDC) at Loughborough University.

This report was authored by Ian Ross (OPM), Rebecca Scott (WEDC), Isabel Blackett (WB) and Peter Hawkins (WB). The broader research team who contributed to the study included Ana Mujica, Zach White, Rashid Zaman and Simon Brook from OPM, as well as Mike Smith, Andy Cotton and Sam Kayaga from WEDC. Andy Peal (independent consultant) also contributed to certain aspects of the methodology.

The inputs of many other World Bank staff, consultants and data collection firms are acknowledged with thanks from the task team. They have all contributed to the research, findings, analysis and reviews but are too numerous to mention.

Executive summary

Context

Urban sanitation remains a significant challenge for most low- and middle-income countries. The urban population of the group of Least Developed Countries (LDCs) more than tripled between 1990 and 2015. While access to sanitation in LDCs has increased in relative terms, in absolute terms the number of people using unimproved sanitation has increased. Under the post-2015 Sustainable Development Goals (SDGs), there is now a focus on the whole sanitation service chain from containment through to disposal. The challenge for urban sanitation under the SDGs is therefore not only to achieve universal access to toilets, but also that all excreta is safely managed along the whole sanitation service chain.

Safely managed excreta and non-networked sanitation

A range of technologies exist for safely managing excreta along the sanitation service chain. Pit latrines, septic tanks and sewered systems can all 'safely manage' excreta as per the SDG definition. For over 100 years networked sewerage, whereby excreta and associated wastewater are conveyed through a network of pipes to treatment, has been widely considered to be the preferred solution – but is expensive and unaffordable in many cases. As a result, access to a sewerage system is low or non-existent in many developing country towns and cities. Most people are using 'non-networked' (on-site) sanitation options in urban settings, where excreta and wastewater discharges either into a septic tank or pit, or directly into a drain, river, sea or open ground.

Estimates of the number of people relying on non-networked sanitation solutions in low- and middle-income countries are typically between 60-100% depending on the city and country. These systems contain fecal sludge (FS) which is a highly variable mix of raw and partially-digested feces and urine, along with different amounts of contaminated wastewater, and in some places solid waste and other materials.

Fecal sludge management services

In many cities, even where improved on-site facilities are used to contain excreta, the level of quality and access to services for the emptying, conveyance, treatment and disposal of the resulting fecal sludge is usually limited. These services are collectively called fecal sludge management (FSM) services. FSM services are the focus of this study, within the broader context of urban sanitation and integrated urban water management (IUWM).

The fecal sludge which is removed from non-networked facilities rarely reaches a treatment plant for safe reuse or satisfactory disposal in accordance with local environmental standards, if they exist. In general, safe management of fecal sludge downstream of the household is severely neglected by utilities, local governments and households alike.

Purpose of this report

This document provides a summary of the diagnostic tools developed for assessing FSM services and is based on field work carried out in the five cities of Balikpapan in Indonesia, Dhaka in Bangladesh, Hawassa in Ethiopia, Lima in Peru and Santa Cruz in Bolivia. It summarizes the tools themselves, lessons learnt about their use, and general policy recommendations. The target

audience is those advocating for or implementing city-wide, poor-inclusive urban sanitation services.

This report is complemented by a detailed report on the tools, which includes as annexes generic terms of reference and survey instruments which can be adapted for use in specific situations, and the five case studies.

The tools

Three key **diagnostic tools** were developed under this project.

- Firstly, the Fecal Waste Flow Diagram (SFD) represents where fecal waste goes, what proportion is managed and where the unmanaged portion ends up.
- Secondly, the City Service Delivery Assessment considers the enabling environment and quality of service delivery along the service chain, identifying areas for attention.
- Thirdly, the Prognosis for Change (Political Economy Analysis) identifies the interests and incentives that could block action, and possible entry points for overcoming them.

Together, the outputs of these tools give a diagnosis of problem areas and provide data and information for developing an appropriate response.

Two **decision-support tools** then help guide a practical response to the problems.

- Firstly, the Service Delivery Action Framework guides the identification of actions in relation to the enabling environment.
- Secondly, the Intervention Options Assessment is a guide for identification of technical interventions along the service chain.

Other tools, which can play an important role but were not developed as part of this initiative, are also discussed in the report.

The case studies

The aim of the city case studies was to test existing and new tools in real-world settings using primary data, so as to inform both their development and their application. The immediate objectives of the five city case studies were to field test the tools to capture quantitative and qualitative data on the sanitation situation in the city from a socio-economic perspective, specifically as it relates to FSM services. Such work was linked to a World Bank investment project, wherever possible. The data is representative of the city as a whole and also provides a separate picture of the situation in low-income areas. The studies also provided initial recommendations to guide discussions around future interventions in the sanitation sector in the city, by contributing credible data and analysis of findings.

A two-page summary of each city case study is provided in this report, as well as a synthesis of the most significant experiences and lessons gained from deploying the tools in the five cities. It aligns these experiences and lessons with the typical project cycle of a financing institution, such as a development bank. Furthermore estimates of costs and resources needed for using the tools are provided.

Policy recommendations

Policy recommendations were developed based on an analysis of the lessons emerging from the five FSM case study cities, with additional evidence from studies undertaken by team members under other World Bank sanitation projects and technical assistance. Key areas are

(i) FSM in national policy and legislation

FSM services are an essential component of urban sanitation: On-site sanitation systems are the norm for both rich and poor in cities and towns of many developing countries, and are often the only form of sanitation available to poor people. However, they have been largely neglected by the institutions responsible for sanitation, and the construction and servicing of on-site facilities is typically left to an unregulated informal sector. This is compounded in many cases by outdated legislation that may outlaw pit latrines or other non-sewered sanitation options.

FSM services need to be included in national sanitation policies: In order to manage on-site sanitation and FSM effectively, they must be included in national policy and funding arrangements, and any assessment of sanitation services needs to include a focus on how the poorest communities can best be served. This must be complemented with city-level sanitation planning systems, and byelaws that allow the authorities to oblige both households and service providers to play their part in delivering a full sanitation service chain.

(ii) Drivers of improved urban fecal sludge management services

The private sector needs incentives to stimulate and meet demand for affordable FSM services, while also ensuring safe practices, and requires access to safe disposal sites at economical distances from collection areas.

Bury and forget is common practice but is not sustainable over time as houses are extended, rental units constructed, and back yards get smaller. Rebuilding latrines every few years also discourages investment in a permanent structure and perpetuates a perception that pit latrines are unsatisfactory. Improved water supplies often lead to the gradual adoption of manual or cistern flush toilets requiring more sophisticated facilities, which are cheaper to empty than to rebuild.

Protection of groundwater requires consideration of all options: Discouraging the use of shallow wells by providing clean piped water is invariably a cheaper, more effective solution, and more popular than installing sewerage to 'protect' the ground water – which it usually fails to achieve in any case. Shallow groundwater is also contaminated by industrial and commercial wastes, leaking drainage channels and leachate, making investments in sewerage alone of little use unless they are part of an integrated urban water management approach.

(iii) Institutional, regulatory, legal and financial matters,

Clear institutional roles are needed for FSM at local level: While there is no 'one model fits all', the utility, together with the private sector, may be best placed to manage FSM services where piped water access is substantial. Where local government has responsibility for FSM, the municipality will often be a service provider, which also provides capacity to deal with public emergencies and sends price signals into the market through a limited service for paying customers.

Effective and enforceable regulations for FSM: Clear local byelaws or ordinances are a necessary element in the extension of institutional responsibilities to cover FSM. Regulations need not be overly complex to start with, especially when transitioning from informal services. The

increased recognition and formality also often results in emptiers feeling less marginalized and stigmatized.

Planning and budgeting processes for FSM: FSM service targets in city development plans, viable service funding arrangements and an FSM component in city-wide sanitation investment plans are all essential, but often missing. Well-designed national plans, funding windows and reporting mechanisms can also be critical to achieving success at scale.

Monitoring FSM service outcomes requires seeing FSM as an end-to-end system, with the key outcome being that people do not and cannot interact with fecal sludge. This is hard to measure so a useful proxy indicator is the proportion of fecal sludge discharged to a proper treatment or safe disposal facility.

Equity in subsidizing the sanitation chain is needed to realize the public good element of sanitation. It is a strong argument for subsidizing urban sanitation, and especially for smart, targeted subsidies for poor FSM customers. Innovative subsidy mechanisms need to be developed, that target specific cost elements through the entire service chain and are not necessarily limited to conveyance (as for sewerage) without compromising the sustainability and inclusiveness of the services.

(iv) Planning for incremental change

While sewerage will be the preferred long term sanitation solution in many cities, it will not be possible to make the change at once for both financial and logistical reasons, so an incremental approach to improving sanitation is needed. Several sanitation options will be in use at any time, and these will change differently over time in different areas. The responsible authorities need to identify and prioritize the type and location of interventions to optimize public health and environmental outcomes. Even when the long term vision is for widespread sewerage, it will still also be appropriate to invest in improving on-site sanitation, rather than channeling all available resources into sewerage and leaving the population using on-site systems to fend for themselves.

Knowledge gaps

Knowledge gaps on city-wide urban sanitation and specifically FSM include:

The need for inclusive delivery of effective sanitation facilities to specific user groups such as: for tenants of low-cost rental accommodation; sanitation in challenging environments such as high water table and flood-prone areas, rocky ground and steep hillsides, settlements over water, cold climates, etc; upgrading on-site facilities at scale to improve emptiability and user hygiene; modalities and timing for effective urban sanitation and hygiene promotional campaigns; and ensuring that the institutions responsible for health centers, schools, etc. provide adequate sanitation for users.

Institutional issues such as developing the community engagement capability of utilities (or other responsible authorities) to enable effective planning and community mobilization for both sewerage and non-networked sanitation; complementary roles and collaboration modalities for utilities, local government and the private sector in diverse governance environments; financing of capital and operating costs, including subsidies where appropriate; the design of institutional incentives; and the development of better political economy analysis tools.

Institutional aspects of fecal sludge management such as developing viable business models for FSM, including considerations of scale, linkages with solid waste management services, on-demand vs. scheduled emptying, etc; the elimination of manual emptying and introduction of improved methods and/or alternative sources of income for manual emptiers; use of charging

systems that promote fecal sludge discharge at approved sites; and PPPs for production and marketing of end-use products derived from sludge.

Technical aspects of fecal sludge management including the use of transfer stations or alternatives; improved technologies for dealing with thick pit latrine sludge; fecal sludge treatment plant design; and specific arrangements for greywater management where there is no sewerage.

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List of abbreviations

CSDA	City Service Delivery Assessment
FS	Fecal sludge
FSM	Fecal sludge management
IUWM	Integrated urban water management
OSS	On-site sanitation
PEA	Political economy analysis
PFC	Prognosis for change
USSI	Urban Sanitation Status Index

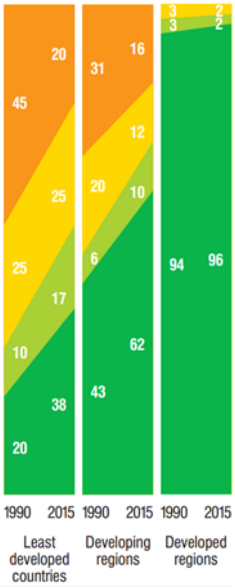
1 Background and introduction

1.1 The urban sanitation challenge

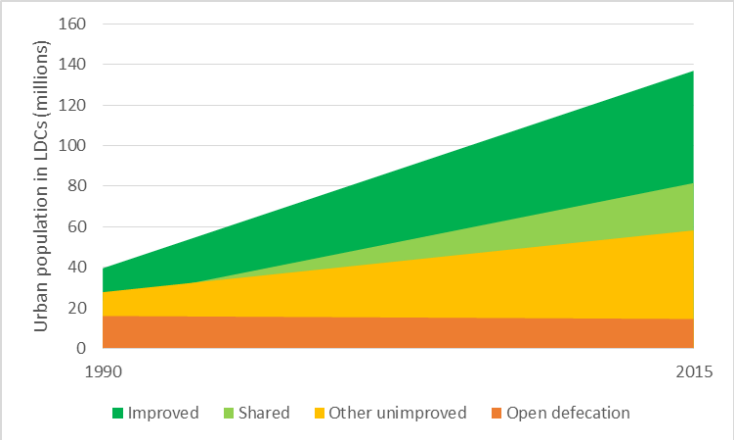
Urban sanitation remains a significant challenge for most low- and middle-income countries. Figure 1 below shows the situation, which is compounded by population growth and rapid urbanization. As shown in Figure 1(a), while sanitation coverage has been increasing across both the 48 Least Developed Countries (LDCs) and developing regions as a whole, progress has been relatively slow. Around 53% of the urban population in the least developed countries are still using unimproved sanitation. As shown in Figure 1(b), in absolute terms the number of urban dwellers in LDCs using improved sanitation increased between 1990 and 2015. However, the population using shared and other unimproved sanitation facilities also increased significantly.

Figure 1 Urban sanitation use in 1990 and 2015

(a) Proportions of the urban population using different sanitation options



(b) Numbers of urban population in Least Developed Countries using different sanitation options



Source: (a) WHO / UNICEF (2015), (b) calculations based on WHO / UNICEF (2015)

The data above only refer to the type of containment facility used, which was the focus of the Millennium Development Goals (MDGs). The MDGs did not monitor where the toilet discharged to – whether this was to sewer, septic tank, pit, open ground or drain – nor what happened finally to the liquid and solid products. Under the post-2015 Sustainable Development Goals (SDGs), there is now a focus on the whole sanitation service chain, as shown in Figure 2 below.[1]

[1] Further details and examples of the sanitation service chain can be found in other publications, such as Strande et al (2014) and Tilley et al (2014)

Figure 2 The sanitation service chain



Under the post-2015 Sustainable Development Goals (SDGs), there is now a focus on the whole sanitation service chain from containment through to disposal. The challenge for urban sanitation under the SDGs is therefore not only to achieve universal access to toilets, but also that all excreta is safely managed along the whole sanitation service chain.

1.2 'Safely managed excreta' along the service chain

A range of technologies exists for safely managing excreta along the sanitation service chain. Pit latrines, septic tanks and sewered systems can all 'safely manage' excreta as per the SDG definition (Box 1). However, for over 100 years networked sewerage, whereby excreta and associated wastewater are conveyed through a network of pipes to treatment, has been widely considered as the preferred solution. The term "sewerage system" covers a number of options (e.g. decentralized, conventional, small-bore, shallow, condominial, etc.) and components (tertiary, secondary and trunk sewers, associated infrastructure and treatment facilities). When functioning together through the service chain, these are considered as 'networked' sanitation options. However, access to a sewerage system is low or non-existent in many developing country towns and cities. Some utilities have succeeded in increasing access to sewerage networks, but universal access to sewerage in urban areas is a long way off in most of the developing world and may not, in any case, be the most cost-effective solution in many situations.

Box 1 WHO/UNICEF definition of 'safely managed' excreta

Safe management of household excreta is defined as the containment, extraction and transport of excreta to a designated disposal or treatment site, or the safe re-use of excreta at the household or community level, as appropriate to the local context. The share of households with safely managed excreta is defined as the fraction of households whose excreta:

- Are carried through a sewer network to a designated location (e.g. treatment facility);
- Are hygienically collected from septic tanks or latrine pits by a suction truck (or similar equipment that limits human contact) and transported to a designated location (e.g. treatment facility or solid waste collection site); or
- Are stored on site (e.g. in a sealed latrine pit) until they are safe to handle and re-use (e.g. as an agricultural input).

Source: WHO / UNICEF (2015a)

In the meantime, most people are using 'non-networked' sanitation options in urban settings, where excreta and wastewater discharges either into a septic tank or pit, or directly into a drain, river, sea or open ground. Furthermore, while urban residents practicing open defecation are in the minority, they still accounted for 181 million people in developing regions in 2015 (WHO / UNICEF, 2015).

The WHO/UNICEF Joint Monitoring Program (JMP) does not yet have detailed figures for the proportion of fecal waste that is safely managed, and estimates are only available at the global level disaggregated between urban and rural areas. These estimates (which include North America, Europe, etc.) show that around 60% of urban residents use toilet facilities linked to sewers, leaving 40% using non-networked solutions. Estimates of the number of people relying

on non-networked solutions in low- and middle-income countries are typically 60-100% depending on the city and country. For instance, among utilities serving the largest cities in Sub-Saharan Africa, only half report operating a sewerage network, and these mostly serve less than 10% of the population (Morella et al, 2009). In a recent study of 30 cities and towns in Africa and Asia, Nairobi was the only African city with close to 50% of the population having access to a sewer (Chowdhry and Kone, 2012).

Non-networked systems are therefore the norm in the majority of low and middle income countries, particularly amongst the poorest urban residents. These systems contain fecal sludge (FS), which is raw or partially-digested feces and urine, along with a variable amount of contaminated wastewater, often mixed with solid waste, menstrual hygiene materials and other waste dropped into toilets or directly into pits and tanks. In many cities, even where improved on-site facilities are used to contain excreta, the level of quality and access to services for the emptying, conveyance, treatment and disposal of the resulting fecal sludge is usually limited. These services are collectively called fecal sludge management (FSM) services. FSM services are the focus of this study, but located within the broader context of urban sanitation and integrated urban water management (IUWM), as explained in more detail in the next section.

Even in regions doing relatively well in terms of overall sanitation access, for instance in Latin America and the Caribbean, there is still a substantial reliance on unplanned on-site systems and even open defecation in many cities. In Brazil, for example, nearly 2 million urban residents practice open defecation, and a further 28 million rely on unimproved or shared toilets (WHO/UNICEF, 2015). From East Asia to Latin America, inadequate services are concentrated principally, but not exclusively, in slums and informal settlements, and among poorer households.

The fecal sludge which is removed from non-networked facilities rarely reaches a treatment plant for safe reuse or satisfactory disposal in accordance with local environmental standards.[2] In general, safe management of fecal sludge downstream of the household is severely neglected by utilities, municipalities and households alike, regardless of the nature (improved or unimproved) of the household facility. This is a particular challenge in densely occupied urban environments where sludge removal is necessary for sustained access once the containment facility becomes full, unlike in low density urban or rural settings, where latrines can be relocated when full.

The challenge as outlined above, and especially now for the SDG era, is to achieve *safe management of excreta along the whole sanitation service chain*, in addition to *universal access to sanitation*. While the JMP data in Figure 1 shows progress on the use of improved sanitation, three important aspects are disguised:

- Sewerage in poor countries, especially Sub-Saharan Africa and Asia, only serves a small proportion of the urban population, with the great majority of residents relying on non-networked sanitation – which in turn requires some form of FSM services to be safely managed;
- The problem of poorly managed excreta from non-networked sanitation is particularly acute in large informal settlements and slums, and applies to every developing region;

[2] This refers to FS that is intentionally removed, using manual or mechanical emptying arrangements. In reality, FS generated in urban settings often escapes from poorly-constructed containment into into drains and waterways or directly into the environment.

- Even when excreta is safely removed from containment in on-site facilities, it is rarely safely managed along the whole sanitation service chain.

With this further nuanced challenge in mind, Section 1.3 goes into more detail on how fecal sludge management services fit within the broader context of urban sanitation and integrated urban water management.

1.3 Fecal sludge management within urban sanitation

1.3.1 FSM in context

FSM services can constitute an important component amongst the multiple urban sanitation service chains serving a given city. Achieving sustainable FSM services may therefore be viewed as a realistic short-, medium- or long-term measure to complement the services provided through networked sewerage systems, to ensure that all excreta is adequately managed through the sanitation service chain The service delivery gaps within and between stages of the chain become a greater challenge as sanitation access increases in poor urban areas. In all cases, failure to ensure strong links throughout the chain results in untreated fecal sludge contaminating the environment, with serious implications for public health.

FSM has often been considered an inferior, stop-gap solution compared to conventional sewerage options, by governments, utilities and urban planners alike. However, they are increasingly recognizing that it will take many years, or may not be cost-effective, to achieve safely managed sanitation services via universal access to sewerage. Furthermore, FSM services are increasingly recognized as part of the solution in areas where sewerage is not technically feasible (e.g. steep hillsides, rocky soil), or in low-density settlements where there is sufficient absorption capacity in the soil and limited use of local groundwater. Crucially, FSM services represent a feasible sanitation solution for many unplanned areas where it is hard to justify major public investments in underground infrastructure, for example due to the urban layout undergoing continual change, or to land tenure issues restricting opportunities for infrastructure development.

Safely managing fecal waste is a particular challenge in unplanned settlements resulting from rapidly expanding cities. In these areas, fecal sludge is often allowed to accumulate in poorly designed and built pits, and then discharges directly into storm drains and open water, or is removed from the pit and dumped into waterways, wasteland and insanitary solid waste disposal sites. Only a small percentage of fecal sludge generated in such areas is managed and treated appropriately.[3] The problem is significant for many cities and medium and small towns in developing countries.

Interest in the development of FSM services has increased in recent years amongst WASH sector organizations, development partners and a growing number of national and local government agencies. There remains, however, much to be done to develop, pilot and scale up business models, technologies and evidence of ‘what works’, and also to fully understand the nature and quantities of the fecal sludge generated and needing collection and treatment.

The focus of this study is on how to develop sustainable FSM services within the broader context of inclusive urban sanitation services. The study does not advocate that FSM services

[3] This was a key finding of a review of the status of FSM in 12 cities, using secondary data (Peal et al, 2014). This study has identified that ineffective management of fecal sludge is not only restricted to unplanned settlements but can also occur city-wide (such as in Dhaka).

are necessarily the most appropriate or only means to safely manage fecal waste, but they are likely to be an essential component of sanitation services in most developing country cities. In a city such as Dhaka (Bangladesh), with dense housing, an only partially functional sewerage system and a high proportion of latrines discharging to the open drainage system, improving FSM is a priority. However, in a smaller and less densely populated city such as Hawassa (Ethiopia) where most residents use pit latrines which are covered after filling, FSM may be less of an immediate priority, although it may become more important as the city becomes more densely populated.

In summary, in many cities and small and medium towns across Africa, Asia, Latin America and the Caribbean, the single most important intervention for improving sanitation for areas served by non-networked sanitation is to ensure the adequacy of FSM services, to protect both public health and the environment. At present, few cities have the management structures, institutional and regulatory arrangements, infrastructure, skills, or financial systems to deliver adequate FSM services. Consequently it has remained, until very recently (with exceptions such as Durban, Ouagadougou, Dakar and Malaysia and some cities in the Philippines), a significant but largely neglected challenge. It has been commonly addressed by a mostly unregulated private and informal sector, often employing grossly unhygienic emptying methods.

Going beyond the context of improving sanitation, FSM is an issue which sits naturally within the wider scope of Integrated Urban Water Management (IUWM). IUWM is a holistic approach that recognizes the inter-linkages between water supply, sanitation, drainage and solid waste management, and the wider contextual issues of urban land use and water resources management. FSM affects or is affected by many of these factors, including urban land use (limited road access, limited space on-plot), groundwater (infiltration into pits, pollution of wells), surface water (illegal discharges from on-site facilities to drainage system, effluent from dumping sites and treatment plants), water supply (types of on-site facilities, volume of fecal sludge), solid waste (disposal in latrine pits, blockage of stormwater drains containing illegally discharged fecal waste).

IUWM is appropriate where several of these elements present development challenges that can best be resolved in an integrated way (as in many developing country cities) and where there is adequate leadership, governance and institutional capacity to drive the process forward. It typically requires a holistic diagnostic involving all stakeholders, leading to a strategic action plan/framework that prioritizes interventions to be implemented through a single integrated project, or a program of single or multi-sectoral interventions which all contribute to the same overarching goals.

1.3.2 Urban sanitation as a suite of servicestructure.

Figure 3 below shows some examples of routes along the sanitation service chain, with sewerage and FSM service chain options indicated in different shades of brown. The figure aims to demonstrate how urban sanitation can be seen as three kinds of services: private services, public services, and infrastructure development services.

1. **Private services**, provided directly to users – these are often viable on a commercial basis as they are essentially private goods.

2. **Public services** are downstream of the users – these serve the general public by keeping the environment clean and healthy. They produce public goods, and as such it may not be possible to finance them entirely by direct user charges.

3. **Infrastructure development** – this is an important component necessary for the public services. It is frequently undertaken by a different actor, as the authority responsible for service provision may well lack the necessary financial resources for building major infrastructure.

Figure 3 Urban sanitation as a suite of services

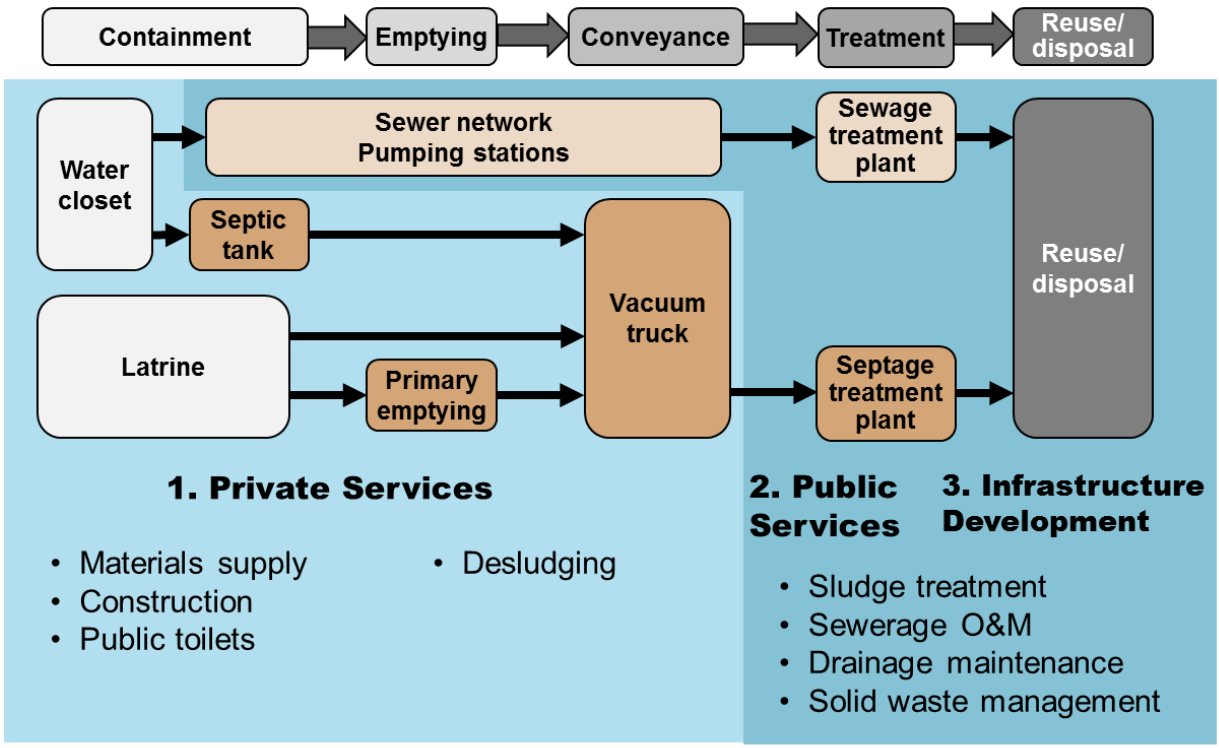


Figure 3 illustrates how, for the sewerage service chain, the sewer network and pumping stations are generally seen as public services. However, for the FSM service chain, the emptying and conveyance stages are generally seen as private services. Following the logic above, municipalities often implicitly see FSM as a private good and sewerage as a public good, with the result that sewerage services typically attract far more public finance by way of capital and recurrent subsidies than FSM services.

For instance, in Dar es Salaam, Tanzania, while only 10% of the population is connected to sewerage networks, 99% of public funds over a three-year period were used to finance these networks and associated sewage treatment (Trémolet and Binder, 2013). In a specific $165 million WASH project in Dar es Salaam, 70% of funds were allocated to water, 20% to sewerage and 10% to non-networked sanitation.[4] In Nakuru, Kenya, the utility reportedly charges a sanitation levy at 75% of the water bill, regardless of whether that household is connected to the sewer (Edwards et al., 2015). However, the levy mainly finances the sewer system. The wastewater treatment plant is supposed to also treat fecal sludge from non-networked systems, but this can be detrimental to its operation where significant volumes of FS are involved as it requires a different type of treatment to sewage. The paper suggests that, despite weaknesses in the data, the levy benefits only a small number of sewer-connected customers who are typically richer than average.[5] In Nakuru there are 14,000 sewer

[4] The Dar es Salaam Water Supply and Sanitation Project, financed by the World Bank and others (e.g. African Development Bank and European Investment Bank) between 2002 and 2010.
[5] The Trémolet and Binder (2013) study also found that the CAPEX and OPEX costs of building and maintaining non-networked sanitation are higher than connecting to the sewerage network (with associated regular charges).

connections for a population of between 326,000 and 650,000.[6,7] Calculations made in Dakar Senegal, show that of a total annual per capita cost (including capital) for sewerage of $54.64, $52.63 is borne by the utility, whilst it only bears $1.86 of the $11.63 annual per capita cost for non-networked systems (Dodane et al, 2012).

Where municipalities have funding for non-networked sanitation, this is, with few exceptions, typically allocated for sanitation and hygiene promotion software activities (e.g. demand promotion and enforcement) rather than supporting FSM services.

The role of the state in urban sanitation service provision, specifically with respect to FSM services, is a broad topic that this report cannot cover in detail. The section has however outlined the private/public service distinction as a key issue when comparing different options for the sanitation service chain, and that there is some evidence that the perception of FSM services as private services mitigates against public finance for FSM.

1.4 About this report and its structure

This document provides a summary of the key findings and implications from the development of a suite of FSM diagnostic tools and case studies in five cities around the world. It is part of a World Bank Economic and Sector Work (ESW) study entitled 'Fecal Sludge Management: Diagnostics for Service Delivery in Poor Urban Areas', hereafter "the global FSM study". This work is funded by the World Bank Water and Sanitation Program (WSP). The FSM tools and findings are based on field work carried out in the five cities of Balikpapan in Indonesia, Dhaka in Bangladesh, Hawassa in Ethiopia, Lima in Peru and Santa Cruz in Bolivia. More details on the purpose of the global FSM study are given in Section 2.

This Summary Report is one of a number of documents (see Table 1 in Section 2) arising from the global FSM study. It summarizes the learning and general policy recommendations that flow from application of a suite of diagnostic tools and guidelines developed and refined under this study. The target audience are those advocating for or implementing city-wide, poor-inclusive urban sanitation.

The specific objectives of this Summary Report are to:

- Present key findings from the case studies
- Assess the lessons learnt from the application of the diagnostic and decision-support tools in preparing the case studies; and
- Identify policy recommendations for enhanced FSM service delivery as part of developing urban sanitation services.

The report is structured as follows:

- Section 1 has provided the broader context of urban sanitation and the role FSM services play;
- Section 2 explains the outputs of the study and introduces the tools and guidelines themselves, as well as intended audiences;
- Section 3 summarizes the case study methodology and gives an overview and summary of the five case studies;

[6] Official estimate, 2009
[7] Unofficial estimate, 2015

- Section 4 briefly describes and explains lessons learned from applying the tools and guidelines, and how they can be used in different stages of a typical project cycle;
- Section 5 gives policy recommendations for future development of urban sanitation services;
- Section 6 summarizes next steps for developing and adapting the tools to address urban sanitation in general;
- Section 7 concludes.

This report should be read in conjunction with the other documents produced under the global FSM study:

- Tools and Guidelines
- Data Collection Instruments
- Terms of Reference
- Case Studies

2 Purpose of this study and application of findings

2.1 Overall purpose of this study

The objective of the global FSM study was to develop diagnostic tools, decision-support tools and guidelines for the development of investment projects to improve FSM services as part of urban sanitation strategies and plans. It considers the factors affecting fecal sludge (sometimes called septage) management services from a city-wide perspective, but with a clear secondary focus on how to serve poor urban communities. The findings are based on the collection and analysis of both primary and secondary data. Five in-depth case studies from different regions were used to develop the analysis.[8] The study consultants were Oxford Policy Management (OPM), in partnership with the Water, Engineering and Development Centre (WEDC) at Loughborough University, UK.

The rationale for this global study came from realizing that there were very few existing tools and guidelines to help city planners navigate complex FSM situations, despite increasing demand for them. This study built on some of the existing frameworks and tools, in particular the City Service Delivery Assessment (CSDA) scorecard, and use of the Fecal Waste Flow Diagram (also known as a Shit Flow Diagram, or SFD). Some of these were developed in the context of a preliminary review in 12 cities, using secondary data (WSP, 2012).

The further development of these tools and guidelines was informed through primary data collection in five cities, supported by interaction with city stakeholders. Acknowledging the difficulty of reforming FSM services in cities, political economy questions around FSM were explicitly included as part of the overall analysis. The aim was to produce diagnostic and decision-support tools and guidelines that are based on real-life examples. Where possible, this was linked to ongoing World Bank operations, in order to provide insight on their practical application. Section 2.3 provides an overview of the tools used.

A key principle underlying the study is that city-wide solutions must aim to deliver effective sanitation to the city as a whole, while ensuring that specific or tailored solutions for poor urban areas are integrated into the planning and implementation of those solutions. The data collection, analysis and outputs in the form of the tools and guidelines within the study follow this principle by deploying analyses for both city-wide and low-income areas in parallel where possible.

2.2 Outputs and how they can be used

2.2.1 Overview of outputs of the study

Table 1 below summarizes the main outputs of this study, which are each separate documents, each aimed at a specific group of target audiences.

- This ***Summary Report*** primarily aims to collate the lessons learned from developing and applying the tools and guidelines in five cities around the world.
- The ***Tools and Guidelines*** describe in detail the data and analytical framework used to produce the outputs, and how to apply them.

[8] These were: Dhaka (Bangladesh), Hawassa (Ethiopia), Balikpapan (Indonesia), Lima (Peru), and Santa Cruz (Bolivia).

- The ***Data Collection Instruments*** are generic instruments covering all key aspects of the diagnostics, which should be adapted to each specific local situation.
- The ***Terms of Reference*** are generic documents for contracting FSM diagnostics to consultants, to be adapted according to the local situation and the scope of studies and analysis required.
- The full findings of the city case studies are in five ***Case Studies***.

This Summary Report treats each city study individually, rather than attempting to make any comparison between them, unless this is instructive for the whole study. It synthesizes the lessons learned from developing and applying the tools, as well as drawing overarching conclusions and policy recommendations from the case study findings.

Table 1 Outputs from this study

Title	Content	Target Audience
Summary Report	The flagship – a full summary report on the tools and case study findings and what they tell us about urban sanitation	Project managers, national and local government personnel, utility managers
Tools and Guidelines	The 'how to' – detailed report on the tools with examples and details on their use	Project managers, consultants or staff using or supervising use of the tools
Data Collection Instruments	Generic survey instruments covering all aspects necessary for the diagnostics – will require adaptation to local situation	Consultants or staff using the tools to develop FSM diagnostics
Terms of Reference	Generic terms of reference for contracting FSM diagnostics to consultants – will require adaptation to local situation	Project managers or consultants contracting or subcontracting use of the tools
Case Studies (5)	The detail – in-depth studies of individual cities	Professionals working on sanitation in the given city, or extending the experience to others

2.2.2 Audiences for the outputs and how they are intended to be used

The reports in the table above are tailored to the intended audiences. It is helpful to distinguish between (i) users of the outputs of the tools (e.g. diagrams and tables), (ii) users of the tools themselves (e.g. questionnaires and spreadsheets).

- ***Users of the tool outputs*****:** The reported results and recommendations need to appeal to, and be used by, a range of decision-makers working in government, utilities, municipal authorities and international development agencies. The outputs of applying the tools are therefore designed to be visual, clear and accessible to people with both technical and non-technical backgrounds. The outputs would typically be used in project or program concept, preparation and design documents.

- ***Users of the tools*****:** evidence-based project design work is typically outsourced to consultants or carried out in-house by city stakeholders or staff of financing institutions. The intended users of these tools are therefore consultants or in-house staff with the appropriate expertise, capacity and means to apply the tools in a participatory manner. The results and recommendations are then intended to be discussed with their clients or managers as the principal output.

Various approaches and documents already exist e.g. Sanitation 21 and the Strategic Sanitation Approach, Community-Led Urban Environmental Sanitation (CLUES) to help decision-makers identify actions to take at city level. However, these do not to have a specific focus on FSM services, or address the political economy aspects. They also tend to focus on municipal and community action, with limited acknowledgement that tackling the problems will require substantial external support, resources and capacity. This may typically be provided through other levels of government or under project-type arrangements. The tools set out below take these factors into account, and aim to help stakeholders consider how to develop urban sanitation services that safely manage all fecal waste rather than only that which is discharged to sewers.

2.2.3 Limitations of the tools and guidelines

The five case studies have been developed for the context of the global FSM study. Some limitations include:

- The tools developed and tested in this study are designed to be globally useful, but will need to be adapted to specific country contexts (using local administrative sub-divisions, technical nuances, terminology, institutional arrangements, etc.) reflecting the range of sanitation, geographical, climate, institutional legal and historical variables in any given country or city. In planning such a study, about two weeks should be allowed for the adaptations to be made and pretested with local stakeholders before starting the diagnostic process.
- The tools require appropriately qualified, experienced and trained people to use them and to undertake data collection. Some of the key skills required are shown in Section 4.3.
- Analysis and interpretation of, or at least dialogue about, the collected data needs to be undertaken by people who understand the local context and are sensitive to the political economy, as well as having solid experience of urban sanitation issues.
- The household surveys were a relatively small sample and provided 90% confidence, whereas academic studies typically aim for a minimum of 95% confidence. The sample sizes enabled testing of the FSM tools and provided input to existing World Bank investment and technical assistance projects. As such they helped provide a common understanding of the existing situation and informed the discussion about which next steps and options should be taken. They are not designed for detailed planning of an intervention in specific areas, for which tools such as the Urban Sanitation Status Index, or USSI (see Section 2.9.5), can be a valuable addition where a geographical focus of intervention is required.

2.3 Overview of the diagnostic tools

As explained above, the details of the tools are covered in some of the companion documents produced by the global FSM study. The tools are divided into two types:

- **Diagnostic tools** ask questions such as “Where is the waste going?”, “What policies, laws, institutions, processes and budgets exist for FSM services, and where are there gaps?”, or “Why is it like this? Who benefits, who loses out? What factors could facilitate improvements?” These tools aim to improve the understanding of the nature of the sanitation problem, and from this material identify necessary actions and provide evidence-based data for use in decision-making.

- **Decision-support tools** respond to the identified situation, but go further, asking questions such as "What should we do next?", "What legislation and regulation is needed?" "What technical options may work?" and "What are the immediate and medium term priorities?" These tools aim to structure discussions around possible technical interventions and their economic and financial implications, and to bring together the outputs of all the tools to guide identification of policy, institutional and financial interventions necessary to deliver desired results.

Table 2 below summarizes the tools developed and used in the study and their objectives. Other related diagnostic tools, which can play an important role, but were not developed as part of this initiative, are also included in this table for context.

Table 2 FSM Tools and their objectives

	Tool	Objective
Diagnostic tools	1. **Fecal Waste Flow Diagram**	Where does the fecal waste go?" Represent where fecal waste goes, what proportion is managed and where the unmanaged portion ends up
	2. **City Service Delivery Assessment (CSDA) for FSM**	"What policies, laws, institutions, processes and budgets exist for FSM services? Where are there gaps? Assess the local enabling environment and quality of service delivery along the sanitation service chain, identifying areas for attention
	3. **Prognosis for Change** (Political Economy Analysis)	"Why is it like this? Who benefits, who loses out? What factors could facilitate improvement of the services?" Identify the interests and incentives that could block action, and possible entry points for overcoming them
Decision-support tools	4. **Service Delivery Action Framework**	"Which aspects of the enabling environment need development next?" Guide identification of actions in relation to the enabling environment, necessary to deliver desired results
	5. **Intervention Options Assessment**	"Which technical options may work?" Guide for identification of technical interventions along the service chain – linking to program design guidelines
Tools being developed by partners	**Fecal sludge technical tools**	Quantify volumes and characteristics of sludge, using standard methods. Assess FS end-products to suit market potential, evaluate collection and transport options and optimized treatment processes for resource recovery.
	Urban Sanitation Status Index	Quantify and represent in cartographic form the status of sanitation services, disaggregated by neighborhood
	FSM finance tools	Estimate the costs of fecal sludge management services

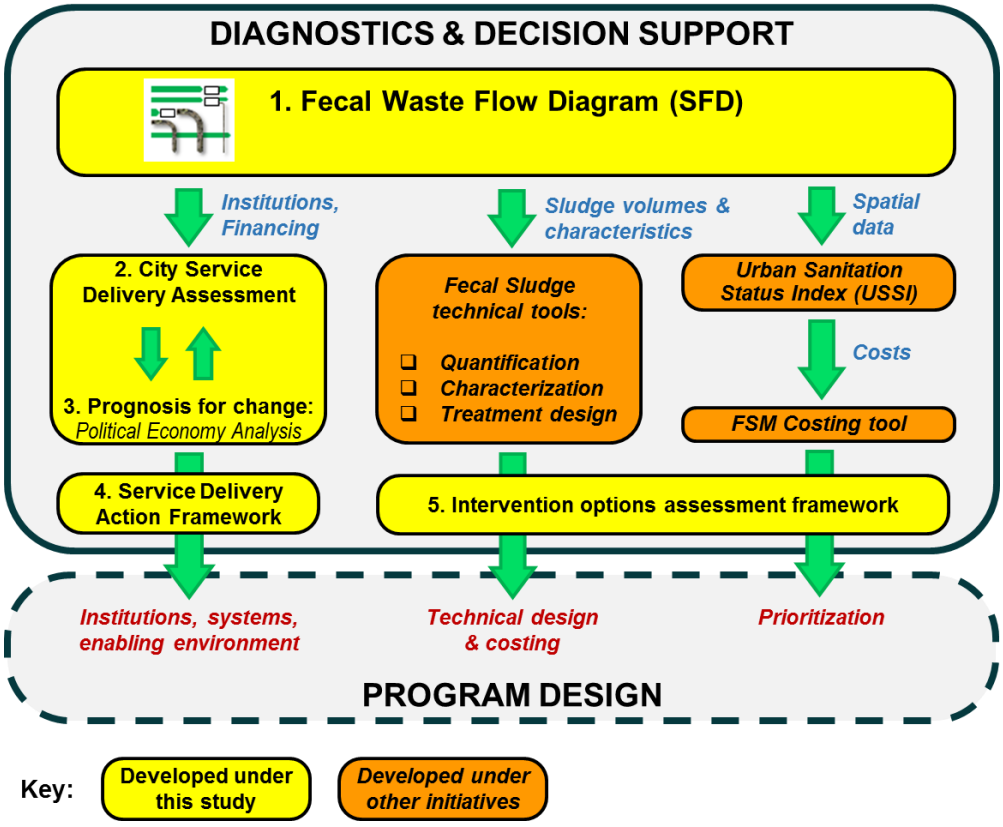
Figure 4 below maps the interrelations between the tools and their findings. The fecal waste flow diagram (see Section 4.4.1) acts as the starting point for the other tools: each subsequent tool provides further information on a different aspect of the overall analysis. Each tool is linked to one of three elements of program design (enabling environment, technical design and prioritization), while the outputs of all tools provide inputs to the implementation options assessment framework.

Most of these tools apply to urban sanitation overall. The City Service Delivery Assessment (CSDA), as applied in this study, is FSM-specific, but could equally be applied, in a modified form, to urban sanitation in general.

From the Fecal Waste Flow Diagram (SFD - Box 1 in Figure 4) there are three 'streams' of information required for program design. The first relates to institutions and financing (to inform enabling environment interventions), the second to sludge and wastewater volumes and characteristics (to inform technical interventions) and the third to spatial data and costs to inform prioritization of interventions. Information and analysis under all three 'streams' should inform a comprehensive approach to program design.

For the enabling environment stream, the City Service Delivery Assessment (CSDA - Box 2 in Figure 4) assesses the quality of processes affecting service delivery, intermediate and resulting service outcomes along the sanitation service chain and diagnoses the main impediments within the current enabling environment to supporting the development, expansion and sustainability of FSM services. The Prognosis for Change/Political Economy Analysis (PFC/PEA - Box 2 in Figure 4) is strongly linked to the CSDA, identifying the interests and incentives that could block action, and possible entry points for overcoming them. In addition, an emerging FSM finance tool supports the analysis of different models for who should pay, which must be proposed with an understanding of the political economy and current financing context. This then feeds into the Service Delivery Action Framework (SDAF – Box 4 in Figure 4) which suggests appropriate non-technical (or "soft") interventions for improving FSM, as a function of the status of the enabling environment.

Figure 4 Diagram of how the tools fit together



On the technical design stream, intervention options should be based on an understanding of the predominant characteristics of fecal sludge in the city, including how much of it there is to manage – which is, perhaps surprisingly, not a simple question. This avoids inappropriate or ineffective technical options being proposed. SANDEC's published material on urban sanitation

and FSM are state-of-the-art resources for supporting the quantification, characterization and design of treatment for sludge.

Finally, the prioritization stream helps decision-makers decide where to focus their efforts. The USSI tool supports this by showing where deficiencies in sanitation are spatially distributed. An FSM costing tool, currently in the initial stages of application, allows for the comparison of FSM service and infrastructure options, to support the selection of cost-effective interventions.

Public health risk assessment tools, such as those being developed by the Centre for Global Safe Water at Emory University, the Development Planning Unit at University College London (UCL), The Water Institute at the University of North Carolina (UNC) and other universities, can help identify 'hot spots' in the city where the health burden is greatest. However, none of these tools is as yet in a usable form. When ready they will constitute a valuable addition to the tools for prioritizing interventions.

Together, the outputs of these tools provide comprehensive information on the physical situation which feed into the identification of technical intervention options

2.4 Tool 1: Fecal Waste Flow Diagram

A Fecal Waste Flow Diagram is a visualization of how fecal waste (consisting of both fecal sludge and wastewater) flows along the sanitation service chain for different segments of the population. The diagram seeks to answer the question "Where does the fecal waste go in the city?" The proportions of households using different sanitation options are identified according to where the waste discharges (e.g. sewer, on-site containment etc.). At each stage of the chain, the proportion of fecal waste that is *effectively managed* continues as a green arrow, while any proportion identified as *ineffectively managed* "escapes" from the service chain and turns into a brown arrow, representing fecal pollution of the residential and natural environment.

Data sources used to develop the figures for the diagrams include household surveys, key informant interviews, secondary and grey literature, reports, observation of service provision and measurements at treatment facilities.

Figure 5 and Figure 6 show examples of fecal waste flow diagrams for Lima, Peru. The first represents a city-wide picture, while the second represents the situation for informal settlements in the city.

This is made possible by the sampling approach taken in the primary surveys – see link to data collection instruments below. This separate analysis allows decision-makers to focus on delivering city-wide services which are also poor-inclusive.

As illustrated in this case, the situation in slums is much worse than the city-wide picture, with far more fecal waste going directly into the local area, especially via poorly built unlined pits. This may help inform the development of poor-inclusive intervention options, for example improvements to on-site containment.

Figure 5 City-wide fecal waste flow diagram for Lima, Peru

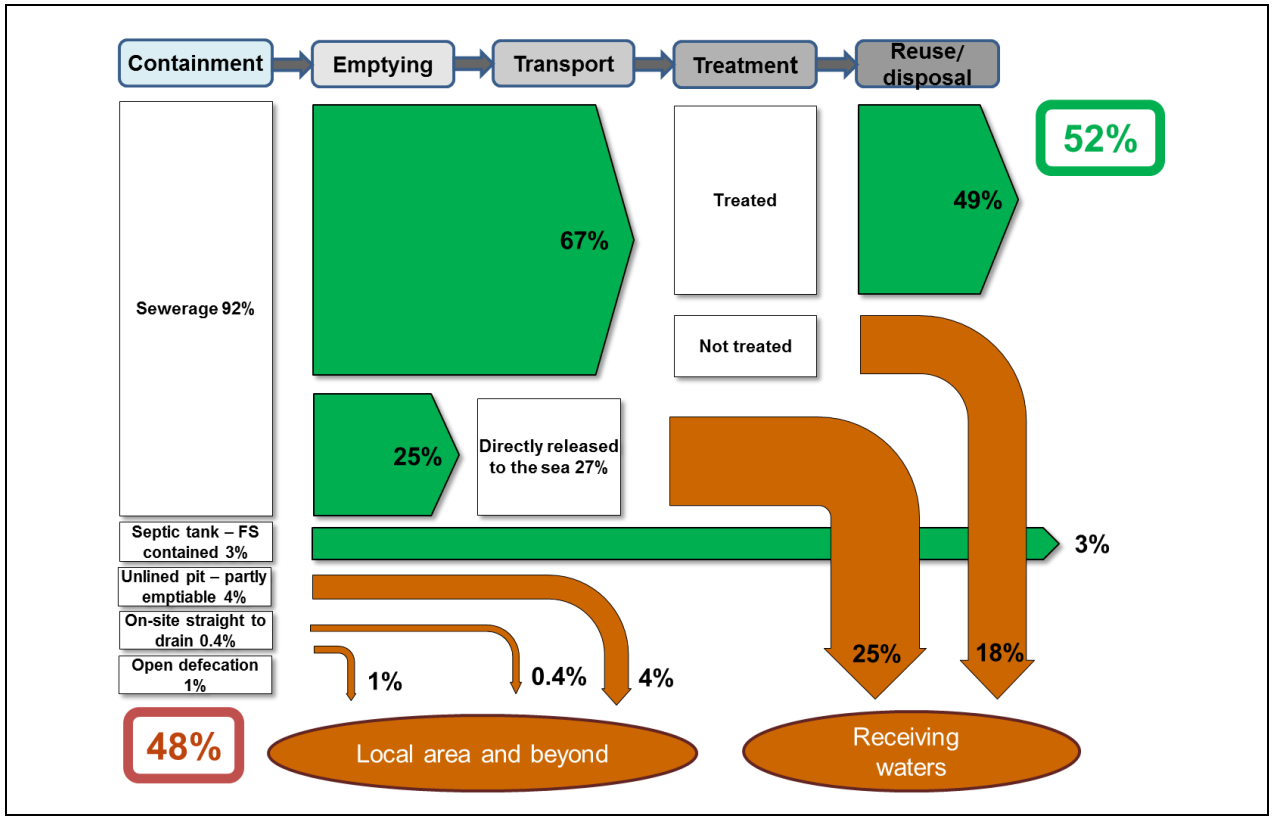
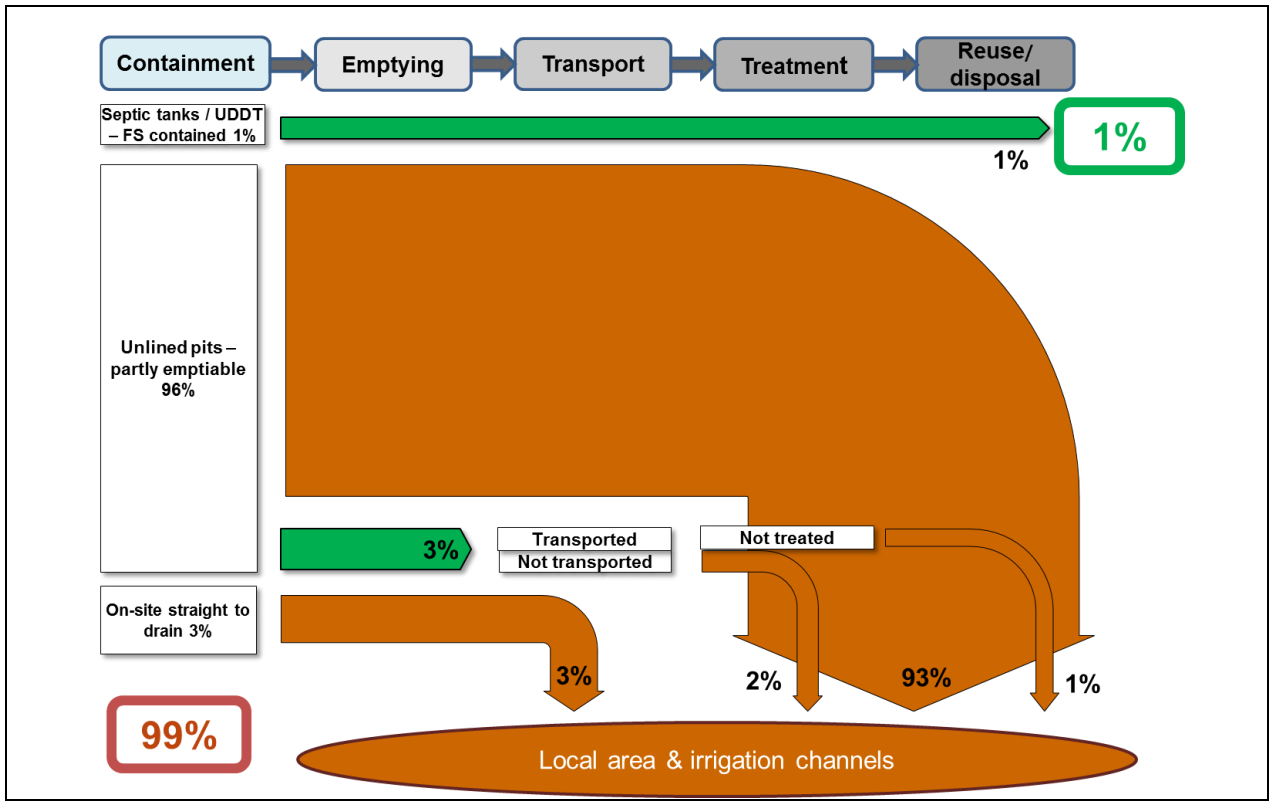


Figure 6 Fecal waste flow diagram for informal settlements in Lima, Peru



Important link

- BMGF-funded Fecal Waste Flow (SFD) Promotion Initiative
- For details on quantifying the factors determining fecal waste flows, see Data Collection Instruments

2.5 Tool 2: City Service Delivery Assessment

The City Service Delivery Assessment (CSDA) for FSM aims to answer overarching questions about the quality of the enabling environment, the extent of FSM service development and the commitment to FSM service sustainability. These are questions such as "What policies, planning processes and budgets exist for FSM services? How are these monitored? Are services expanded and do they meet the needs of all users?" The CSDA provides a structured assessment, based on responding to objective questions on FSM service performance through all stages of the service chain, so as to identify priority areas for action. The current format is adapted from that of the FSM 12-city study (WSP, 2013), which itself was derived from WSP's Country Status Overviews for water and sanitation (see AMCOW, 2011).

A key output from the CSDA process for FSM is the CSDA scorecard. An example for Balikpapan, Indonesia is shown in Figure 7. The process of developing the CSDA is important, as it requires key stakeholders to discuss all stages of the service chain and use the evidence about the current situation to agree scores. This evidence may have come from key informant interviews, secondary literature, field-based observations or focus group discussions. An initial stakeholder mapping exercise is necessary to ensure interviews are targeted at those best placed to inform and to generate unbiased scoring. Details of questions and indicators used in the process are in the Tools and Guidelines.

The resulting CSDA scorecard shows areas of strength and weakness for FSM and identify priority areas for action – which may include a national dimension (Table 2). As illustrated in the case of Balikpapan (Figure 7), likely priority areas for action are: establishing plans and associated budgets to improve FSM services, as well as focusing on poor-inclusive technical interventions to deliver services to all.

Figure 7 CSDA scorecard for Balikpapan

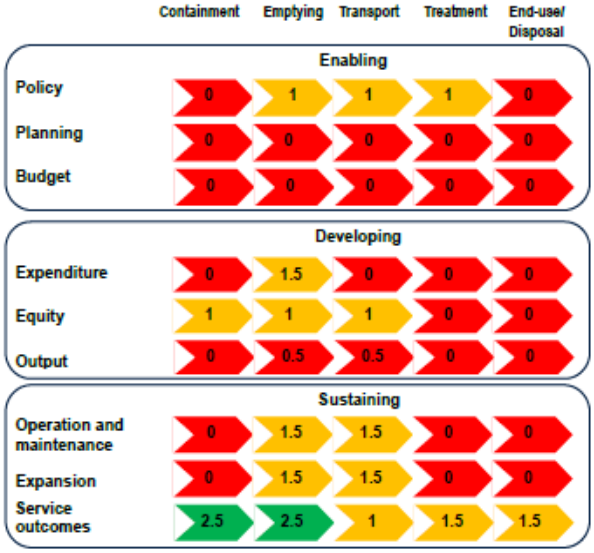
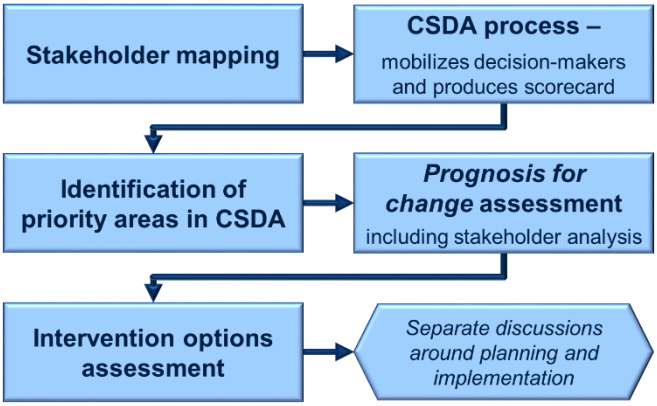


Figure 8 Interlinked CSDA and PFC process



The CSDA process does not explain why the situation prevails, nor identify potential obstacles to progress. The CSDA must be an iterative process which also takes into account the political economy of FSM in that city. A Prognosis for Change (PFC) assessment (next section) looks at why the CSDA looks like it does. Figure 8 summarizes this interlinked process, starting with stakeholder mapping. Once priority areas in the CSDA have been identified, a PFC assessment is undertaken. This then informs the intervention options assessment (see Section 2.8), so possible interventions are considered in the context of the city's political economy realities.

Important links

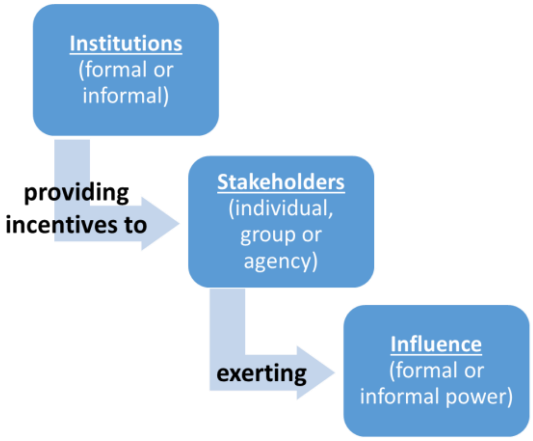
- For the CSDA questions and process, see Tools and Guidelines and Data Collection Instruments
- For guidance on stakeholder mapping, see p.126ff of the World Bank sourcebook on Tools for Institutional, Political, and Social Analysis of Policy Reform

2.6 Tool 3: Prognosis for Change assessment

The PFC assessment considers the positions of various stakeholders, in particular the institutions and incentives at play. It asks questions such as "Why are things like this?", "What are the formal and informal interests and incentives?" and "How is influence exerted?". A PFC assessment is essentially a political economy analysis in which topics are sensitively addressed, so that analysis can be shared and discussed among stakeholders.

A PFC assessment aims to understand three things, as shown in Figure 9. Firstly, it considers how "institutions" function. Institutions are defined as "the rules and norms governing human interaction", rather than a narrow definition of "organizations". Institutions can be formal (such as regulatory standards or byelaws about dumping FS legally), or informal (such as attitudes to reusing fecal sludge in agriculture).

Figure 9 Three key concepts in PFC assessment



Secondly, a PFC considers the incentives which institutions provide to stakeholders. In FSM, examples of relevant stakeholders may include sludge truck companies, the City Council, line Ministries, or slum-dwellers.

Finally, a PFC considers how stake-holders exert influence, defined as the formal or informal power to cause or prevent something. A city council may have formal legal power, but if their FSM byelaws are openly flouted, then their influence is very low.

Figure 10 Process map for Dhaka

Entry points	Formal Process	*Informal Process*
	Developer applies to RAJUK for permit	
Improve application scrutiny by all parties	RAJUK reviews application and consults other relevant authorities linked to FSM service provision (e.g. DCCs, DWASA)	*RAJUK expects DCC/DWASA to provide services, without asking*
	RAJUK approves construction	
	Developer constructs building with septic tanks & leach pits not connected to drains	*Developer connects toilets or septic tanks directly to the storm water drains*
Improve quality of inspections by RaJUK	RAJUK inspects during and after construction for compliance	*Not enough RAJUK staff to do proper inspections & enforce compliance*
	Occupants of completed building arrange for emptying of septic tanks when req'd	*Occupants do nothing, as all waste goes to drains*

The political economy is strongly linked to a financing dimension. The availability of finance, and the mechanisms through which it is distributed, have a profound impact on what actually happens. In order to be practically useful, a PFC assessment should consider the implications of the findings for effective engagement in a reform or change process. National policy and fiscal approaches are relevant here. In many cities, local resources are lacking and will continue to require (if not depend on) some assistance from higher levels of government – which ought to be rooted in national level policy.

Various tools for PFC assessment are included in the Tools and Guidelines, and an example of one of them is given in Figure 10. It shows a process map for the construction of a building in Dhaka. The central column shows the normal process, while the right-hand column shows the informal process which happens in practice. The left-hand column then shows entry points for engagement, crucial to getting value out of PFC analysis.

Important links

- WSP study with OPM on the political economy of sanitation in three countries
- The World Bank sourcebook on Tools for Institutional, Political, and Social Analysis of Policy Reform contains many examples of tools for PFC assessment

2.7 Tool 4: Service Delivery Action Framework

The diagnostic tools produce a comprehensive set of information and highlight priority areas for action throughout the service chain. This, in turn, informs a further process of identifying both technical and non-technical intervention options for improving services. These will guide the detailed project planning and implementation processes. The Service Delivery Action Framework makes recommendations on institutional issues, based on the components of the CSDA. The process for assessing technical intervention options is outlined in the next section.

This tool conceptualizes the range of non-technical or 'institutional' interventions that may be appropriate for a given city, depending on the status of FSM services development. Actions are grouped according to how well-developed the enabling environment is currently, with three stages characterized as: *Basic, Intermediate or Consolidating*. Actions are informed by the current reality experienced on the ground and are defined to highlight where best to focus attention for each aspect of the enabling environment, with the goal of improving services. Table 2 presents actions in an abridged format, in the interests of space. The Tools and Guidelines includes more comprehensive descriptions. Elements of the enabling environment are informed by recent research (see below).

For each component of the enabling environment (policy, institutional arrangements, budgets, etc.), specific activities can be identified. This may result in a range of actions taken from any of the *Basic, Intermediate or Consolidating* stages, as appropriate to a given city. Stakeholders must consider how actions will need to be implemented through pragmatic steps to be 'actionable'. The result will be a range of actions targeted at national, city and user level, which can then be considered in more detail to inform project planning and implementation.

Identifying the most appropriate actions must take into account the reality of any given city and recognize that the stages are essentially sequential – i.e. starting with Basic actions before moving towards Intermediate, and then Consolidating actions. Thus, if a city has already addressed Basic actions, Intermediate actions will most likely be the ones to focus on for that particular component.

This is illustrated by way of an example of a resulting Service Delivery Action Framework for Dhaka in Table 3. It highlights appropriate actions for each element of the enabling environment, informed by the extent to which actions have already been achieved in the city. Actions to consider are shown in the boxes with bold outline and shading:



Dhaka city's CSDA scorecard highlighted that progress in the enabling environment is limited to developing policy around containment and establishing an institutional framework for FSM services more generally. A focus on Intermediate actions is needed in relation to these areas, but Basic actions remain the priority in all other areas, including planning, budgeting, promotion and capacity.

A further step in the process is to take the actions from each of the highlighted areas and translate them into objectives, targets, indicators and inputs that respond to the specific context of the given city – at an appropriate scale (e.g. city-wide, or focused on specific locations) to enable detailed planning. This step must not be overlooked, as it requires a significant commitment of time, resources and skills to achieve effective results

Important links

- An Enabling Environment for Urban Sanitation: SPLASH Urban Sanitation Research Programme Briefing Note 1

Table 2 Service Delivery Action Framework

Stages of action		Basic actions *Critical interventions for public health protection*	Intermediate actions *Strengthening existing foundations*	Consolidating actions *Focused on full-chain, sustainable services*
National	**Policy, legislation and regulation**	• Review national sanitation policy and ensure FSM is included • Review regulatory framework around the protection of public health & environment	• Set norms / standards for public health and environmental protection • Establish legal basis for regulation of FSM services	• Require local regulation and its enforcement • Develop a policy/regulatory framework to incentivize treatment and re-use options
	Institutional arrangements	• Review institutional arrangements for sanitation – ensure FSM is included • Identify an institutional framework for FSM with clear roles and coordination	• Establish institutional framework for FSM with defined roles and coordination mechanisms • Establish institutional roles for fecal sludge treatment and re-use options	• Strengthen institutional framework to enhance service outcomes, with fully implemented roles and coordination • Consider (dis)incentives for improved FSM
	Planning, monitoring and evaluation	• Build awareness of FSM in national planning entities and relevant sector ministries (works, housing, health, environment, etc.)	• Establish monitoring framework for service standards – focus on emptying services • Establish systems to evaluate service quality	• Strengthen monitoring of all services • Develop plans to enhance treatment capacity and re-use technologies
	Capacity and TA*	• Identify scale of the capacity gap and TA required to address FSM service needs	• Build public and private sector capacity for city-wide FSM services	• Strengthen sector capacity for services, including treatment & re-use markets
	Financing	• Build awareness and agreement around the budgetary requirements for FSM services	• Develop programs with FSM funding windows and incentives for cities	• Mobilize finance for FS processing, re-use and disposal
Local	**Legislation and enforcement**	• Review/establish byelaws, ensuring they address on-site systems and FSM services	• Strengthen byelaws and their enforcement • Introduce regulation of service providers • Incentivize disposal at recognized sites	• Regulate pollution of receiving waters • Penalties for indiscriminate FS dumping • Enforce use of emptiable facilities
	Institutional arrangements	• Review institutional arrangements for sanitation – ensure FSM is included • Identify local institutional framework for FSM	• Establish local institutional framework for services – with roles defined and agreed • Establish roles for FS treatment and re-use • Consider (dis)incentives for improved FSM	• Strengthen institutional roles for managing improved FS management, including treatment facilities and re-use options • Implement (dis)incentives for improved FSM
	Planning, monitoring and evaluation	• Conduct area-based, gender and pro-poor focused diagnostic studies • Develop plans, finance & institutional needs • Plan and design FS treatment options	• Establish revenue streams • Refine and implement local service plans • Establish monitoring and evaluation (M&E) of service standards	• Introduce plans to enhance treatment capacity and re-use arrangements • Strengthen M&E of treatment and re-use arrangements against service standards
	Promotion	• Stimulate customer demand/ WTP for FSM	• Disseminate public FSM services information	• Stimulate market demand for re-use of FS
	Capacity and technical assistance* (TA)	• Identify capacity gaps and required TA • Promote appropriate private sector services • Implement measures for safer disposal of FS currently dumped in the environment	• Promote/support development of improved, emptiable containment facilities • Strengthen role of service providers • Pilot scheduled desludging/ transfer stations	• Consolidate/expand services based on outcome of pilot studies • Build/rehabilitate FS processing plants and develop business models for re-use of FS
	Financing	• Identify the extent of financing required to address service improvements to the poorest	• Introduce specific pro-poor financial arrangements (such as targeted subsidies)	• Identify opportunities for financial flows generated from the sale of FS end products
Users	**Planning**	• Consult communities, identify needs & wants	• Gain user feedback on improved services	• Gain user opinions on re-use options
	Tenant sanitation	• Engage with / consult landlords and tenants on constraints to FSM services	• Develop assistance and enforcement packages for landlords	• Focus on enforcement of service quality for landlords

Table 3 Prioritized actions: illustrative example for Dhaka city

Stages of action		Basic actions *Critical interventions for public health protection*	Intermediate actions *Strengthening existing foundations*	Consolidating actions *Focused on full-chain, sustainable services*
National	**Policy, legislation and regulation**	• Review national sanitation policy and ensure FSM is included • Review regulatory framework around the protection of public health & environment	• Set norms / standards for public health and environmental protection • Establish legal basis for regulation of FSM services	• Require local regulation and its enforcement • Develop a policy/regulatory framework to incentivize treatment and re-use options
	Institutional arrangements	• Review institutional arrangements for sanitation – ensure FSM is included • Identify an institutional framework for FSM with clear roles and coordination	• Establish institutional framework for FSM with defined roles and coordination mechanisms • Establish institutional roles for fecal sludge treatment and re-use options	• Strengthen institutional framework to enhance service outcomes, with fully implemented roles and coordination
	Planning, monitoring and evaluation	• Build awareness of FSM in national planning entities and relevant sector ministries (works, housing, health, environment, etc.)	• Establish monitoring framework for service standards – focus on emptying services • Establish systems to evaluate service quality	• Strengthen monitoring of all services • Develop plans to enhance treatment capacity and re-use technologies
	Capacity and TA	• Identify scale of the capacity gap and TA required to address FSM service needs	• Build public and private sector capacity for city-wide FSM services	• Strengthen sector capacity for services, including treatment & re-use markets
	Financing	• Build awareness and agreement around the budgetary requirements for FSM services	• Develop programs with FSM funding windows and incentives for cities	• Mobilize finance for FS processing, re-use and disposal
Local	**Legislation and enforcement**	• Review/establish byelaws, ensuring they address on-site systems and FSM services	• Strengthen byelaws and their enforcement • Introduce regulation of service providers • Incentivize disposal at recognized sites	• Regulate pollution of receiving waters • Penalties for indiscriminate FS dumping • Enforce use of emptiable facilities
	Institutional arrangements	• Review institutional arrangements for sanitation – ensure FSM is included • Identify local institutional framework for FSM	• Establish local institutional framework for services – with roles defined and agreed • Establish roles for FS treatment and re-use	• Strengthen institutional roles for managing improved FS management, including treatment facilities and re-use options
	Planning, monitoring and evaluation	• Conduct area-based, gender and pro-poor focused diagnostic studies • Develop plans, finance & institutional needs • Plan and design FS treatment options	• Establish revenue streams • Refine and implement local service plans • Establish M&E of service standards	• Introduce plans to enhance treatment capacity and re-use arrangements • Strengthen M&E of treatment and re-use arrangements against service standards
	Promotion	• Stimulate customer demand/ WTP for FSM	• Disseminate public FSM services information	• Stimulate market demand for re-use of FS
	Capacity and technical assistance (TA)	• Identify capacity gaps and required TA • Promote private sector emptying services • Implement measures for safer disposal of FS currently dumped in the environment	• Promote/support development of improved, emptiable containment facilities • Strengthen role of service providers • Pilot scheduled desludging/ transfer stations	• Consolidate/expand services based on outcome of pilot studies • Build/rehabilitate FS processing plants and develop business models for re-use of FS
	Financing	• Identify the extent of financing required to address service improvements to the poorest	• Introduce specific pro-poor financial arrangements (such as targeted subsidies)	• Identify opportunities for financial flows generated from the sale of FS end products
Users	**Planning**	• Consult communities, identify needs & wants	• Gain user feedback on improved services	• Gain user opinions on re-use options
	Tenant sanitation	• Engage with / consult landlords and tenants on constraints to FSM services	• Develop assistance and enforcement packages for landlords	• Focus on enforcement of service quality for landlords

2.8 Tool 5: Intervention Options Assessment

The previous section outlined how actions relating to the enabling environment are identified, while this section outlines the process for assessing technical intervention options.

The starting point in identifying technical intervention options is the fecal waste flow diagram for the area under consideration. Taking the diagram, the focus should be around the *ineffectively managed* portions of fecal waste flows. The significant problems need to be identified for each system type shown in the diagram (e.g. flush to a sewer, on-site containment that is not emptied), to build up a table that 'maps' system types against stages of the service chain. Informed by expertise on good sanitation and fecal sludge management practices appropriate for the target city, potential technical solutions can be proposed for the various stages. As a technical solution is identified at a given stage in the service chain, it is essential to consider the implications for the other stages of the chain and identify the associated interventions required.

Table 4 shows an example of Intervention Options Assessment, based on proposed solutions for slum areas of Dhaka. In the interests of space, it shows only one or two interventions through the service chain for each system type and is focused on FSM services. The same table can and should be applied to other aspects of urban sanitation, including sewered options, as explained in the Tools and Guidelines. This example highlights how technical interventions will be most varied at the stages of containment, emptying and conveyance, while treatment, disposal and end-use options are likely to coalesce into similar interventions.

Table 4 Intervention options for different system types: FSM in Dhaka slums

System type • **Key problems** (only one example per system given here)	**Potential solutions** (one or two options for each system type shown here)					
	Containment	**Emptying**	**Conveyance**	**Treatment**	**Disposal**	**End-use**
On-site containment: emptiable • Limited use of emptying services – high rate of FS discharge to drains	Improve the design and construction of septic tanks (STs) and pits, with standards followed to maximize retention of FS.	Improve range of responsive & affordable emptying options and services	Identify, pilot and develop innovative transport solutions (mechanized or human powered), offering affordable and responsive services Introduce transfer stations for small-vehicle operators – linked to larger collection services to take FS to treatment sites	Introduce a range of decentralized treatment facilities and/or FS handling station at wastewater treatment plants	Modify existing sites and manage new FS disposal sites – to minimize risk to public and environ-mental health	Explore financially viable options for FS end-use
On-site containment: non-emptiable • poor containment infrastructure	Modify existing STs/pits, to convert to being emptiable and also providing effective containment	Extend emptying services to additional sanitation facilities				
No containment • direct discharge to environment	Invest in new household-level containment options, where acceptable to users	Identify innovative servicing of household containment options that have no outlet				

Once technical options have been proposed, it is essential to consider the 'institutional' elements within the broader enabling environment that show up as priority areas for action in the CSDA scorecard and in light of the Prognosis for Change. These elements must be addressed if technical interventions are to provide effective and sustainable services. This process is structured around a Service Delivery Action Framework, discussed in the previous section.

Important links

- *Poor-Inclusive Urban Sanitation: An Overview*, WSP, 2013

2.9 Other tools, including those developed by partners

2.9.1 FSM costing tool

USAID have supported the development of a FSM costing and financing tool, which has been adapted for and is being field tested in Indonesia. This comprehensive tool has been developed by MWH, a global consulting firm, and has potential for adaptation for use in other countries. The tool estimates the number of staff, number of trucks, capital cost and on-going operation and maintenance costs for a complete FSM system including scheduled (regular) collection, treatment, management and community engagement. The tool calculates an appropriate monthly tariff to cover all these costs, based on local capital and recurrent unit cost data, and presents relevant financial data in a variety of formats and reports. Other functionalities of the tool include:

- Evaluation of distances and times required for collection of septage;
- Comparisons between different FSM service delivery models (private sector and government) and septage treatment options;
- Modeling of capital and recurrent financing from government and non-government loans, grants and revenue in addition to funding obtained from customers of the service.

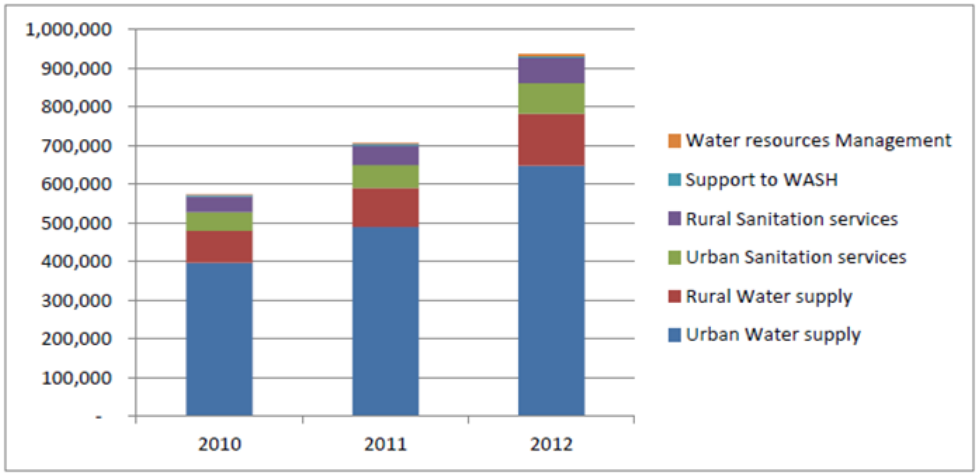
It is not widely available yet, and still requires further testing and development. It would in any case need to be adapted for application in any specific country or city, or for 'on request' FSM services.

2.9.2 TrackFin

The TrackFin (Tracking Financing) Initiative of UN-Water GLAAS provides a methodology to track financial flows into and throughout the WASH sector. A guidance document has been developed to help users prepare WASH Accounts for their country. Tracking finance in this way enables a comprehensive understanding of what funding is available for different purposes and where it is coming from. TrackFin is designed for the national and sub-national level. This focus means that it is less directly relevant for the project level, which is the main concern of this study, although these analysis can provide useful background for these analysis. However, it has been applied to sanitation finance tracking in several countries (including in Brazil, Morocco and Ghana), and has the potential to be used for tracking funds to urban sanitation nationally and sub-nationally, which could be of use to those using the other tools in this study. The guidance document is available on the WHO website.

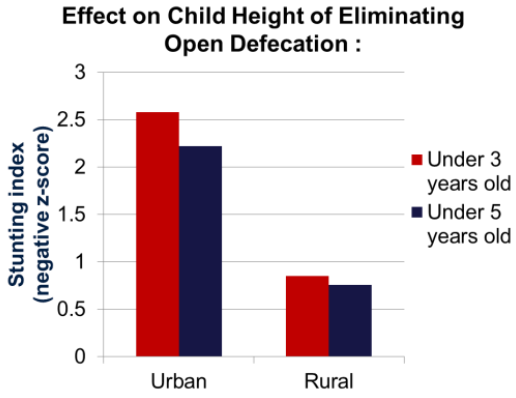
Figure 11 below shows TrackFin results for WASH financing in Ghana over 2010-12, which shows spending for urban sanitation (Trémolet, n.d.). The study's authors were mainly intending to develop a proof of concept for the methodology, so did not sub-divide spending by type of services or along the sanitation chain. However, this is technically possible using the TrackFin methodology and could be carried out by studies using it in the future.

Figure 11 TrackFin results for Ghana by subsector in millions of Ghana Cedis



2.9.3 Public Health Risk Assessment Tools

Figure 12 Relationship between open defecation and stunting



Source: Spears, D (2013) - DHS data from 130 countries

The principal rationale for improving sanitation is to improve public health. Statistical analysis (see Figure 12) shows that stunting, which aggregates many of the effects of poor sanitation, is closely correlated with levels of open defecation, and this correlation increases in densely populated urban areas. Many other studies show that improving sanitation reduces diarrheal disease, although a precise causative relationship is hard to determine.

Public health risk has two major components: hazard (the levels of fecal contamination along various pathways from feces to mouth) and exposure (the frequency and extent of contact with each contamination pathway). Hazard may be estimated from measurements of fecal pollution in the environment, or by taking the SFD a stage further by consideration of microbiological decay along the various pathways. Exposure is much more difficult to estimate, but may involve individual and group surveys, observation, key informant interviews, GPS mapping, etc. Various initiatives are in progress to address these complexities and may eventually be developed to a stage where they can help to pinpoint priority public health risks in specific areas of the city, which can then be targeted with specific interventions. The most advanced tool in development is SaniPATH, developed by Emory University in the USA. SaniPATH guides the user through a comprehensive environmental microbiological sampling and analysis process, and links this with behavioral observations and discussions.[9] The tool is not yet ready for routine use and is being further developed to make it both easier to apply and more reliable. The University of North Carolina in the USA is developing an analysis of the return of fecal pollution to the environment, which focuses more on hazard than risk (= hazard x exposure) since exposure is hard to measure. This initiative is at an early stage, so it is not yet clear in which direction it might develop.[10] University College London (UCL) in the UK was involved in the SPLASH program, of which one

[9] See http://sanipath.org/
[10] See http://waterinstitute.unc.edu/publication/unsafe-return-human-excreta-environment-literature-review/ for a literature review on the subject

sub-project further developed community-based risk assessment tools which are more subjective, but incorporated exposure issues through working directly with the target populations.[11] The World Bank Global Water Practice is in contact with all of the above-mentioned groups. It may be realistic to hope for easily usable tools or viable heuristics within the next 2-3 years. At present, the priority is to support such developments and get the various ideas field-tested.

2.9.4 Fecal Sludge Technical Tools

In low and middle-income countries, regulations relating to fecal sludge often do not exist, or if they do, are not enforced. This makes defining performance goals for fecal sludge management challenging. Most sanitation infrastructure projects are designed to overly-stringent performance goals, but end up not performing as intended and therefore 'failing'. While over-designing wastes money and resources, under-designing does not provide adequate protection of human and environmental health. Technologies designed to enable and optimize *resource recovery* opportunities can be used as a way to define more appropriate performance goals, including increased financial flows to offset costs in the sanitation service chain.[12] The technologies can also provide an incentive for efficient and effective collection and transport arrangements, as well as the operation of optimized treatment plants, functioning on the basis of meeting a market demand.

SANDEC at EAWAG is currently developing a series of tools to support an integrated approach to designing fecal sludge treatment.[13] The tools will be based on field experience in fecal sludge management and address five core areas and objectives:

- Market Driven Approach: to aid selection of treated end-products with the greatest potential for market volume and growth;
- Evaluate collection and transport service delivery and the siting of treatment plants;
- Optimized treatment technologies for resource recovery: to optimize existing treatment technologies for increased volumetric capacity or reduced footprint of the treatment plant;
- Fecal sludge quantification and characterization: to reasonably estimate the characteristics and quantities of fecal sludge on a city-wide scale, or an appropriate scale to suit the intended treatment plant; and
- Laboratory methods: to prepare reliable and replicable standard methods for laboratory analysis of fecal sludge.

Publications supporting development of the tools can be found on the SANDEC website at www.sandec.ch/fsm_tools, following the link to Excreta and Wastewater Management. In support of this SANDEC has published *Fecal Sludge Management: Systems Approach for Implementation and Operation*, which is the first book dedicated to fecal sludge management. It compiles the current state of knowledge of this rapidly evolving field and presents an integrated approach that includes technology, management and planning. It addresses the planning and organization of the entire fecal sludge management service chain, from the collection and transport of sludge and treatment options, to the final end use or disposal of treated sludge.

In addition to providing fundamentals and an overview of technologies, the book goes into details of operational, institutional and financial aspects, and provides guidance on how to plan a city-level fecal sludge management project with the involvement of all the stakeholders.

[11] See http://splash-era.net/outputs.php and the outputs listed under the CLASS-A drop-down option
[12] Noting that the most appropriate technology is dependent upon the characteristics of the waste, costs associated with the technology and the potential scale of the re-use market
[13] Department of Sanitation in Developing Countries (Sandec) of the Swiss Federal Aquatic Research Institute (EAWAG)

The FSM book (Strande et al (eds.), 2014) can be downloaded free of charge from Fecal Sludge Management: Systems Approach for Implementation and Operation

2.9.5 Urban Sanitation Status Index

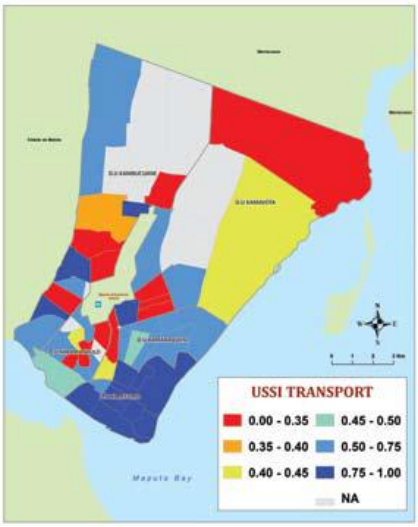
The Urban Sanitation Status Index (USSI), developed by <>>>, is a tool based on the sanitation service chain that visualizes the sanitation status at the neighborhood level, which is usually the lowest administrative unit within a city. It is based on 15 qualitative indicators assessed via household surveys and key informant interviews. The USSI uses similar data (but in larger quantity, allowing spatial disaggregation) to those required to develop an SFD, but also includes very basic data on solid waste and drainage, which are important complementary aspects of sanitation in its narrower sense of excreta management.

The 15 qualitative base indicators are aggregated into 9 numerical indicators and then into 4 components (see Table 5 below), grouped according to stages the sanitation service chain: (i) containment; (ii) emptying and conveyance; (iii) treatment and disposal; and (iv) complementary services (solid waste and drainage). The indicators can be mapped by neighborhood to give a sense of where the service chain is failing most severely (see Figure 13). They can also be aggregated into the overall USSI using the analytic hierarchy process, whereby sanitation experts familiar with the area under study provide relative rankings of pairs of the numerical variables, which are aggregated and used to generate a weighted geometric mean of all the variables.

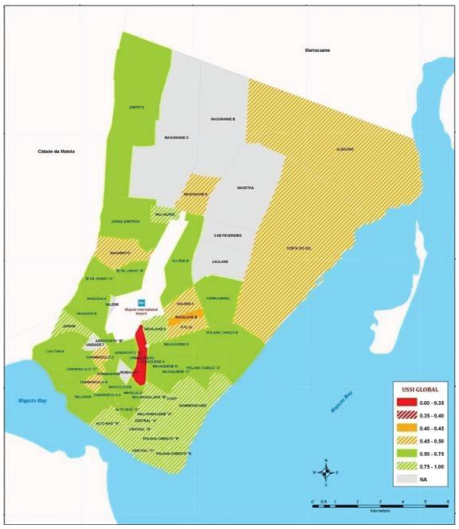
Table 5 Components and indicators in the USSI

Component	Indicator	Information capture
Containment	Access to toilet	Household
	Structural safety	Household
	Hygienic condition	Household
Emptying and Conveyance	Access to emptying services	Household
	Transport safety	Neighborhood/KII/FGD
Treatment and Disposal	Level of treatment	Household
	Final disposal	Household
Complementary Services	Solid waste management	Household + Neighborhood/KII/FGD
	Storm & greywater management	Household + Neighborhood/KII/FGD

Figure 13 Examples of USSI output maps from Maputo, Mozambique



Emptying and Conveyance



Overall Urban Sanitation Status Index

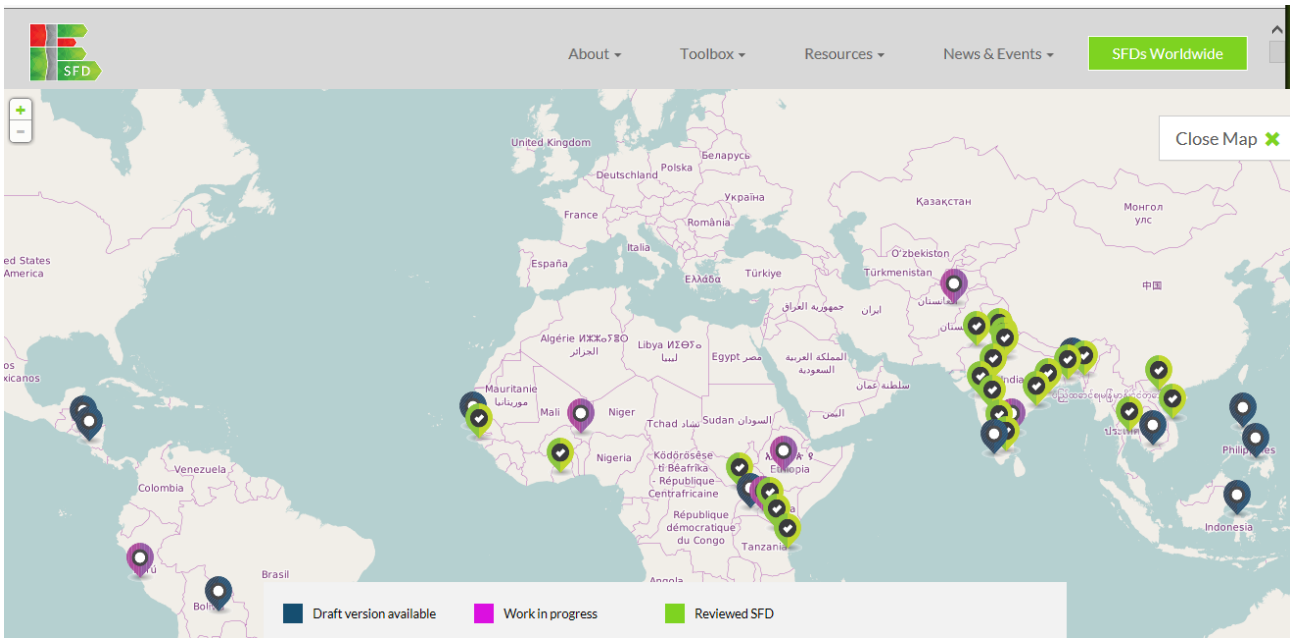
2.9.6 SFD promotion initiative

Based on the Fecal Waste Flow Diagram (SFD) developed by the World Bank/WSP, a number of institutions active in excreta management convened in June 2014 to further develop it. In addition, the CSDA tool was adapted to enable a short-form of reporting on key elements of the enabling environment. This joint initiative is managed under the umbrella of the Sustainable Sanitation Alliance (SuSanA) and has been funded by BMGF since September 2014.[14]

BMGF's first grant kick-started a process of developing tools and mechanisms for the easy production of standardized SFDs, backed by a description of information sources and the enabling environment in the city concerned. The approach is being tested in cities across Africa, Asia and Latin America and the results disseminated via the SuSanA website (see Figure 14). The aim is to promote better understanding of excreta management by demonstrating the power of the SFD to summarize and present what happens to excreta in cities. The SFD is recognized as an advocacy and decision-support tool, which has the potential to shift the focus of attention, money and activities towards more effective and inclusive urban sanitation and more efficient investments. In a second phase, the initiative is being extended further to support the creation and use of SFDs as widely as possible.

Existing SFDs, e-tools and guidance about how to develop new ones are available online from the website.

Figure 14 SFD SuSanA Website (see http://sfd.susana.org/)



[14] The consortium consists of the Global Sector Program on Sustainable Sanitation of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ GmbH) commissioned by the German Federal Ministry for Economic Development and Cooperation (BMZ); the water@leeds research group of the University of Leeds (UoL); the Water, Engineering and Development Centre (WEDC) of Loughborough University, the Department of Water and Sanitation in Developing Countries (SANDEC) at the Swiss Federal Institute of Aquatic Science and Technology (EAWAG); the Centre for Science and Environment in Delhi (CSE) and the World Bank Water and Sanitation Program (WSP).

2.10 When to apply the tools

At the inception of this study, the tools were at different stages of development. This study has developed the tools and guidelines through case studies, to make them more useful in practice. In most cities, the case study was linked to a World Bank investment project.

The tools can be used as a package, and were designed to be complementary. However, depending on the city context and especially if substantial prior work has been undertaken relating to FSM services, they can be applied individually to address particular issues. In the absence of relevant prior evidence-based FSM work, the strongest analysis will be gained from applying all of them together, as shown in Figure 4.

For stakeholders who already know the city FSM context well, use of the tools is unlikely to provide a large amount of new information. Rather, the benefit of using them will be in bringing information together under a clear analytical framework, and providing a basis for bringing all stakeholders (particularly those who may not be so well-informed) to a common understanding. This facilitates the case for intervention (if required) through a collaborative and participatory process. Section 4.2 below explains how each tool is relevant at different stages of the project cycle. For example, if the city is already at the project planning stage, then it may be too late for new diagnosis of what is needed.

It may therefore not always be necessary to collect new data. In the Balikpapan case study, as detailed in the next Section, the team worked largely from existing data being collected under another initiative. Likewise, some diagnosis was not felt to be necessary in that city, even for the purposes of stakeholder cohesion, because a strong shared diagnostic and understanding already existed.

3 Case Study Overview and Methodology

3.1 Rationale and objectives of case studies

The aim of the case studies was to test existing and new tools in real-world settings using primary data, so as to inform their development and refine both them and their application. The immediate objectives of the five city case studies were to provide:

- Quantitative and qualitative data on the sanitation situation in the city from a socio-economic perspective, specifically as it relates to FSM, but in a city wide sanitation context.
- Data that is representative of the city as a whole but also provides a separate picture of the situation in low-income areas (linked to a World Bank investment project wherever possible).
- Initial recommendations to guide discussions around future interventions in the sanitation sector in the city, by contributing credible data and analysis.

The study was therefore primarily socio-economic rather than technical, and most primary data collection (e.g. surveys, focus groups) was carried out by non-technical enumerators. It did not carry out technical inspections of infrastructure (beyond observations of the latrine superstructure, slab, etc.) or produce detailed maps with neighborhood-level analysis and recommendations.[15] For those who have worked in the city on sanitation for some time, there were not many surprises. However, the primary data allowed them to tell a story about FSM with stronger evidence than just experience and intuition.

This chapter will first explain the case study methodology, including data collection instruments and sampling. Next, key headline data for each city are shown, followed two-page summaries of each case study, which introduce the key service delivery challenges and summarize main findings and intervention options for each city.

3.2 Case study methodology

An important aspect of the study's research framework (research questions and data collection instruments) was to consider FSM in the context of the sanitation service chain, so as to maximize its relevance and effectiveness. The research design was adapted in slightly different ways to each city, but the broad overview is shown in the table below. For further information on the methodology for each city, refer to the specific city case studies.

The rationale for selecting particular data collection instruments and the associated sample sizes is set out in the Tools and Guidelines. Sampling was designed so as to allow conclusions to be drawn about the city-wide situation as well as the specific context of low-income areas or slums.

[15] This is, however, an output of the USSI tool, developed in other work carried out at the same time under a different program, and a recommended component of the suite of tools considered by this study.

Table 6 Summary table of data collection instruments

	Instrument	Data source	n per city
Quantitative	1. Household survey	Survey of households (i) across the city, (ii) in slums / informal settlements	720
	2. Observation of service provider practices	Observation of containment, collection, transport/disposal and treatment/disposal	5
	3. Testing fecal sludge characteristics	Samples from (i) pits/tanks during emptying, (ii) truck/vessel outflow, (iii) final drying bed or outflow	5
	4. Transect walk	Observation of environmental and public health risks through transect walk Drinking water supply samples, tested for fecal contamination and chlorine residual Drain water samples, tested for fecal contamination	40 60 60
Qualitative	5. Key informant interviews	(a) Government (e.g. council / utility, ministries) (b) Service providers along the sanitation chain (c) Other key FSM agencies	As required
	6. Focus group discussions	FGDs with slum, low-income and informal communities	10

3.3 Overview of city-specific data

Case study cities were selected so as to be spread across the principal regions of the developing global South, and to provide a variety of contexts in terms of city size and stage of sanitation development. Further criteria for case study city selection were to work with ongoing investment projects financed by the World Bank, and a mix of regional and capital cities.

Table 7 below shows that the five cities span four continents and range from a population of 350,000 to 10 million. In terms of sanitation, the percentage of the population with a sewer connection ranges from 0% to 92%. This gave a breadth of contexts in which to develop and test the tools, to make them as broadly applicable as possible. Detailed findings can be found in the full case studies. In the table, cities are ordered by the proportion of people using a sewer connection, from highest to lowest.

Population data is approximate from the latest available data, and in most cases refers to the geographical area under the jurisdiction of the municipality (e.g. Dhaka “mega-city” has a population closer to ~14,000,000 compared to population of ~7,000,000 living within the municipal jurisdiction). Data on the sanitation chains present in the cities comes primarily from household surveys carried out under this study, or from secondary data if surveys were not conducted. Full details and references are given in the city reports.

Table 7 Headline data for each city

City	Population		Containment and conveyance (the three columns total 100%)			Whole sanitation chain
	Approximate population	Approximate annual growth rate	% using sewer connection	% using non-networked sanitation	% using a toilet which discharges directly into the environment, or practicing open defecation	% of excreta identified as safely managed
Lima, Peru	10,000,000	2%	92%	7%	1%	46%
Santa Cruz, Bolivia	1,900,000	4%	47%	47%	6%	31%
Dhaka, Bangladesh	7,000,000[16]	3%	25%	54%	21%	0.3%
Balikpapan, Indonesia	650,000	4%	2%	89%	9%	33%
Hawassa, Ethiopia	350,000	4%	0%	100%	0%	74%

Source: Case Studies

3.4 Lima, Peru

Overview and key FSM service delivery challenges

Lima is the capital city of Peru. It is the third largest city in Latin America, with a population of almost 10 million distributed across 49 districts, the majority of which are entirely urban. Rural-urban migration has been one of the main drivers of population growth, with around 60% of Lima's citizens coming from other regions of the country. Lack of long-term planning has resulted in many settlements in peri-urban areas having limited or inadequate access to basic public services, e.g. electricity, water and sewerage. According to the 2013 National Household Survey (ENAHO), around 92% of Lima's population has a sewer connection, but this is the case for only 43% of the population in the lowest quintile. The sewerage system is far from perfect, but is broadly functional. However, FSM services do not really exist in the low-income areas.

Lima's main service delivery challenge is addressing the current and future FSM needs of the 1.2 million people in peri-urban areas of Lima who do not have a sewer connection. Amongst households in the lowest quintile, 12% practice open defecation, while 17% rely on septic tanks and 19% use lined/unlined pit latrines. Analysis of demand and supply for FSM services finds that there is basically no demand or supply of services to empty these pits and tanks. The most common practice among poor peri-urban households is to dig a new pit once the one in use fills up, although there is an increasing usage of urine-diverting technologies that are being provided by NGOs (e.g. X-Runner and PEBAL).

Study findings

The fecal waste flow diagrams for Lima were already presented in section 2.4.

[16] This is the population within the jurisdiction of the two municipalities; Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC)

Analysis of demand and supply for FSM services finds that there is basically no demand and no supply for the urban poor in Lima. That is not surprising in the context of the SFD above, and particularly the household survey finding that only 4% of households in non-sewered areas who had a toilet with a pit or septic tank had it emptied when full. Households in non-sewered areas generally cover and abandon their pit once it fills up, digging a new one nearby. However, there have been several reports (both in the media and also in the focus group discussions) about people running out of space in their plots to dig new pits, which may be encouraging the demand for FSM services. Nonetheless, current prices remain too high and unaffordable for the majority of households in poor non-sewered areas. On the supply side, there are currently no large-scale FSM services for poor households, with private service providers mainly serving only public facilities (e.g. hospitals, schools) or households in wealthy areas of Lima. Given the lack of knowledge about the potential market for FSM services as well as the low willingness of households in poor peri-urban areas to pay, private service providers have had little incentive so far to offer services in these areas.

Findings from the transect walks show that there are very few instances where blackwater was visible in irrigation channels. Although open defecation (OD) is not a major problem in Lima, OD was reported in 10% of the non-sewered areas sampled, mainly practiced by a few children or elderly people. FS was also reported to be dumped alongside solid waste – focus group discussions revealed that this was primarily carried out by households whose pit had filled up and were unable to dig a new pit, or by people who use a chamber pot (as opposed to a toilet) at night. The main issue in the majority of locations was the accumulation of solid waste on a daily basis. Overall, the combination of instances likely to introduce risks to public health occurred in a total of 17 locations in non-sewered areas and 3 locations within lowest-income areas.

The City Service Delivery Assessment for FSM shows that public policy is deficient, while there is a severe shortage of capital investment and operational oversight of FSM services throughout Lima. Although for the city as a whole, the lack of FSM services may not seem to be a priority (given the high level of sewerage coverage), there are 1.2 million people in poor areas without a real and sustainable solution to their daily sanitation needs. Sustainable solutions will only come about when an FSM framework translates into clearly defined, capacitated and financed action. This requires recognition of the scale of the problem, and dialogue and engagement with public, private and civil society bodies to ensure appropriate infrastructure and services can be systematically developed and adapted to respond to the various contextual challenges of the city. Segmentation and lack of coordination is already a key constraint in the provision of basic services, so bringing all key stakeholders together and aiming at reaching a consensus on a course of action, and a clear definition of stakeholders' roles is an imperative.

Next steps for the city

Recommended intervention options from the study are grouped according to the key stages of the sanitation service chain (focusing on the lowest-income non-sewered areas of Lima). Extending the sewer network will be part of the picture, but a large proportion of the more than 1 million people currently unconnected will remain so into the medium-term. Much of the focus is on the containment stage, given the precarious structure of the pits and toilets. To improve the likelihood of safe emptying, interventions include promoting the use of a wider range of affordable pit-lining and construction arrangements for pits and septic tanks, including twin compartment -pit or other permanent options. These options should be incorporated into a broader sanitation marketing strategy. To the extent this results in demand for emptying services increasing over time, it will be important to promote the use of a wider range of emptying and transport options (manual and mechanized), strengthen the capacity of the private sector to provide affordable services and build

decentralized treatment sites, such as drying beds, at locations to incentivize effective disposal, treatment and viable market-based options for end-use of fecal sludge.

Finally, the Prognosis for Change shows that current incentives discourage actions by both public and private stakeholders. On one hand, responsibilities and mandates for FSM (e.g. of municipalities vis-à-vis utilities) at both national and local levels have not been clearly designated, and thus neither effective planning nor adequate financing for FSM are likely, as no stakeholder can be held accountable for investments and results. Most interventions also concentrate on sewerage infrastructure or toilets, rather than behavior change or aspects of FSM service delivery. Evidence from key informant interviews (KIIs) also suggests that, although there seems to be no political opposition to the development of FSM services, neither is there significant political will or political incentives to carry this forward. On the other hand, without a clear demand (current and future) for FSM services, private service providers are unwilling to develop a market that may be unprofitable. Moreover, households may be reluctant to invest in upgrading their containment facilities, partly because many regard sewerage as the only long-term option, but also because the lack of land tenure and ownership generally discourages investment. Change is achievable, but interventions will not be successful unless these interventions address the incentives which deliver the current *status quo*.

3.5 Dhaka, Bangladesh

Overview and key FSM service delivery challenges

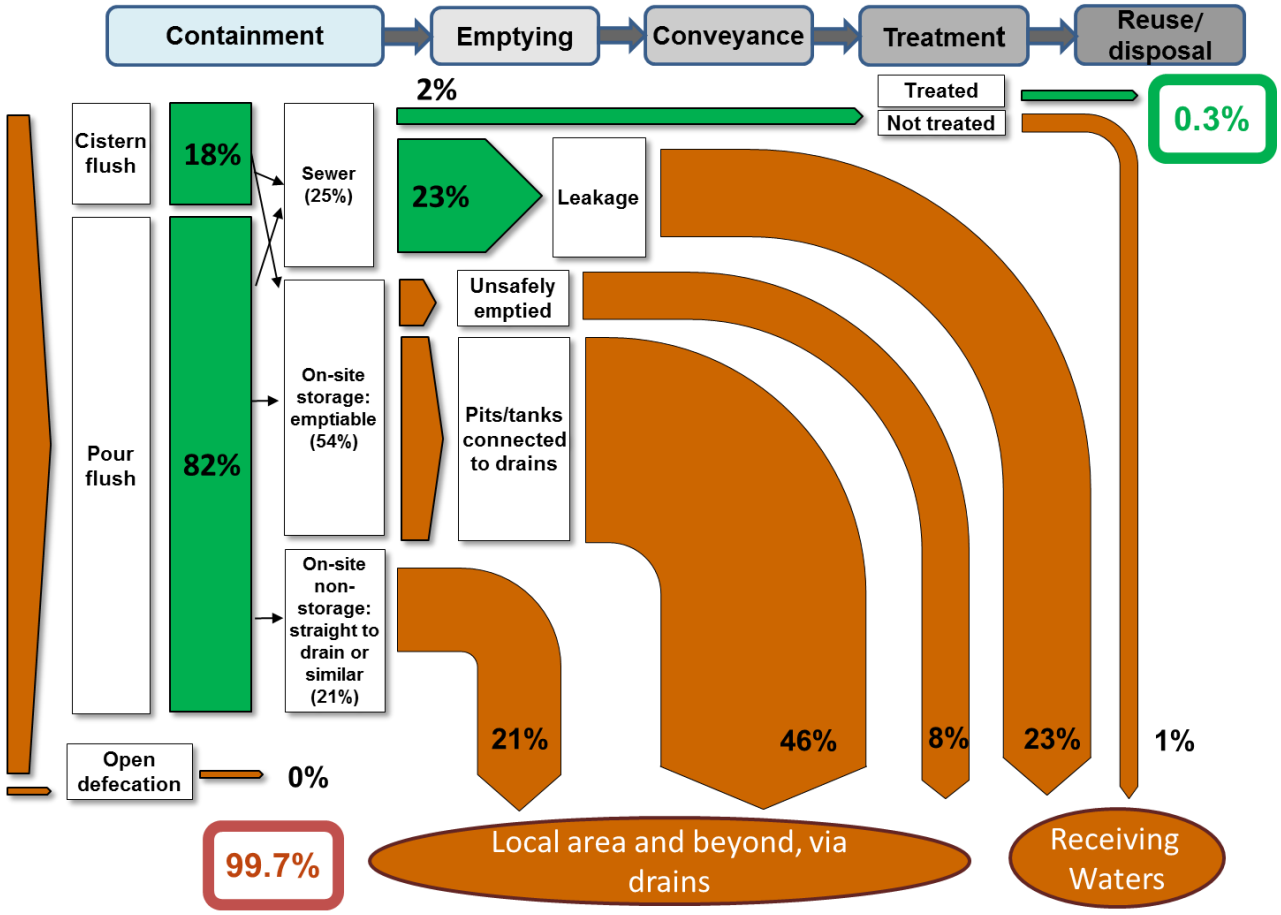
Dhaka, the capital city of Bangladesh, is one the fastest growing cities in the world. Depending on the definition of its boundaries, between 7 to 14 million people live in Dhaka. As well as population expansion, an associated trend is the vertical expansion of the city, which is seeing low-rise houses making way for multi-story apartment blocks, which in turn have made way for high-rise buildings.

Dhaka's key service delivery challenge is that expansion of the sewerage network has not kept up with population growth, and instead the drainage network runs as a sewer. Furthermore, the sewer network that exists is ineffective due to leakage and non-functional pumping stations. Those without sewer connections (around 75% of the population) use on-site sanitation, but a large proportion of these people either connect their pits/tanks to the drainage system, or do not have any intermediate containment at all. This results in the near absence of a mechanical emptying market in Dhaka. Manual sweepers play a key role in some areas, but overall effective demand for FSM services is still relatively small. This is due to the city's reliance on the drainage system running as a sewer.

Study findings

The fecal waste flow diagram for Dhaka is shown below. This is the city-wide version, while a second diagram in the full Case Study shows the situation for slums in particular.

Figure 15 Fecal Waste Flow Diagram for Dhaka – city-wide sample



The data in the table above paints a picture of almost all FS ending up in the drains or in the environment one way or another. It is therefore not surprising given the high levels of poverty in the city, that a functioning market for FSM services barely exists.

Analysis of demand and supply for FSM services finds that demand is very low and supply is weak. That is not surprising in the context of the SFD above, and particularly the household survey finding that only 13% of households city-wide who had a toilet with a pit or septic tank had ever experienced it filling up. On the supply side, there are very few mechanical emptiers in operation. The bulk of service provision, when demanded, is carried out by manual emptiers. Of those households who had emptied a pit tank city-wide, 97% had used a manual emptier last time. This is also reflected in reported intentions next time the pit or tank filled up.

Findings from the transect walks emphasize that all of Dhaka is affected by poor FSM – it is not only a problem for slum-dwellers. Latrines empty into drains throughout the city, and drains run through all areas – slums and non-slums. Having large amounts of FS in the drains and environment is an externality which affects everyone in Dhaka. Therefore, poor FSM is not only a private household matter – it is a public health and environmental hazard.

The City Service Delivery Assessment for FSM shows that there is a severe shortage of public policy, capital investment and operational oversight of FSM services throughout Dhaka. This allows the current unsafe practice of latrines emptying into drains to continue. This in turn eliminates the need for much of the effort and financial cost required to achieve effective construction, management and maintenance of appropriate infrastructure. A viable solution will only come about when an FSM framework translates into clearly defined, capacitated and financed actions to establish a fully-functioning service chain for all of Dhaka's fecal waste flows. This

requires recognition of the scale of the problem, and engagement with public, private and civil society bodies to facilitate the systematic development and adaptation of appropriate infrastructure and services to respond to the various challenges of the city (crowding, tenancy, flooding, poverty, etc.).

All of this suggests that improving fecal sludge management practices in Dhaka will demand significant reform of the regulatory systems that currently govern all stages of the service chain. Clearly segregating the roles for regulation, licensing and service management may improve the incentives for overall compliance and investment.

Next steps for the city

Recommended intervention options from the study are identified, grouped according to the key stages of the sanitation service chain. With the vast majority of Dhaka's population relying on on-site sanitation systems that eventually or directly discharge into the extensive drainage network, a priority must be to introduce correctly built *containment* that stops excreta getting into the local environment and enables systematic and safe emptying services to function. Systematic and progressive steps to introduce improved containment infrastructure will need to be accompanied by measures to disconnect latrine outlets from drains, as alternative 'outlets' are introduced, such as local, decentralized sewerage arrangements or FSM services. All newly-constructed buildings should be prohibited from discharging fecal matter to drains.

The elimination of the practice of manual sweepers entering pits and tanks is a high priority, and might be achieved by gradually improving their operations through the provision of a range of affordable mechanical, or improved manual, *emptying* devices and services that can respond quickly to demand, especially for shared sanitation facilities and for the urban poor. Licensing, service agreements and contracts can help service providers to invest in improved equipment and business operations, supported by better regulation to achieve service standards. Formalized and operational *conveyance, treatment and end-use* stages of the fecal sludge service chain need to be identified and eventually put in place. This should focus on enabling fecal sludge to be safely received, treated and managed at designated fecal sludge treatment facilities, linked to the increased demand from upstream arrangements. This process will take time to roll out, requiring good planning and oversight as identified areas of the city transfer from to non-networked to networked sanitation services. Effective business and financial models supporting viability of both public and private service providers will be needed for each stage.

The prognosis for change surmises that the externalities of poor FSM are both public and dispersed, whereas addressing the lack of proper containment would involve private costs (from households and property developers). A credible threat of enforcement, which would raise the cost of inaction on the part of these stakeholders, is therefore critical. Proper containment will require that existing emptiable facilities (pits/tanks) are disconnected from drains, that existing non-emptiable systems are upgraded, and that newly-constructed buildings have an appropriate containment system. Change is achievable on this front, but interventions will not be successful unless they address the incentives and lack of enforcement of regulations which deliver the current outcome, which is the drains running as sewers.

3.6 Hawassa, Ethiopia

Overview and key FSM service delivery challenges

Hawassa, the capital of the Southern Nations Nationalities and Peoples Region (SNNPR), is one of Ethiopia's newly emerging cities, with a population in 2015 of approximately 350,000 and an

annual growth rate of just over 4%. It is located on the shores of Lake Hawassa in the Great Rift Valley, which is a source of pride and responsibility which underlies the city administration's goal of achieving clean and green development.

The city consists of three main settlement types, with different population densities. Well-defined residential housing and new industrial areas are of low density with well-planned road access, while old government and compound housing plots (*kebele houses)* within the city center are of medium to high density. Many *kebele houses* are planned to be replaced with multi-story dwellings (condominium housing). The newly expanding informal peri-urban areas inhabited by the poor have high density semi-permanent housing where they are within the city boundary, while those further out are currently more rural in nature.

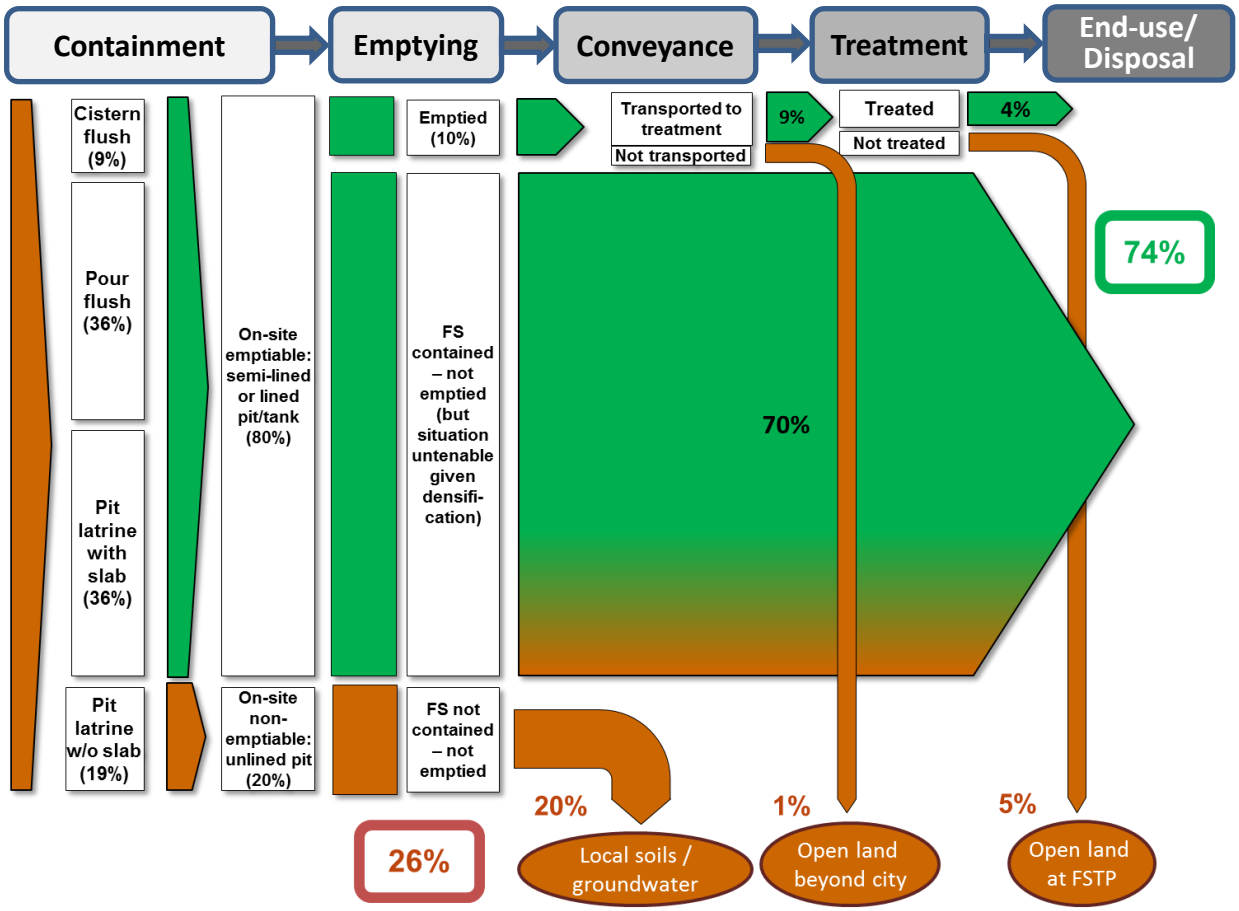
The main challenge facing current and future sanitation service provision in Hawassa is the rapid urbanization of the city. All households currently use on-site sanitation options, with little visible evidence within the city that this is a problem. Wastewater and fecal sludge is managed by privately and publicly operated vacuum trucks, with the liquid fraction leaching from septic tanks and pits into the volcanic, fractured and highly permeable soil below. Many operate this way for many years without the need to be emptied. The densification of the city center and growing peri-urban fringe, accompanied by shifting settlement patterns and increased generation of wastewater and fecal sludge, will result in increasing saturation of soils and higher levels of groundwater contamination. This may increase public health risks, and, perhaps more significantly, may lead to environmental contamination of Lake Hawassa and other water bodies in and around the city.

Study findings

The SFD that follows shows that, while there is effective access to some form of on-site sanitation facilities throughout the city (resulting in no open defecation being reported through the household survey, backed by limited evidence through other data collection tools), not all fecal waste is being effectively managed through the later stages of the FSM service chain. The mixed green and brown shading for facilities reported as not being emptied indicates an anticipated change in the overall risk from these fecal waste flows over time. The situation will reach 'crisis point' when there is insufficient subsoil absorption capacity for the total liquid effluent load being generated. As buildings are built in more central and planned areas of the city at above say 3 stories high, there will be a need for sewerage systems to service those buildings. Other more informal and outlying areas of the city are likely to maintain the existing pattern of low-quality sanitation systems, while septic tanks will become more common in the intermediate areas.

The transect walks indicated little visible evidence of environmental contamination resulting from poor fecal sludge management services, with the most notable source of contamination being dumped solid waste. As indicated in the fecal waste flow diagram, this does not mean that environmental pollution is not occurring – but rather that it is not above ground. What the transect walks also identified is the extent to which the low-income areas are becoming increasingly densely populated, with the resulting shortage of land creating the need for alternatives to the current practice of abandoning and rebuilding latrines when pits become full.

Figure 16 Fecal Waste Flow Diagram for Hawassa – city-wide sample



The City Service Delivery Assessment shows that, in general, Hawassa's FSM service context is considered to be making progress in relation to the three major components of the assessment: enabling, developing and sustaining services. However, greater attention has been given to providing and promoting toilet facilities, and to some extent the provision of emptying services. Weaknesses were identified in relation to the existing treatment facility and the effective disposal of dried fecal sludge, or actions to develop options for fecal sludge end-use applications. The current extent of 'treatment and disposal' of fecal sludge in-situ (the 70% shown on the SFD, where containment relies on local soils to continually absorb leachate from pits and tanks) may be satisfactory for now, but as areas of the city become more densely populated and soil infiltration capacity is surpassed, increased risks of localized surface ponding of effluent and pit collapse are anticipated. Residents of low-income areas also voiced concerns that the decreasing space to build new pits when current ones become full make this practice increasingly difficult to sustain.

All of this suggests that, without greater attention given to investing in the future needs of the city, risks to public health will increase, particularly in the expanding low-income areas, where concerted efforts will be needed to address issues of inequity and inferior service outcomes. To improve FSM services in Hawassa as a whole, greater attention needs to be given to investment in a range of services that will be appropriate, affordable, available and adapted to the needs of all users.

Next steps for the city

Recommended intervention options to improve the delivery of FSM services are driven by the need to address urban growth and the resulting densification of settlements throughout the city. It is recommended that Hawassa Municipality address both improvement and enforcement of

construction standards for the range of containment facilities, especially for government-owned and compound (*kebele*) housing and low-income areas. They should also investigate and identify the extent to which sewerage must be eventually implemented in high-density areas and where on-site facilities constitute a clear risk to polluting Lake Hawassa. Where non-networked systems are to remain, a greater variety of smaller-scale fecal sludge emptying options need to be investigated (e.g. Gulper pumps, VacuTugs) for low-income areas. Steps need to be taken now to identify and plan for the future land requirements of more conveniently sited treatment plants that can incorporate market-based end-use options of treated sludge, considering co-located wastewater treatment, fecal sludge treatment and solid waste management disposal. In parallel, the appropriate division of roles for public and private service providers, notably in relation to the operation of vacuum tankers and fecal sludge treatment facilities, needs to be more clearly defined, within an environment of more strongly regulated and enforced service tariffs and performance standards.

3.7 Santa Cruz, Bolivia

Overview and key FSM service delivery challenge

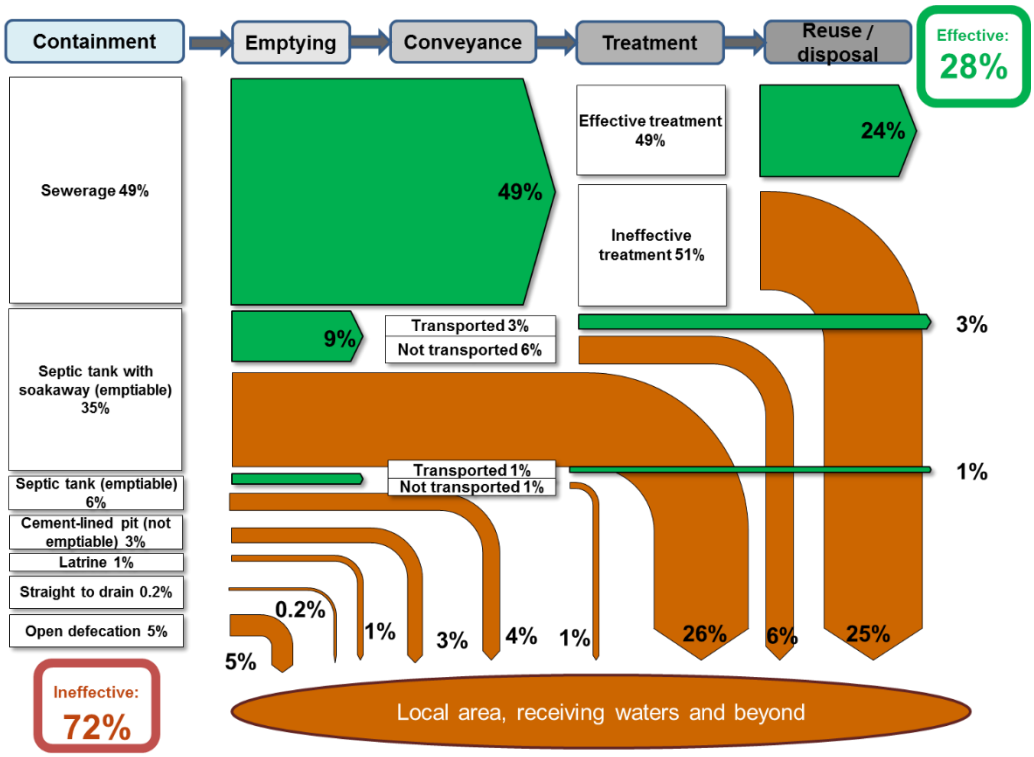
Santa Cruz Metropolitan Area is the second largest urban area in Bolivia, encompassing six municipalities and around 1.9 million inhabitants. Santa Cruz has faced high rural-urban migration since the 1980s, with annual growth averaging around 5% in the late 1990s and 4% from 2001 to 2012 (Caceres Magnus, 2015; Rivera, 2010). As with other Latin American countries, urbanisation has not been coupled with equitable access to basic services and sanitation coverage remains a challenge, with only 61% of the urban population having access to an improved sanitation facility. The 2012 Census data for Santa Cruz indicated 47% of the population connected to sewerage, with 21% and 26% of facilities emptying into a septic tank or a lined pit respectively. 6% of households had no reported sanitation facility, i.e. practising open defecation.

Although the Santa Cruz FSM services context is relatively developed, several challenges remain. In particular, although the policy and regulatory framework is comprehensive for emptying, conveyance and treatment stages, standards and guidelines for containment and reuse are limited. Resources to ensure the enforcement of regulations are also lacking and FSM services remain unaffordable for the very poor.

Study findings

The SFD below shows that the majority of excreta (69%) are not effectively managed. While 47% of households have a sewer connection, about 23% of wastewater does not reach the treatment plant due to leakage and a further 1% is not effectively treated. In addition, only 9% of fecal sludge (FS) contained in emptiable systems reaches a treatment facility and is adequately managed. Facilities emptying FS straight to drains together with open defecation practices account for around 6% of total FS produced by households, while all single-use pits (covered and abandoned when full) and around 33% of septic tanks and lined pits allow FS to leach into the surrounding environment.

Figure 17 Fecal Waste Flow Diagram for Santa Cruz – city-wide sample



An analysis of the demand and supply for FSM services suggests that around 79% of households using non-networked facilities discharging into a septic tank or a soakaway use emptying services. Access for emptying is not a major issue, with 83% of emptiable facilities having a purpose-built hatch. Fill-up rates and therefore demand, are highly variable; while some septic tanks (~20%) need desludging every 6 months and 36% of soakaways between 7-12 months, on average facilities take around 2.5 years to fill-up. Willingness to pay for emptying services among households in non-sewered areas is generally below the average cost for an FS emptying and transport service (US$68). Other concerns relate to service reliability and quality, especially regarding how hygienic the service is. Around 27 of the emptying and transport service providers (ERTLs) are legally registered (i.e. operate in the formal market) to the Water Supply and Basic Sanitation Supervision and Societal Oversight Authority (AAPS). ERTLs are generally subcontracted by one of the ten WSS utilities/cooperatives (EPSAs) in Santa Cruz, allowing them to use the EPSAs' treatment facilities for discharge. However, only SAGUAPAC, the main WSS cooperative, has adequate wastewater treatment facilities, which currently has contracts with 14 of the 27 ERTLs. Estimates indicate that around 24,000 m^3 of FS are illegally dumped every year.

The City Service Delivery Assessment shows that Santa Cruz is currently addressing the enabling, developing and sustaining environments for FSM services. Policy and regulatory frameworks have been significantly developed since 2009, but roles and responsibilities of municipal and national institutions remain unclear, hindering the adoption and enforcement of regulations. There are no known processes for coordinating FSM investments, with all resources currently directed towards the expansion of the sewerage network and the construction of new wastewater treatment plants.

Oligopolistic competition between ERTLs limits access to FSM services for the poorest households, making the market inequitable. Nonetheless, FS emptying, transport and treatment services are generally good, though there are still improvements to be made with regards to the availability of treatment facilities for collected FS and guaranteeing that ERTLs comply with all administrative and technical standards. Considering the sustainability of FSM services, so far no policies and procedures have been developed to stimulate demand for emptying services, although

performance of current service outcomes is good, with some improvements to be made on minimising health risks for personnel during emptying and maximising equity.

Next steps for the city

A Prognosis for Change analysis reveals that the roles and responsibilities across stakeholders at national, departmental and municipal governments are not clear, resulting in limited engagement on the design and implementation of FSM policies. Responsibilities for FSM services have been delegated to AAPS (given its role as the main regulatory agency), the EPSAs and the ERTLs. Although at the micro level, the FSM market seems to be performing relatively well, lack of government involvement at the macro level has affected the availability and allocation of financial and human resources to develop FSM services. Some investments are being made to increase capacity for wastewater treatment, but there is no explicit focus in FS treatment and its subsequent reuse. Besides up-take from national and departmental authorities, consumers (i.e. households, commercial establishments and industry) also need to play a more active role by taking interest in environmental concerns (such as quality of containment infrastructure, or ensuring FS is taken to a treatment facility) and in ensuring that only formal ERTLs services are used.

Within this context, future city interventions are likely to focus on ensuring that recent policy and regulatory frameworks are adequately implemented and enforced. The current processes for the formalisation of ERTLs, although much needed, seem to be quite cumbersome for certain smaller firms. Enforcement of administrative and technical standards is also required to guarantee FSM services are of the highest quality, customers are satisfied, and demand is sustained in the medium to long-term. Competition among ERTLs needs to be encouraged to increase access to the poor, but this needs to be coupled with dissemination and enforcement of standards for the construction and maintenance of on-site facilities. Focus in the FSM sector should also be directed towards developing a FS reuse market, coupled with improvements in FS treatment capacity, and on securing financial and human resources from both public and private stakeholders.

3.8 Balikpapan, Indonesia

Overview and key FSM service delivery challenge

Balikpapan city, located in the province of East Kalimantan, Indonesia has a reported population of approximately 640,000 people and annual population growth of about 4.5% (approximately 1.5% due to natural growth and 3% due to immigration). According to the latest health census, 99.5% of households in Balikpapan own their own home, while only 0.5% rent their property.

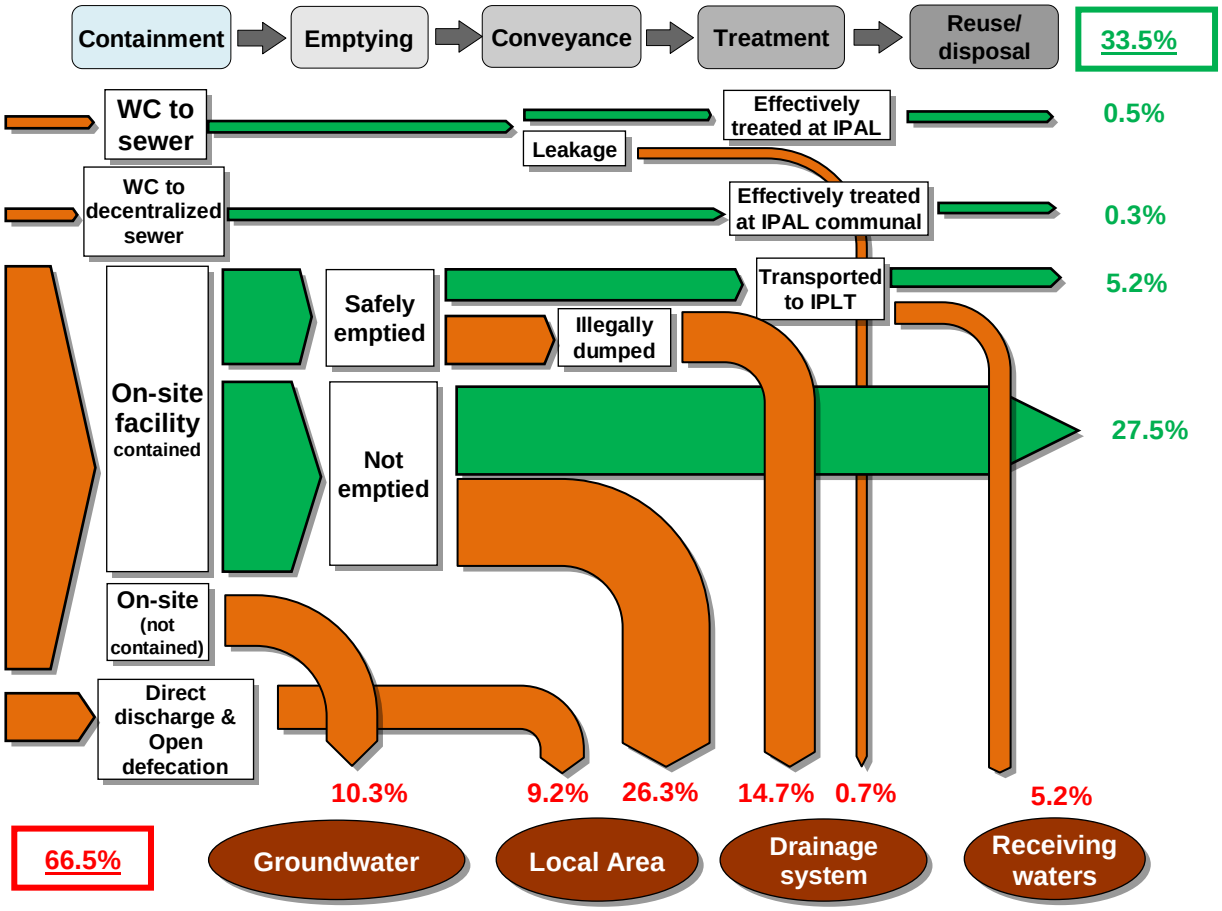
A key challenge facing the development of Balikpapan's sanitation and FSM services is the lack of clarity around institutional roles and responsibilities, particularly in relation to the provision and regulation of emptying and transportation services. The DKPP (Agency of Cleanliness, Housing and Parks – the institution currently undertaking the role of managing any FSM activity in Balikpapan) manages the septage treatment plant. However it plays no direct role in the emptying and transportation elements of FSM services, though these services do exist and are supplied by various private sector entities. DKPP focuses on solid waste management, constructing roads and drainage. It is unclear who, if anyone supervises and issues permits for the construction of on-site containment (tanks and pits), exacerbated by a lack of standards, guidelines and norms.

Study findings

The fecal waste flow diagram for Balikpapan below shows that, while almost 90% of households have access to non-networked sanitation facilities (predominantly pour-flush latrines emptying to

tanks), service arrangements for managing fecal sludge beyond these tanks are limited. Almost 60% of on-site facilities are reported to have never been emptied, limiting demand for the emptying services, provided by private providers. Some of the 'non-emptied' systems are no threat to the environment or public health but a proportion are in areas of high ground water where the groundwater is used for domestic purposes. Where households do have fecal waste removed, it is often indiscriminately dumped, resulting in very little of the fecal sludge generated actually being taken to the septage treatment plant.

Figure 18 Fecal Waste Flow Diagram for Balikpapan – city-wide



Analysis of demand and supply for FSM services highlights that, while private providers of emptying services are available, the demand for these services is limited. Results of a willingness to pay survey identified that the majority of households are prepared to pay for a monthly desludging service, at a price commensurate with the fees currently charged for emptying – if this is assumed to occur approximately every 5 years. The current low demand for emptying is however exacerbated by a combination of the poor quality of onsite infrastructure and the lack of regulation to enforce regular emptying. Households predominantly rely on non-compliant standards of containment facilities, where pour-flush latrines discharge to a single or double compartment "*cubluk*" (rather than a septic tank). Only partially lined, the *cubluk* effectively operates as a soak-pit. Other containment facilities have overflows that allow fecal sludge to discharge into drains or open water bodies. Both conditions significantly impact on the required demand of scope and frequency of emptying.

The City Service Delivery Assessment of Balikpapan highlights priority areas for action to establish and implement city-wide plans to improve FSM services, together with associated budgets. It is important that private sector providers of emptying services are incentivized to both stimulate and meet demand for affordable FSM services, as well as to correctly use the disposal site in a way that is economical. This must be accompanied by attention given to improving technical standards

and arrangements for on-site facilities, with consideration for a range of emptying services that can reach into poor areas and provide affordable services. Without this, demand for emptying services will continue to be constrained.

Next steps for the city

Presentation of the Fecal Waste Flow diagram to city officials in Balikpapan resulted in an immediate acceptance of the problems facing FSM services. This lead to a constructive discussion on "*How do we solve this?*" and "*Who should be responsible for doing what?*". A Sanitation Working Group has been established and a City Sanitation Strategy (CSS) developed that lays out targets and identifies required sanitation development activities. This in turn has enabled the new Head of Bappeda (the City Planning Agency) and the city Mayor to identify and propose new institutional arrangements to enhance FSM services and effective treatment of septage from on-site sanitation systems at the treatment facilities. Policy, regulatory and legislative arrangements to support these changes will need to be developed. Budget allocations, poorly coordinated in the past, will need to be oriented in line with the new institutional arrangements as they are translated into law and responsibilities for asset ownership transferred.

The local House of Representatives has been formulating a sanitation law, with regulation focusing on issues of tariffs and off-site sewerage services. It has been identified that the development of a new city sanitation master plan should include regulation around non-networked services and private sector emptying, to ensure these issues are included in future legislation. While new institutional arrangements and plans for FSM services, as part of the sanitation master plan, are starting to be addressed, consideration will need to be given to the costings (investment and recovery) for a range of service levels and intervention options, to support implementation. Bappeda have indicated plans to invest in more private sector-operated desludging trucks and construction of a new septage treatment plant. Use of emptying services by households is currently constrained by cost, location and access (to the property and into the tank itself), especially for the urban poor. Those who use desludging services report being satisfied with them, but the sanitation master plan must also identify how these services will expand to meet future demand, to ensure safe transfer of fecal sludge to effectively managed treatment facilities.

4 Experiences and lessons from case studies in applying the tools

4.1 Introduction

This section synthesizes the most significant experiences and lessons gained from deploying the Tools in the five cities. It aligns these experiences and lessons with the typical project cycle of a financing institution, such as a development bank. The accompanying Tools and Guidelines, explains in detail how the tools work, as well as providing guidance on how to use them, whilst the ToRs and Data Collection Instruments provide material to operationalize the tools.

4.2 Using tools within the project cycle

Figure 19 below summarizes a typical project cycle, whether of a development finance institution or a locally responsible agency such as a utility or municipality, and which tools would be appropriate at which stages. Specific factors in any given case, such as individual corporate procedures, prior work, limited time or budgets, and political economy factors, may mean that the process looks somewhat different in practice, but the underlying principles are still valid. The FSM tools are flexible with respect to when they are applied, and the level of detail used in data collection and analysis. The following discussion is based around five stages used to describe the project cycle.

1. Project Concept and Identification

This upstream work may be spread over one, two or more years, with the objective of bringing urban sanitation and fecal sludge management to the attention of decision-makers, and gaining traction for the development and implementation of a project to address them. Once a decision has been taken in principle, the project concept can be developed more fully by identifying the links in the sanitation service chain and geographical areas to be targeted.

This stage begins with diagnostic work, based on published data, results of key informant interviews, focus group discussions and field surveys. These methods are used to develop the SFD. The SFD demonstrates where the sanitation service chain is not functioning in the target city, and has been found to be an effective means of convincing decision-makers of the need for action. The USSI tool, based on the same data with a few additions, can show which geographical areas are contributing most to the overall sanitation problem. The CSDA tool is also applied at this stage, to provide an initial idea of institutional, legal and financial constraints and opportunities. The TrackFin tool, as used by WHO in the GLAAS water and sanitation sector assessments is designed for use at national level, but may also be useful at this stage to supplement financial aspects of the CSDA, providing a broader picture.

Typically, this stage ends with a project description or concept used to obtain funding from an international development partner or a national or local funding window.

2. Project Planning and Preparation

Data obtained in the previous stage can be used in the development of specific investment and institutional development components of the proposed project, and in feasibility assessment. In addition, the Prognosis for Change / Political Economy Analysis (PFC/PEA) tool will help to identify and address key non-technical bottlenecks (institutional, legal/regulatory, financial, etc.), as well as the interests and values that prevent decision-makers from acknowledging and responding to issues related with non-networked sanitation. For larger projects or more complex situations, it may be necessary to produce a city-wide sanitation strategy, Master Plan, or Integrated Urban

Water Management Plan, if not already prepared during the Project Concept and Identification stage, of which the FSM project or intervention would address specific parts.

Other useful tools developed by other partners are the FSM costing tool, which can help estimate the economic benefits of planned interventions, and a public health risk analysis which would focus and further prioritize health-related project components.

Figure 19 Typical project cycle



1. Project Identification	2. Planning & Preparation	3. Intervention Design	4. Project Monitoring	5. Evaluation & Learning
▪ Fecal Waste Flow Diagram (SFD) ▪ *Urban Sanitation Status Index (USSI)* ▪ Initial City Service Delivery Assessment (CSDA)	▪ SFD/USSI data ▪ City Service Delivery Assessment (CSDA) ▪ Prognosis for Change/Political Economy Analysis (PFC/PEA) ▪ *FSM costing tool* ▪ *Public health risk analysis*	▪ Intervention Options Assessment ▪ Service Delivery Action Framework ▪ *SANDEC Book on FSM* ▪ *SANDEC online resources*		▪ Fecal Waste Flow Diagram (SFD) ▪ *Urban Sanitation Status Index (USSI)* ▪ City Service Delivery Assessment (CSDA)

Tool developed under this work *Tool developed by others*

3. Design of Interventions

This stage moves from the project components outlined and costed in the project description to their detailed design. This comprises technical/infrastructure elements and institutional development programs, including both responsible authorities and service providers if these are different. At this stage, it is also useful to identify early interventions that can achieve short term impact, as a means to generate political dividends for local decision-makers (and development partners, if involved) and gain further traction for the project.

The Intervention Options Assessment tool or process helps to match technology choices to the specific challenges diagnosed at the inception stage, drawing on technical expertise and up to date reference material. Choices must be validated with the relevant stakeholders (responsible authorities, service providers, users, etc.) and more detailed technical and social fieldwork will probably be needed to enable the choice of suitable final designs. One of the more difficult tasks at this stage is to identify the quantification and characterization of fecal sludge and an assessment of the end-use market, to enable optimal choice and design of treatment facilities. While tools to identify these results remain in development, achieving meaningful parameters on which to design optimal treatment and end-use stages of the service chain remains a significant challenge.

The Service Delivery Action Framework builds on the results of the CSDA and PFC/PEA. It is designed to indicate the next steps in building up sustainable service delivery arrangements, starting from the current situation. These steps are then translated into technical assistance and other supplementary inputs to be provided under the project.

A key external resource for this stage is the material produced by EAWAG/SANDEC, which lays out clearly in one place much of the technical knowledge around sanitation and fecal sludge management technologies.[17]

4. Project Implementation

The tools developed and used in this work are focused on diagnostics and project design, so are not intended to add substantially to the project implementation stage.

5. Project Closure, Evaluation and Learning

The fact that a need has been expressed for the tools laid out in this work clearly indicates the need for systematic learning, both to refine the tools and develop implementation methods. From a more general perspective, it may be useful to re-run the basic diagnostic tools (SFD, USSI and CSDA) to assess progress made under the project, and how sustainable it is.

[17] See for example: http://www.eawag.ch/en/department/sandec/publications/publications-excreta-and-wastewater-management/

4.3 General lessons learned in using the tools

Many of the lessons learned in the process of developing and applying the tools are applicable to them all. This section summarizes those lessons, then later sections go into more detail on specific tools.

Table 8 Broad lessons applicable across the tools

Lesson	Explanation and example
Using the tools	
1. Stakeholder engagement in the process is key to building a common understanding	Involving stakeholders in the process of design and data collection is important to promote their ownership and understanding of the results and acceptance of the findings. In all cities the SFD was found to foster a common understanding and a more realistic overview of the current situation that key stakeholders "recognize" as representing their city. In Hawassa conversations around the range of possible intervention options to address the current complexities affecting low demand for emptying and ineffective treatment of fecal sludge were made much easier by everybody having common reference points.
2. Focus on what is important at the city level	The tools and associated data collection methods may require adapting, or supplementing, to accommodate issues which are key to informing action in the city concerned. In Balikpapan a technical survey of containment systems and a willingness to pay study were undertaken, as city stakeholders had identified those as specific areas of interest.
3. Explain the objectives and limitations of the tools	It is necessary to explain what can and cannot be achieved by using different tools from the outset. For example, Planners may expect recommendations for interventions in specific geographical areas. This was not possible from applying the SFD in the case study cities based on the sample survey design and resulting level of representativeness. It can be achieved however by applying the USSI tool, if more geographically localized decisions are needed.
4. Use the tools as part of an iterative process	The stakeholder engagement and participation process should be iterative, which requires a series of consultations and opportunity to comment as reports are prepared. The more engagement there is, the more likely it is that findings will be used (either implicitly or explicitly).

Data collection for quantitative instruments e.g. household survey, transect walks	
5. Good quality survey management and enumerators are needed	An SFD based on primary data requires a well-organized field operation to administer the household interviews. Enumerators need to be well trained and have access to a sanitation specialist, to ensure good understanding of the survey questions and how to interpret answers or unforeseen situations. Field managers need to fully understand the sampling methodology to ensure the results are robust and representative at the level of interest. Quality control should be continuous, and can usefully be done in real time if mobile-based technology is used (such as PDAs). In Dhaka, where an experienced firm had undertaken many similar surveys, the basics of fieldwork management were not an issue, allowing training time to focus on the technical details.
6. City experience of enumerators is valuable	Higher-quality data is likely if enumerators have pre-existing knowledge of the city – to check inconsistent responses (such as a household latrine "discharging to sewer" when sewers do not exist nearby). For example, in Hawassa, some enumerators who were from the city or had studied there, knew their way around and could ensure the training benefitted from local examples.
7. Do not underestimate the time for preparation and supervision	If key issues (e.g. in sampling, questionnaire design, fieldwork model) are addressed early on, higher-quality data is likely. This allows the survey firm to prepare well and the enumerator training to focus on the required details. As specified above, during implementation of the survey it is essential to have a sanitation specialist available *in situ* to resolve technical questions and to follow up on inconsistent or apparently erroneous data as soon as possible, while the survey team is still mobilized.
Data collection for qualitative instruments e.g. key informant interviews, focus groups	
8. Engage consultants with a breadth of knowledge and expertise	A consultant or other suitable expert with tacit knowledge of the city's administrative roles and functions, as well as the broader policy environment, is extremely valuable to achieving credible CSDA scorecard results and a rich political economy analysis. Working together with a consultant knowledgeable in technical aspects of sanitation and fecal sludge management services, this can provide a strong team to identify many of the more sensitive realities underlying the service delivery challenges. As the breadth of knowledge and expertise required is rarely found in a single individual, a team is recommended.
9. Tacit versus explicit knowledge and analysis - for open discussion	The CSDA and PFC/PEA often engage with issues that experienced (local or otherwise) professionals are familiar with, and they may not see the value in conducing more analysis. However, not all stakeholders with an interest or responsibility in the city's sanitation services will necessarily have the same level of knowledge or perspective. The CSDA and PFC/PEA provide an invaluable way to capture tacit knowledge, analyze and present it in a coherent form that can be discussed openly.

4.4 Specific lessons learned in using the tools

4.4.1 Fecal waste flow diagram

As summarized in Section 2.3, the objective of the fecal waste flow diagram, or SFD, is to represent where fecal waste goes, what proportion is effectively managed and where the unmanaged portion ends up. It provides a credible and compelling visual summary of how fecal waste (including fecal sludge and wastewater) flows along the sanitation service chain for a given population – specifically highlighting at which stages the fecal waste becomes ineffectively managed.

In Figure 4 (Section 2.3) the SFD is the trigging tool from which the other analyses flow, so in many ways it is the most critical of the diagnostic tools. Accordingly, SFDs were developed for all five city case studies and, where possible, separate SFDs were developed for:

- The city-wide situation, and
- The situation in low-income areas / slums.[18]

This approach was in line with the overall principle of analysis being both city-wide and poor-inclusive, as outlined in Section 2.1. The work therefore acknowledges that solutions serving the entire city are required, while also emphasizing that specific solutions for poor urban areas must be included in implementation plans. Primary data collection methods followed this principle, with two sub-samples used for the household survey. A detailed description of the methodology is provided in the Tools and Guidelines. If the USSI tool is used, the data collected will be granular enough to enable both city-wide and low-income area SFDs to be prepared.

Key experiences and lessons from **using the SFD in city-level discussions** were:

- **Visual summary of current status**: City authorities and stakeholders find that the SFD (and the USSI, where it has been used) gives a clear and strong visual summary of current sanitation status, including where along the service chain and to what extent problems are occurring (i.e. where fecal waste is not being effectively managed). For example, in Dhaka, the SFDs generated a discussion focused on non-networked sanitation rather than the more commonly discussed sewerage network. In Balikpapan, the high data credibility (from primary data collection, corroborated by a department of health census) resulted in an immediate acceptance of the SFD, so that within a very short time a constructive discussion on “How do we solve this?” and “Who should be responsible for doing what?” emerged.

- **Focus on low-income areas:** Producing a separate SFD for low-income areas reveals the extent to which poor services, in certain areas, can be ‘masked’ in aggregated city-wide results (as for wealth-quintile disaggregated results for service coverage more generally). For example, in Lima 90% of people city-wide are shown to be connected to a sewer, but when looking at low-income areas only, the SFD highlights that FSM services are almost totally non-existent. However, this approach may not work well in cities where rich and poor households live in a more intermingled way – for example in Indonesia or Ethiopia.

- **Put results in context:** The SFDs must be reviewed in conjunction with the supporting CSDA results and narrative, as well as the underlying data on the quality of sanitation facilities. This is important to understand both the current status of services and what

[18] The terms “slum”, “informal settlement” or “low-income area” are variously used in different cities depending on the national context.

interventions can realistically be made. In Dhaka for example, septic tanks do not function well due to impermeable soils and a high water table, resulting in dysfunctional leach pits and households often connecting septic tank outlets to covered or open stormwater drains. Construction of future septic tanks must therefore identify alternative arrangements for handling the effluent, such as connecting septic tank outlets to localized (simplified or shallow) sewers.

Key experiences and lessons from **data collection to produce SFDs** were:

- **Early discussion of sampling frame:** The sampling frame for sub-samples is the key determinant of what conclusions can be drawn. For example, in Lima it was agreed to exclude areas with more than 90% sewerage coverage (based on the last census), the major social and public health issues arise from the non-sewered areas. This had implications for what conclusions could be drawn, which were understood from the start. The data was useful for the specific purpose of this study, but would be of less use from a broader city-wide perspective.

4.4.2 City Service Delivery Assessment for FSM

The City Service Delivery Assessment (CSDA) for FSM is a tool designed to help diagnose the main impediments within the current enabling environment to support the development, expansion and sustainability of FSM services. The process uses a set of objective criteria and a standard scoring system to assess the quality of service delivery through all stages of the service chain. The resulting color-coded scorecard provides a clear visual overview of the quality of the *current* enabling environment.

As shown in the Tools diagram Figure 4 in Section 2.3, results of the CSDA are considered alongside the Prognosis for Change (discussed in Section 4.4.3) to inform aspects of program design affecting the institutions, systems and broader enabling environment for service improvement.

Key experiences and lessons from **using the CSDA in city-level discussions** were:

- **Represents the complexities of the enabling environment**: The CSDA scorecard for a city provides a clear, visual representation of the complexities of the enabling environment affecting the delivery of sanitation and FSM services. It helps to identify where contextual elements are stronger, and where attention most needs to be focused to tackle the identified weaknesses.

- **Initial draft CSDA presented for validation**: Presenting a draft CSDA for consideration during stakeholder validation meetings allows adjustments to be made to the scores, based on further data or evidence that is made available, and increases stakeholder ownership. A revised CSDA, mutually agreed on by city municipality and other stakeholders, provides a stronger basis for action.

- **A common basis for action**: Stakeholders may be familiar with some, or many of the issues the CSDA covers (e.g. legislation, financial constraints, role of the private sector). However it is unlikely that all stakeholders will have had a common basis on which to agree, discuss and identify potential strategies and actions. Such actions should address the full range of political, institutional, financial and equity challenges facing FSM service improvements, and the prospects for sustainability.

Key experiences and lessons from **data collection to produce CSDAs** were:

- **Value of the CSDA scorecard structure**: The CSDA scorecard itself, consisting of a suite of questions and scoring options, provides a structured means for consultants to gather evidence and use this to analyze the strengths and weaknesses of the enabling environment on a common basis. This helps to ensure all aspects are considered to the extent possible in any city, as a way to achieve consistency within and between resulting scorecards.

- **Background evidence captured**: The documented evidence behind the scores, in the form of the table with the narrative justification and a consultant report, is essential to enable others to see and understand why particular scores have been given.

Key experiences and lessons from **using the results of the CSDA within the study team** were**:**

- **Realistic, workable solutions**: The CSDA results have been used in conjunction with the PFC/PEA tool as a way to develop realistic and informed recommendations for the City Municipality and other responsible actors.

- **Critique and validate results internally before presenting**: A process of critique and validation of the CSDA scores within the project team has helped ensure they can be fully justified against results generated by the survey firm and other data available about the city. On occasion this has resulted in significant adjustments to the draft CSDA scorecard prior to a stakeholder validation meeting.

- **Setting lines of inquiry under the Prognosis for Change**: The CSDA is an important input to the analysis under the Prognosis for Change (PFC). It serves to identify key service delivery blockages which can be the focus of political economy analysis. This further analysis in turn seeks to identify and analyze ways in which vested interests or other factors impact on how decision-makers or communities view different sanitation approaches and interventions.

4.4.3 Prognosis for Change assessment (Political Economy Analysis)

Key experiences and lessons from **data collection to undertake a Prognosis for Change (PFC) assessment** were:

- **Politically savvy national WASH expert:** The most appropriate national WASH expert to use the tools of political economy analysis (PEA) may not have the same profile as a national WASH expert needed for work on technical sanitation solutions. Some unique individuals may cover both bases, but a high-quality PEA requires individuals who are politically savvy and have the required connections to get access to key individuals. It may be necessary that this comes at the expense of technical experience other areas.

- **Give consultants a very clear brief.** The tools of PEA (such as stakeholder analysis, process mapping etc.) are not in the armory of the typical WASH consultant. Guidance can be given (the Tools and Guidelines contains an annex on how to use PEA tools). It is also important to show consultants the kind of output that is required, and examples the kind of insights that would be needed to produce it. This will take time and energy. If using consultants for the CSDA, ideally the same consultant should be used for the PEA, because of the obvious synergies (see next point).

- **Link to a clear analytical process:** The links between the CSDA and the PFC assessment are strong, and stakeholder mapping is key for both. The PFC should build on the CSDA and, in particular, focus on priority areas in the CSDA which were highlighted as

weaknesses in service delivery. The Intervention Options Assessment should then take place under a robust understanding of the political economy of urban sanitation in the city, so as to avoid recommending hardware interventions which will fail.

Key experiences and lessons from **using the results of the PFC/PEA** were**:**

- **Illustrating complex problems:** Outputs of the PFC helped channel people's experience of problems into a coherent framework. In Dhaka, for example, the use of an intuitive "process map" to explain what happens (on paper and in reality) when a new building is constructed helped the team understand a key problem.

- **Sensitivities around 'obvious' interventions:** There may well be an urban sanitation intervention which many stakeholders see as the obvious choice, but which the PFC and other analyses suggest may not work. The opposite case is also possible (attractive intervention which many people say will never work). It is important that the communications around these topics are undertaken delicately, so as to avoid alienating key stakeholders. All recommendations that go against prevailing thinking must be strongly evidence-based.

The following decision-support tools were used by the study team, drawing on the findings from applying the above tools. This evidence is combined with the expertise and knowledge within the study team and drew on available knowledge and publications about the functional (technical) and institutional challenges and solutions to achieve effective sanitation and fecal sludge service delivery, such as resources published by SANDEC, WEDC and the World Bank WSP (refer to References / Bibliography). A more detailed explanation of each decision-support tool and how they are used can be found in the Tools and Guidelines.

4.4.4 Service Delivery Action Framework

The Service Delivery Action Framework responds to the complexity of the enabling environment for FSM and sanitation services, allowing actions to be prioritized in response to the current status.

Key experiences and lessons from **using the service delivery action framework** to identify appropriate interventions affecting the enabling environment of FSM services were:

- **Addresses the "what next?" resulting from CSDA and PFC findings**: This tool provides a mechanism both to avoid over-simplification of the CSDA scorecard, and to identify and propose a set of actions. By linking the CSDA with PFC results, the action framework can be proposed based on the experience of the study team and good practice, in collaboration with city stakeholders.

- **Building on what currently works**: Any actions proposed for the city must relate to the extent to which cities are already showing and achieving progress in the enabling environment. The action framework builds on this foundation to help drive results.

- **Helps city authorities identify where to prioritize and focus actions**: The tool helps first to prioritize the protection of public health, then to strengthen the foundations for this, and finally to achieve fully sustainable services (and downstream interventions) that ensure environmental protection. In this way, city authorities can see where they are achieving good results, but also where they need to give greater attention to the remaining priority issues.

4.4.5 Intervention Options Assessment

The Intervention Options Assessment is a structured way of representing potential interventions affecting the service chain, for each current or proposed service delivery option in the city. The report does not go into detail on FSM business models (e.g. the relative merits of regular desludging versus on-call services).

Key experiences and lessons from **using the Intervention Options Assessment** to identify technical interventions were:

- **Informed by the SFD (and USSI)**: This tool starts with the results of the fecal waste flow diagram (or SFD) and identifies a series of technical interventions in response to the key challenges that the SFD represents. This provides a strong evidence base from which to draw out prioritized actions, allowing a phased approach to be considered in response to the changing physical and institutional realities within the city.

- **Addresses connectivity between service chain functions**: The technical interventions recommended by the study team must be informed by good practice and experience. The recommendations must also ensure continuity of service through the stages of service chain, with changes made to any one of the stages reflected in appropriate interventions to other stages affected by these changes. For example, enforcing standards for effective containment of fecal sludge in septic tanks requires action to increase the availability of emptying services to households who improve their septic tanks, as well as expanded arrangements to dispose or treat fecal sludge safely. Addressing parts of the chain in isolation is not a viable option.

- **Highlights areas of greatest complexity**: Presenting technical interventions in the format of a matrix through the stages of the service chain provides a valuable way to identify where the range of interventions at each stage of service chain results in greater or less complexity. A variety of household containment options may be needed (to suit issues of poverty, access to households, sharing of facilities, groundwater and soil conditions, etc.), while perhaps only one or two different emptying and conveyance models may be relevant to the delivery of fecal sludge to a single new treatment facility – either directly or via local transfer stations.

4.5 Estimates of cost, time and resources needed for using the tools

4.5.1 Cost

Table 9 shows the costs of the studies carried out under this work, and three more (Maputo, Beira, Lusaka) where the same concepts were used in a “live” situation in support of sanitation interventions. The studies undertaken while developing the tools include a mix of several individual local and international consultants plus a firm, and were more complex than those that would be carried out routinely in an urban sanitation project environment (where the emphasis is typically on sewerage). The figures for Maputo and Beira reflect work undertaken in such a context, but are lower than they would otherwise be, as not all the tools were used (notably the CSDA, since its content was already well known to the local project teams). Overall management and the data analysis were carried out by World Bank staff, rather than contracted out, and were therefore not captured as costs. These three studies do however include the USSI, which was not produced for the five cities in this study.

Table 9 Cost of studies in a range of cities

City	Approx. cost (US$)	Remarks
Studies designed specifically for the development of the tools		
Dhaka, Bangladesh	45,000	Household survey, transect walks, FGDs, FS tests and observations (not key informant interviews, which were under a separate contract)
Hawassa, Ethiopia	80,000	As per Dhaka, but no FS tests or observations carried out
Lima, Peru	155,000	As per Dhaka, but with fewer FS tests and observations carried out
Santa Cruz, Bolivia	75,000	Added to another study with different terms of reference. Cost includes household survey, key informant interviews and FGDs (but not transect walks, FS tests or the observations):
Freetown, Sierra Leone	135,000	As per Dhaka. Contract awarded but dropped due to Ebola outbreak
Other studies with similar specifications, undertaken in a project context		
Balikpapan, Indonesia	35,000	Data used from a technical assistance study with different terms of reference
Maputo, Mozambique	55,000	Studies with similar scope, but with leadership and analysis in-house, so not directly comparable
Beira, Mozambique	45,000	

These highly variable costs reflect local prices and whether the local market can provide the resources, or if a mix of local and international firms and consultants are required. The best estimates are that the SFD, USSI and CSDA can be conducted in a sizable city for USD 30,000 - 60,000 depending on the macroeconomic environment of the country and competitiveness of the data collection market. Africa and Latin America are generally more expensive and Asia is generally less costly. The above costs only include delivery of clean datasets. They do not include data analysis and report-writing, which for this study was undertaken by the OPM / WEDC team, as well as individual national consultants.

4.5.2 Time

The data collection and survey work should take around two to four months once the team have been procured. This includes time for adaptation and pre-testing of survey tools, and close consultation with the clients. The time taken for analysis will depend partly on the format and quality of the data collected, but another two to three months including consultation with the clients should be adequate. In most case six months should be adequate for the data collection, analysis and consultation process, and in smaller cities or where this relevant prior work 3 to 4 months may be enough.

4.5.3 Consultant resources

The roles in the data collection fieldwork and analysis will depend on the nature and scale of the data and analysis needed. However, some of the principal team requirements (particularly for household surveys) are set out below, and others are noted in the generic terms of reference.

Field survey manager

There are many things which can go wrong in data collection, particular when collecting data with multiple teams. One small mistake anywhere in the chain from design, to data collection, to data entry and cleaning can drastically reduce the quality or usefulness of all the data.

Therefore, the Field Manager requires extensive experience in field-based data collection and management (e.g. pre-testing instruments, recruiting and training enumerators, implementing sampling protocols, coordinating multiple teams in the field, quality control etc.). They must have a keen attention to detail, as well as be able to motivate the team and make the training as fun as possible.

Experience and knowledge of sanitation is highly desirable, but comes as a secondary priority to data collection and management skills. If sanitation experience is not available, the extensive involvement of a local sanitation specialist in all aspects of preparation and training is required.

Effective management of the whole team by the field manager is essential. She or he must inspire or motivate them, as well as be checking up on them at every stage. In addition, close supervision of the Field Manager by their client is essential, to ensure that they are interpreting instructions or protocols as intended.

Sanitation specialist

Sanitation arrangements vary greatly between and also within countries. Local knowledge of typical arrangements is crucial, especially in design and training. If this experience is not there, then data collection instruments (e.g. response categories to questions) may be inappropriate for the local context and deliver misleading data. Even an excellent questionnaire may be misinterpreted if enumerators are poorly trained and a sanitation expert is not present.

A specific sanitation specialist is therefore required to support design and training. Their role could be small if the field manager is a sanitation specialist, but the field manager has a huge number of things on their plate so it is still important to have a separate sanitation specialist to input as required. It is the extent of their input which would change.

Data manager / programmer

This role is essential regardless of whether paper questionnaires or digital data entry (e.g. using smartphones) is used. Paper questionnaires must be double-entered into computers (to avoid mistakes). A large survey requires a team of data entry clerks who need to be closely managed. Once entered, the data must be cleaned and checked for inconsistencies and errors.

With smartphones, the data manager also has to turn the questionnaire into a smartphone program which is a specific skill. If done badly, this can be catastrophic. Whereas mistakes in paper questionnaire design or data entry can often be found and rectified, a mistake in smartphone program design (e.g. question skipping pattern) can introduce problems which are impossible to correct once the data has been collected. Furthermore, while using a smartphone avoids some data entry mistakes, these can still occur at the enumerator level, and data cleaning processes need to be set up to identify these.

This role is therefore crucial and the field manager will not have the time or head space to do this role themselves. The individual must have experience in doing this kind of role in several surveys of different types.

Enumerators

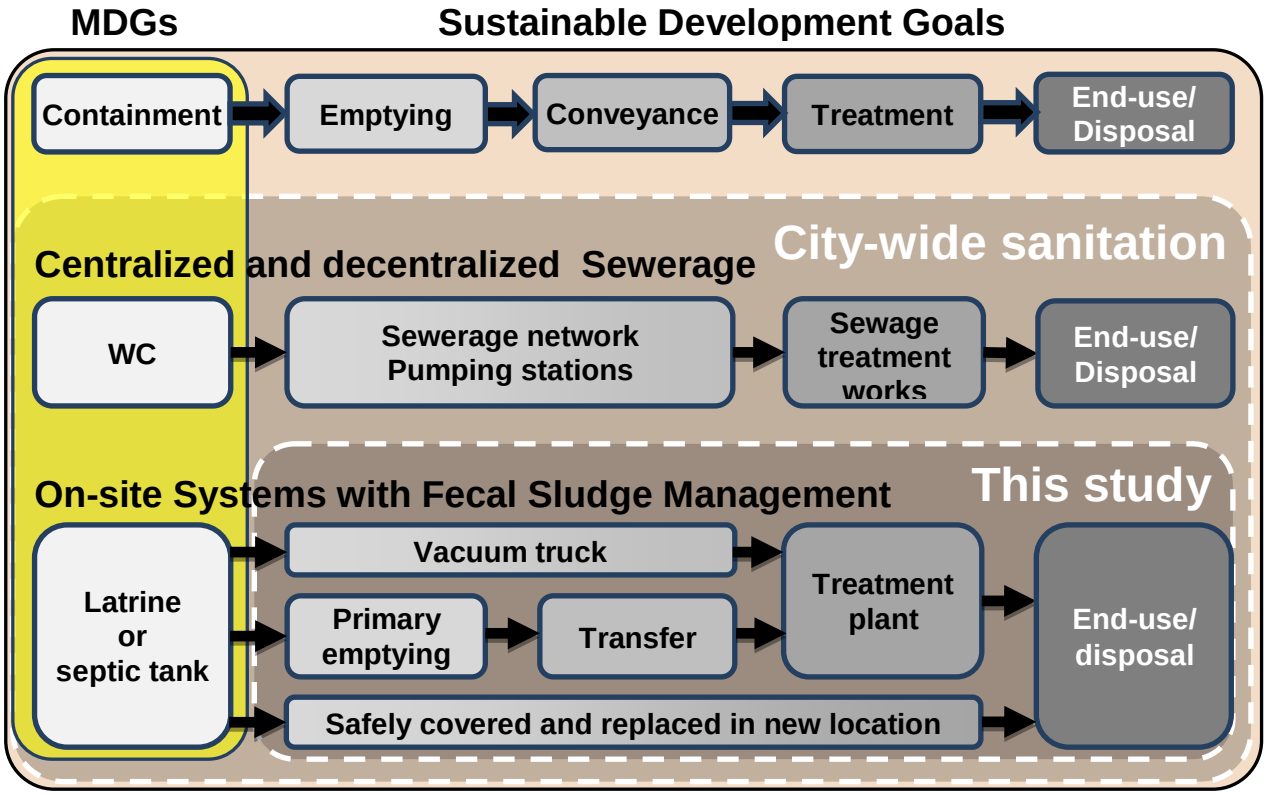
Enumerators are the front line of data collection, and the only people who will interact with respondents other than the quality control team. It is therefore crucial that they are sufficiently qualified and motivated to do the job. Many data collection efforts deliver poor quality data because the enumerators do not fully understand the questions and response categories and so do not know how to interpret the household's answer. It is also not uncommon for unmotivated enumerators to sit under a tree and make up the answers.

The best enumerators are usually (but do not have to be) young and enthusiastic. Recent graduates or even current students are an ideal choice, and are also affordable. They should ideally have a bachelor's degree, and using recent sociology graduates is common. Ideally they would not be sanitation specialists, because they may not concentrate in the training and bring pre-conceived biases.

5 Integrating FSM into the Urban Sanitation Agenda

The FSM tools developed in this study, and others being developed by partners, are specifically designed to support FSM development as one component of a city-wide urban sanitation program. This is because FSM is a significantly under-researched and undocumented aspect of urban sanitation. However, in a live situation, the objective will always be to improve all elements of urban sanitation including, but not restricted to, FSM. The diagram below shows the relative scope of this study and of urban sanitation in general.

Figure 20 Scope of FSM within City-Wide Sanitation



5.1 The FSM tools in the urban sanitation context

Looking in more detail at the tools, some are relevant to urban sanitation as a whole, and some to FSM only. The whole suite is set out in the Figure, and the table below shows which of the tools, as developed and applied in this study, focus on FSM, and which are relevant to urban sanitation overall.

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Table 10 Relevance of the tools used in this study to FSM only or City-wide Sanitation

Tool	FSM Only	City-wide Sanitation
1 Fecal Waste Flow Diagram (SFD)		✓
Urban Sanitation Status Index (USSI)		✓
2 City Service Delivery Assessment (CSDA)	✓	
3 Prognosis for Change/Political Economy Analysis		✓
Public Health Risk Assessment		✓
FSM costing tool	✓	
4 Service Delivery Action Framework	✓	
5 Intervention Options Assessment		✓
SANDEC technical material[19]	✓	

Many aspects of urban sanitation – such as the design of conventional sewer systems and sewage treatment – are well understood, documented and guidance is widely available. However, these are not necessarily linked to other components of real city-wide needs. There is therefore a need to supplement such widely available knowledge with emerging learning to address service provision in previously neglected areas. Tools developed under this study which will require further development to cover aspects of networked sanitation are:

- ***City Service Delivery Assessment:*** Development of a new set of questions that additionally address networked sanitation services;
- ***Service Delivery Action Framework:*** Development of a complimentary series of options corresponding to the development of sewerage in its various forms.

The tools highlighted in blue are those developed by other partners, and require no further development to cover networked sanitation, since the only FSM-specific ones already have widely used equivalents for networked sanitation. As noted above, there is little need for more technical material on conventional sewerage, although other lower-cost forms (condominial, small-bore, settled sewage, simplified sewerage, etc.) are still insufficiently documented.

5.2 Knowledge gaps on city-wide urban sanitation

Based on this study and previous related work, a number of key knowledge gaps and areas of weakness in city-wide sanitation have been identified and include:

a) Inclusive delivery of effective sanitation facilities to users

- Sanitation for low-cost rental accommodation – how to ensure landlords or others provide adequate sanitary facilities for tenants, and how to mitigate the effect this may have on increasing rents;
- Upgrading on-site facilities at scale to improve emptiability and user hygiene;
- Optimum modalities and timing for effective urban sanitation and hygiene promotional campaigns (including for example behavioral change on the appropriate use of sanitation facilities, by avoiding the disposal of solid waste into pits);
- Affordable sanitation technologies for challenging environments such as high water table and flood-prone areas, rocky ground, steep hillsides, settlements built over water, cold climates, etc.;

[19] SANDEC's "Compendium of Sanitation Systems and Technologies" 2nd edition addresses city wide sanitation technologies

- Ensuring that the institutions responsible for health centers, schools, etc. provide adequate sanitation for users.

b) Institutional issues

- Development of the community engagement capability of utilities (or other responsible authorities) to enable effective planning and community mobilization for both sewerage and non-networked sanitation;
- Understanding complementary roles and collaboration modalities for utilities, local government and the private sector in diverse governance environments;
- Financing of capital and operating costs, including subsidies where appropriate;
- Design of institutional incentives;
- Development of better political economy analysis tools.

c) Institutional aspects of fecal sludge management

- Developing viable business models for FSM, including considerations of scale, linkages with solid waste management services, on-demand vs. scheduled emptying, etc.;
- The elimination of manual emptying and introduction of improved methods and/or alternative sources of income for manual emptiers;
- Use of charging systems that promote fecal sludge discharge at approved sites;
- PPPs for production and marketing of end-use products derived from sludge.

d) Technical aspects of fecal sludge management

- The use of transfer stations or alternatives;
- Improved technologies for dealing with thick pit latrine sludge;
- Fecal sludge treatment plant design;
- Greywater management – specific arrangements where there is no sewerage.

e) Making sewerage available to poor households

- Increasing connections to existing and planned sewers and making sewerage systems work better for poor communities;
- Technical and institutional models for simplified, shallow, settled and condominial sewers;
- Pro-poor sewerage tariff design;
- Optimizing scale and centralization vs. decentralization;
- Management of potentially toxic industrial discharges (also relevant for non-networked systems).

f) Complementary services

- Systematic application of an integrated urban water management approach in sanitation intervention design, linking with drainage and solid waste management;
- How to keep solid waste out of latrine pits;
- Expanding the use of infiltration in urban drainage systems.

g) Regulation

- Regulation and licensing of FSM service providers;
- Design and enforcement of sanitation byelaws and building regulations, especially in informal settlements;
- Regulation of end-use products and sludge disposal.

The World Bank and other donors are well placed to advance global knowledge on a number of these issues, based on learning an analysis from its ‘at scale’ implementation experience in urban

sanitation. However some points would be more suitable for research institutions, universities, development agencies, foundations or non-government organizations to address to lead – often in collaboration or partnership with donor knowledge work.

6 Findings and Recommendations

These policy recommendations have been developed based on an analysis of the lessons emerging from the five FSM case study cities, with additional evidence from studies undertaken by team members in World Bank funded sanitation projects (Lusaka, Zambia and Accra, Ghana) and FSM technical assistance (Maputo and Beira, Mozambique and Tabanan, Indonesia)

6.1 The importance of FSM in national policy and legislation

FSM services are an essential component of urban sanitation: On-site sanitation systems are the norm for both rich and poor in cities and towns of developing countries. In Sub-Saharan Africa for example, only about 10% of the urban population are connected to sewers and 8% have no toilet at all (Morella et al, 2009 cited in Peal et al, 2014). In Vietnam, Indonesia and Philippines, sewerage access is even lower, and in Indonesia 14% of the urban population practice open defecation (WSP, 2015). While the vast majority of urban dwellers use on-site sanitation, more wealthy households are likely to have access to improved, private facilities (Hawkins et al, 2013). Almost all informal settlements and poor households are served by on-site sanitation (if they have any sanitation service at all). Such facilities are often shared between many families, and may be unsafe and unhygienic. A desk study of 12 cities carried out in 2012 showed that, on aggregate, only 22% of fecal waste from on-site sanitation was safely managed (WSP, 2013). The five cities in this study have ranges for safely managed fecal waste ranging from 0.3% (for Dhaka) to 74% (for Hawassa), as shown earlier in Table 7. It is clear that fecal sludge management remains a neglected but essential part of sanitation services for the majority of households in many cities, while any assessment of sanitation services needs to include a focus on how the poorest communities can best be served.

FSM services need to be included in national sanitation policies: Policies must consider the entire sanitation chain. FSM services must be addressed in both national sanitation policies and city-level sanitation plans, even where water and sanitation service functions are fully delegated to local government. Definitions in policy documents need to be clear and unambiguous, but are often confusing as they may be based on an assumption that sanitation is the same thing as sewerage. In some cases, bucket latrines are recognized in law and policy, but not FSM. In other cases pit latrines are outlawed despite being the form of sanitation used by most people. Many national sanitation policies focus on access to toilets (containment) and sewerage, without regard to what happens when on-site sanitation facilities require desludging. This was evident in Dhaka and Hawassa where the City Service Delivery Assessment (CSDA) showed policy is strongest, or only really effective, for the containment stage of the service chain.[20]

Even where the policy framework is stronger for FSM, it is often not yet effectively implemented. For example, in Balikpapan and Tabanan, Indonesia, the Local Government is expected to link any new local regulation with an over-arching national policy when formulating local FSM regulations. While National Government is promoting and funding FSM and support exists in principle, the national policy is not yet clear, formalized or reference-able. In Ethiopia, FSM is recognized within the OneWASH National Program and is to be incorporated into the upcoming Integrated Urban Sanitation and Hygiene Strategy. This will address components of sanitation provision through the service chain and institutional arrangements, but it has yet to be implemented (see Hawassa city report for more details).

[20] A draft Institutional and Regulatory Framework for Fecal Sludge Management in Dhaka City was in preparation and being discussed amongst key stakeholders at the time of the study

In some cases, currently widespread practices associated with use of on-site sanitation systems are illegal – for example, in Accra, bucket latrines and the dumping of fecal sludge into the sea are both illegal, but cannot be stopped because the available alternatives (open defecation and open dumping on land) are worse. In Dar es Salaam, where pit latrines are the norm, they are prohibited within the municipal boundary under outdated byelaws. This type of legislation tends to hinder rather than help the phasing out of the undesired practices.

6.2 Drivers of improved urban fecal sludge management services

Incentivize the role of the private sector in FSM: Where formal FSM services are absent or inadequate, the private sector often steps in to provide them in response to customer demand. This is evident from the CSDA analyses of Dhaka and Balikpapan. From the SFDs it is seen that the services, while removing the waste from the household, often result in indiscriminate dumping by both manual and mechanical services in nearby open spaces, rivers and drains. It is therefore important that private sector actors are incentivized to both stimulate and meet demand for affordable FSM services, as well as being granted access to safe disposal sites at economical distances from areas of collection, while observing minimum safe practices for the emptying and disposal of wastes.

Even where the public sector is providing fecal sludge collection services, these are almost always "privatized" by the operatives, who undertake extra work and accept payment directly. The situation is further aggravated by the tendency of public institutions to be very slow in procuring spare parts to keep equipment operational. Private FSM operators tend therefore to be more able to maintain a continuous service.

Bury and forget is common practice but is not sustainable over time: In rural areas and urban areas where housing density is low, people 'self-provide' with pit latrines, which are abandoned, covered and rebuilt elsewhere when they fill up. This practice is often widespread and can be the main method of dealing with full pits in a given city. But as found in Lima, Hawassa and Maputo this approach becomes less viable as housing density increases. Such traditional practices cannot continue to be used as houses are extended, rental units constructed, and back yards get smaller. Even where land-use is not changing much, improved water supply with on-plot connections may rapidly move users towards more aspirational flushing toilets. They require more expensive and strongly built infrastructure such as septic tanks, which users may prefer to empty rather than abandon when full. Also, the practice of rebuilding the superstructure every few years discourages investment in a permanent quality superstructure. This can perpetuate the perception that pit latrines are inevitably an unsatisfactory option.

Protection of groundwater – consider all options: Pollution of shallow groundwater is often given as a reason for not using on-site sanitation systems where the population uses shallow wells for domestic water supply. However, reviews of sewerage systems indicate that considerable leakage, overflowing pumping stations and dysfunctional treatment are the norm – all of which have the potential to pollute groundwater too (Williams and Overbo, 2015). All situations of high groundwater (typically within 5-6m of the surface) should be assessed, but before on-site systems are rejected, options such as providing piped water from alternative sources should be costed. Discouraging the use of shallow domestic wells by providing clean piped water is invariably a cheaper, more effective solution, and more popular than installing sewerage to 'protect' the ground water – which it usually does not achieve. Shallow groundwater is also contaminated by industrial and commercial wastes, leaking drainage channels and leachate from solid waste, making investments in sewerage alone of little use unless incorporated into a comprehensive waste management (or integrated urban water management) approach.

In some cities (for example, Lusaka) the water for piped supply is abstracted from boreholes beneath the city, creating a need to protect the aquifer. However, exactly which technology may do this more effectively is not easy to define. In other cities, such as Dhaka or Hawassa, the water supply comes from sources external to the city, with actions to protect the groundwater aquifer unlikely to be driven by the risks to drinking water but by wider environmental pollution risks – for instance to open water bodies such as Lake Hawassa.

6.3 Institutional, regulatory, legal and financial matters

Clear institutional roles for FSM at local level: All aspects of sanitation services are intrinsically issues which cut across several jurisdictions, including line ministries, municipal departments and service providers. Usually, unless there are clearly assigned institutional responsibilities for all aspects of the service chain, including FSM, nobody will take responsibility, and the result will be unregulated and unhygienic services.

There is no 'one model fits all' situation, but where piped water access is substantial, the water and sewerage utility may often be best placed to manage FSM services – usually together with the private sector. This is the situation in Santa Cruz and Hawassa, and has developed over the study period in Balikpapan and Lima.[21] A drawback of this arrangement is that the utility usually lacks enforcement powers, which are typically vested in local government, and it may be difficult to control the private service providers. The utility may also have an in-built bias toward sewerage – perhaps unsurprisingly, given the lack of exposure to alternatives most engineers are given during their education.

Utilities are usually mandated to provide piped water and sometimes piped sewerage services, and have few obvious incentives to address the challenges of non-networked sanitation. In most cases this has been the result of a legacy – often colonial – or of separating responsibilities for public health from water supply, which has meant that municipalities retained responsibility for public health (including sold waste management), with the role of utilities in sanitation assumed to mean sewerage systems.

Where local government retains responsibility for FSM, as in Mozambique (Maputo, Beira) or Tabanan in Indonesia, the municipality will often be a service provider itself, typically resulting in uneconomically priced services, inadequate maintenance, and a two-level service – cheaper but often much delayed from the municipality, and more expensive but immediate from the private sector. The resulting misplaced subsidies and temporarily overflowing pits are obviously undesirable. However, there is an argument for retaining some minimal in-house municipal capacity to deal with public emergencies and send price signals into the market through a limited services for some paying customers.

Effective and enforceable regulations for FSM: Clear local regulations (bylaws or ordinances), which are both enforceable and enforced, are the logical and necessary extension of institutional responsibilities. Resulting institutional frameworks and byelaws for FSM should ideally be incorporated into broader Integrated Urban Water Management approaches, to achieve credibility and maximum results, but should be developed in any case. Regulations need not be overly complex to start with, especially when transitioning from informal services.

At the most basic level the regulations should ensure clean and safe operation (such as by ensuring correct designs and well-constructed containment infrastructure with regular and effective desludging by registered operators), that all fecal waste is safely disposed at designated treatment

[21] In the case of Dhaka city, the draft FSM framework vests responsibility for FSM services with the two city corporations.

works, that sanctions are applied for disposal elsewhere, and that workers use protective clothing and undergo health checks. The responsible agency should be required to keep complete records and account for its operations and income, and manage the private sector operators in a fair and transparent manner. In Balikpapan, when regular desludging is operating at scale, beyond the limited pilot studies, regulations will necessarily be more complex.

An unexpected benefit of regulating pit emptying properly is that the emptiers themselves move from the informal towards the formal sector, and feel less marginalized and stigmatized by the work they do. This has been observed in Dakar, Lusaka and Maputo.

Incentives to improve disposal practices: This is a relatively new area, with limited experience gained or documented. However, promising approaches include:

- Providing credits to tankers discharging at the authorized sites instead of charging them a tipping fee;
- Provision of cheap loans, possibly by way of a guarantee fund, to operators to allow them access to modern, efficient and reliable equipment;
- Reducing haulage costs (the biggest ingredient of FSM costs) by building more treatment and/or transfer facilities, thus reducing distances;
- Branding and promotion of improved services to wean customers away from unhygienic FSM practices;
- Reducing prices through promoting competition, as with a customer call center established in Dakar which allows for competitive bidding between operators;
- Teaming up with micro-finance institutions to enable facilitated payment for emptying, which is typically a major cost for a poor household, possibly as much as an entire month's income.

Adequate containment and building regulations: In all the cases studied, poorly constructed pits and septic tanks contribute to inadequate FSM, as well as to inadequate hygienic conditions for users. Typically, only septic tanks have regulated designs or design parameters, and in informal settlements, where the bulk of FSM services are typically though not only required, such regulations are, more or less by definition, not enforced. The question therefore arises as to how to persuade residents of informal settlements to adopt adequate sanitation infrastructure. Sanitation promotion is certainly part of the answer and has been found in Indonesia, where regulation tends to be weak, to lead to significant uptake of improved services (WSP, 2009). Another possible approach could be to bundle toilet upgrading or construction with emptying services. A pilot initiative is being tested under the GPOBA project in Sri Lanka (see Box 2) but the approach has yet to be tried at scale.

Planning and budgeting processes for FSM: Even where FSM is identified in policies, the associated planning and budgeting required for implementation are identified as key weaknesses in the FSM City Service Delivery Assessments (in the 12-city study as well as the current project). FSM service targets in city development plans, viable service funding arrangements and a clear FSM component in any comprehensive, city-wide sanitation investment plan are crucial – but usually missing. Well-designed national plans, funding windows and reporting mechanisms can also be critical to achieving success at scale.

Monitor FSM service outcomes: The key outcome when considering only the containment stage of the service chain is use of an adequate sanitation facility. Considering FSM as a complete end-to-end system, the key outcome is that people do not interact with fecal sludge in the environment, but this is difficult to monitor. An important proxy outcome indicator to monitor is the proportion of

fecal sludge discharged to a proper treatment and/or safe disposal facility, as the intended end-point of fecal waste flows.

Equity in subsidizing the sanitation chain: Although it is normal worldwide practice that households pay for their water closet and household plumbing, sewerage is extensively subsidized on the basis of providing public health and environmental benefits. Many of the beneficiaries are businesses and richer residential customers, whilst many customers who continue to depend on non-networked sanitation cannot afford the full market costs of mechanical emptying, which is mostly not subsidized. The public good element is a clear argument for subsidizing urban sanitation and there is a real need for smart, targeted subsidies for poor FSM customers, especially when those better able to pay already enjoy significant subsidies through access to sewers. Sustainable subsidization of an on-going service provided by the private sector is much harder than subsidizing major public investment in sewerage systems. Innovative subsidy mechanisms will therefore need to be developed, that target specific cost elements through the entire service chain (not necessarily limited to conveyance, as in the case of sewerage), without compromising the sustainability and inclusiveness of the services.

Smart subsidies for household on-site sanitation maybe justified by the externalities resulting from a poorly covered pit or one that requires manual emptying. Output-based aid mechanisms, together with improved fecal sludge management, are being tried in a number of countries. (e.g. Sri Lanka, Indonesia) to improve the quality of on-site sanitation and in the process ensure that the facilities are suitable for regular emptying. Box 2 outlines the bundling of toilet upgrading and FSM services in Sri Lanka. A mechanism used in a number of countries is a cross-subsidy from water supply, which can be managed in-house by a utility, or take the form of a transfer to local government if they are responsible for FSM. Whatever mechanism is selected, national government and/or the sector regulator will need to be involved, either to agree on an increased water tariff, or to provide another funding window.

Box 2 Bundling of toilet upgrading and FSM services in Sri Lanka

The National Water Supply and Drainage Board of Sri Lanka is piloting an innovative Public-Private Partnership (PPP) with World Bank output-based aid. The purpose is to help mitigate widespread pollution resulting from dysfunctional on-site sanitation in some of the peri-urban areas of the national capital, Colombo. The challenges are twofold: the sewerage network is minimal, and extending it is a massive and slowly progressing process; and on-site sanitation systems, where they exist, are often not functional and overflow into the nearest canal, causing environmental and public health hazards. The World Bank helped to design a PPP model offering a service to low-income households, which combines the improvement of their on-site sanitation facility with annual desludging and disposal of the septage at an authorized discharge point. The innovation resides in linking the upgrading and subsequent operation of on-site sanitation systems in a single service package, activities until then performed separately by different private companies. Workshops with the private sector confirmed their interest to organize themselves in joint ventures to bid for such services. The PPP offers them visibility with their service provision in the project area, and provides the beneficiaries with a full service, while limiting environmental pollution. The bidding process was successfully completed in December 2015 and four 10-year PPP contracts are expected to serve over 20,000 people. A GPOBA (Global Partnership on Output-Based Aid) grant will bridge the gap between an affordable price and the cost of infrastructure and desludging services for the first two years. Results and lessons will be closely monitored and published. If successful, the approach may be replicated.

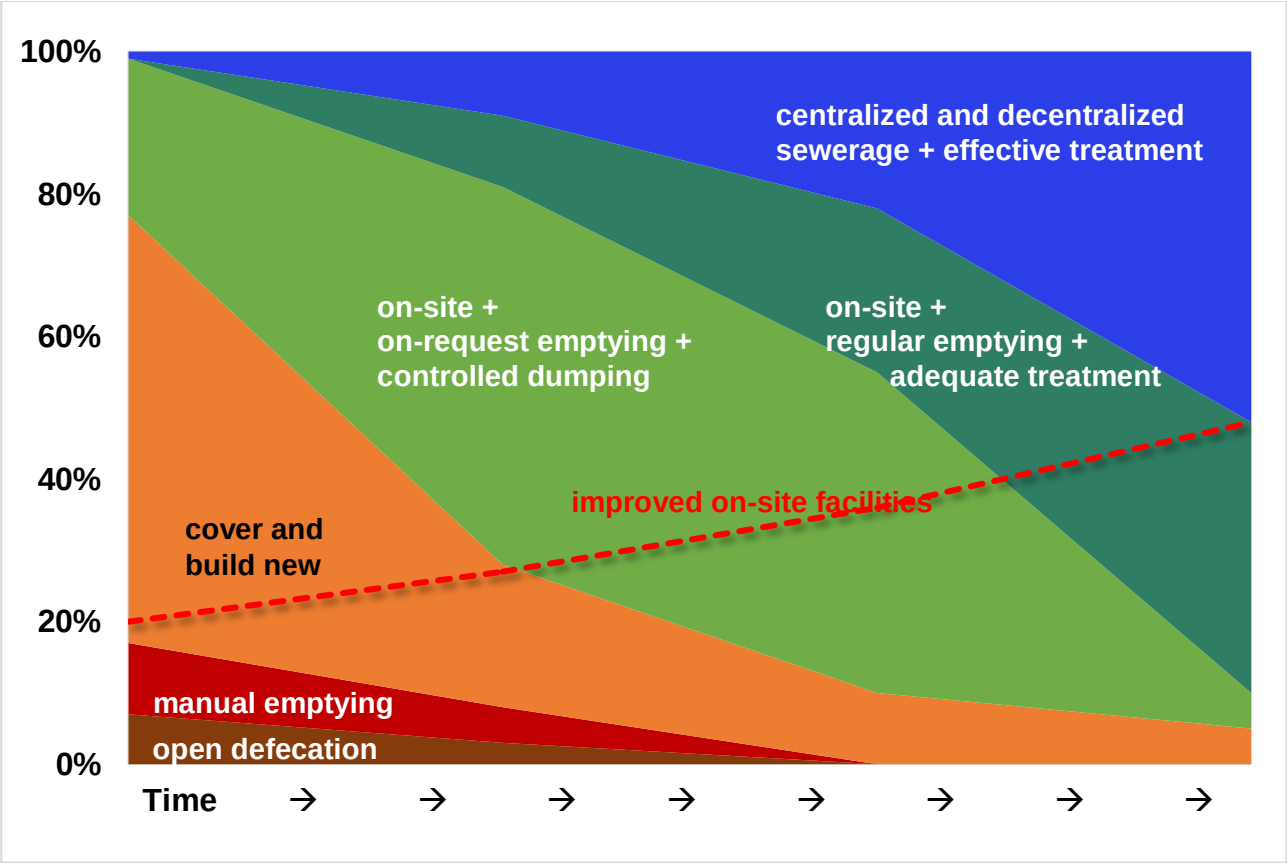
6.4 Planning for incremental changes over time

While sewerage will be the preferred long term sanitation solution in many cities, it may not be appropriate in all areas (e.g. low-density residential areas). As it will certainly not be possible to make the change all at once for financial and logistical reasons, there must therefore be an incremental approach to improving sanitation. A number of sanitation options will be in use at any one time, and these will change differently over time in different areas. It is the difficult job of the responsible authorities to identify and prioritize the type and location of interventions for the best public health and environmental outcomes at any given time. Even if the long term vision is for widespread sewerage, it will in general be more appropriate to invest partly in improving on-site sanitation rather than diverting all available resources towards sewerage and leaving the population using on-site systems to fend entirely for themselves.

The hypothetical diagram below (Figure 21) shows how such changes might play out in practice. The horizontal axis represents time, while the types of sanitation in use are spread along the vertical axis, thus representing the spatial variation in sanitation across the city at any given time. The current situation (at the left of the diagram) is loosely based on Hawassa, with the addition of manual emptying (not observed in Hawassa) for illustrative purposes. Major sewerage investments are anticipated, as industries move in and the city continues to expand rapidly. Some of the key elements of the trajectory of change mapped out in the diagram are:

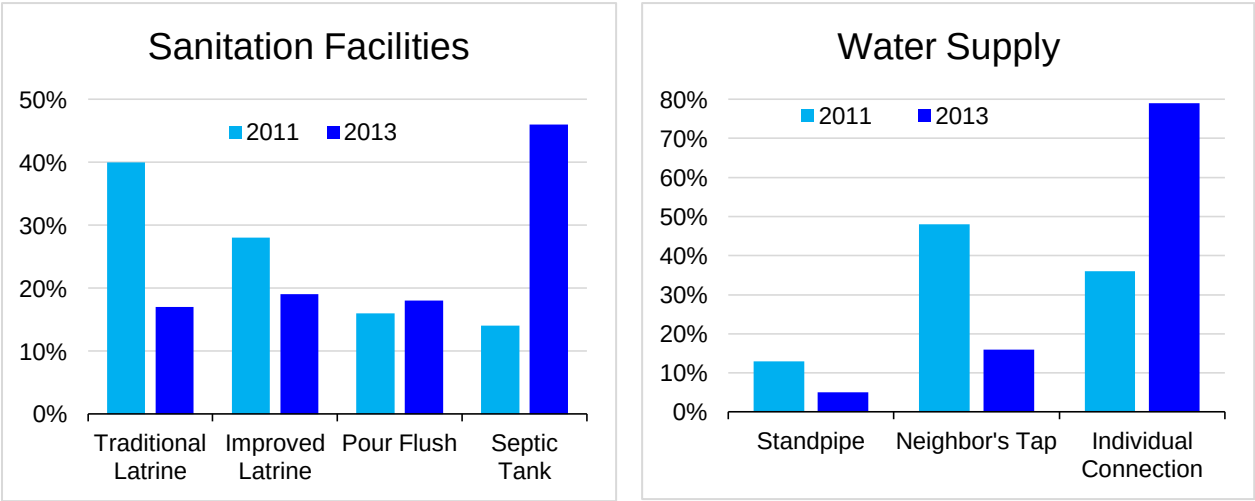
- An initial focus on eliminating open defecation and manual emptying;
- A gradual improvement of on-site facilities to make them more hygienic for users and easier to empty – either by promotion only, or possibly supported by subsidies if appropriate;
- Increased availability of FSM services to serve the growing number of improved facilities;
- Improvement of fecal sludge treatment and disposal;
- Gradual introduction of regularly scheduled emptying;
- Gradual implementation of sewerage in the most densely occupied areas

Figure 21 Evolution over time of the sanitation mix in a city



The aspiration for a water-flushed sanitation facility is a global reality – but this does not or should not necessarily equate to a conventional sewerage system. People may make considerable investments to achieve this aspiration once piped water is available in the house or yard. This impacts the sanitation mix and the demand for FSM services. This is well illustrated by recent experience in Maputo, where piped water supply to the dense unplanned inner city area of Nhlamankulo was substantially upgraded. As the charts below show, on-plot water supply connections rose from about one third of households to almost 80% between 2011 and 2013, while the proportion of households using a septic tank tripled and those using dry latrines fell substantially.

Figure 22 Effect of improved water supply on sanitation in Nhlamankulo, Maputo



Source: Hawkins and Muxímpua (2015)

7 Conclusion

This report synthesizes analysis from five city case studies. In each case study, a set of diagnostics and decision-support tools was applied based on primary and secondary data collection. Overall, the case studies confirm the importance of non-networked sanitation in many developing country cities, and deficiencies in the management of services to manage the resulting fecal sludge. They also show how diagnostic and decision-support tools can be useful in informing interventions to address these problems.

The tools presented in this summary report are available for use by anybody, and their use is encouraged. Key audiences for the outputs of these tools are government decision-makers, development banks, utilities and municipal authorities. They are primarily intended for carrying out a sanitation situation diagnosis and the preliminary selection of intervention options, bringing a focus to each part of the sanitation service chain. They will be particularly useful at the project identification and preparation stage. However, much of the data collected will also be useful later in the design of interventions.

The Tools and Guidelines, contains detailed guidance on how to use the tools and provides more examples of their outputs. It should be used with the generic Terms of Reference and Data Collection Instruments to support the necessary data collection. In addition, the full Case Studies from the five cities are also available for readers wishing to see in more detail how the tools have been used.

Various toolkits already exist or are being developed (e.g. Sanitation 21, Strategic Sanitation Approach, the Asian Institute of Technology's FSM toolkit for Bill & Melinda Gates Foundation etc.) to help decision-makers identify actions to take at city level. However, they do not focus specifically on FSM or address political economy aspects. They also tend to focus on municipal and community action, with limited acknowledgement that tackling the problems will require substantial external support, from other levels of government as well as under project-type arrangements. The tools set out in this report take these factors into account, and aim to help stakeholders consider how to develop urban sanitation services that manage all fecal waste rather than only that which is discharged to sewers.

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Annex A Links to other key documents

This annex contains further details about other key documents which are part of this study, namely the Tools and Guidelines, Data Collection Instruments, Terms of Reference and city Case Studies.

A.1 Tools and guidelines for improving fecal sludge management (FSM) services

The Tools and Guidelines is the 'how to' report, including full details about the tools and how to use them. It goes through each tool, as well as the methods and data sources underlying it. The Tools and Guidelines includes examples from the city case studies, focusing on the SFD, CSDA, Prognosis for Change, Service Delivery Action Framework and Intervention Options Assessment Framework.

It is important to distinguish between the diagnostic tools and the data collection instruments. The **tools** are quantitative and qualitative means of displaying data to support problem diagnosis and decision-making. The data collection **instruments** consist of both the data collection formats (such as the household survey questionnaire) and their associated protocols (which are essentially an instruction manual and methodology), which provide inputs to the tools. A third element is the **Terms of Reference** for commissioning work to use the instruments – these will be helpful to people using the tools, whether they want to contract out the work or do it themselves, but the assumption is that the person doing the work is a consultant. The distinction is shown in the table below.

Table 11 The difference between Tools, Instruments and Terms of reference

Element	Contains	Where to find
Experiences of using the tools		
Summary	Summary of tools, lessons learnt about their use, and policy recommendations.	Summary Report (this report)
How to use the tools		
Overview	Tool objectives, detailed methods and examples	Tools and Guidelines (main body)
How to	Instructions and formats for applying the tool	Tools and Guidelines (Annexes)
Data collection Instruments		
Protocol	Manual on how to use the instrument format	Data Collection Instruments (main body)
Format	Data collection instruments for adaptation to a city context	Data Collection Instruments (Annexes)
Terms of Reference		
TORs	Instructions for staff or consultants (firm or individual) who will implement one or more data collection instruments	Terms of Reference

A.2 Data collection instruments and terms of reference

The Data Collection Instruments (with associated protocols) and Terms of Reference are in companion documents. The various data collection instruments and the research methods associated with them are summarized in the table below.

The TORs should be adapted to a given city context, depending on which tools are planned to be used and the focus of the work. The consultants would need to be provided with the protocols and data collection instruments (once adapted). These are summarized in the table below.

Table 12 Research methods and associated instruments

	Research method	Data collection instrument	City where applied	Diagnostic tool or analysis this informs
Quantitative	1. Household survey	Household questionnaire	Dhaka, Hawassa, Lima, Santa Cruz	SFD tool, CSDA tool, Supply and demand analysis, Economic analysis
	2. Observation of service providers	Structured observation form	Dhaka	Supply and demand analysis
	3. Transect walk	Transect walk form	Dhaka, Hawassa, Lima	Public health risk analysis
	4. Environmental sampling	Water supply and drain water testing protocol	Dhaka	Public health risk analysis
	5. Testing FS characteristics	Test of FS physical characteristics	Dhaka	Reuse analysis
		Test of FS chemical/biological characteristics	Dhaka	Reuse analysis
Qualitative	6. Focus group discussions	Focus group discussion guide	Dhaka, Hawassa, Lima, Santa Cruz	Prognosis for change tool, Supply and demand analysis
	7. Key informant interviews	Interview guide	Dhaka, Hawassa, Lima, Santa Cruz	SFD tool, CSDA tool, Prognosis for change tool, Supply and demand analysis

A.3 City case studies

The city case studies are available via the links below. These are the in-depth studies of individual cities and are therefore targeted at professionals working on sanitation in the given city or the country, but may be of interest to others who want to use the tools or see how they were applied.

- Cities where most or all tools were applied:
    - Dhaka, Bangladesh
    - Hawassa, Ethiopia
    - Lima, Peru
- Cities where some tools were applied:
    - Balikpapan, Indonesia
    - Santa Cruz, Bolivia