Achieving sustainable sanitation chains through better informed and more systematic improvements: lessons from multi-city research in Sub-Saharan Africa

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Water Impact Statement

The sanitation service chain is the predominant sanitation system in towns and cities of low and middle-income countries. A small proportion of human waste is safely treated or disposed of. The vast majority ends up in the surrounding environment, directly impacting on public health, especially for the urban poor, who are least able to bear the burden of poor services.

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Abstract

This paper presents the synthesised findings of the SPLASH Urban Sanitation research programme through the framework of the sanitation service chain. Urban sanitation service chains are complex and fragmented, involving a multiplicity of service providers and typically resulting in unsustainable or inadequate services. The aggregate data set covers a wide range of research methods including; household surveys, a randomised control trial, a willingness to pay survey prototype testing of technologies, focus group discussions and deliberative forums. Thorough the research, it has been possible to identify situations where incremental improvements are being made with varying degrees of success. Most importantly, it has identified weaknesses to the sanitation service chains where progress is either slow or extremely limited. It is through these weaknesses that key questions affecting the long term sustainability of sanitation service chains need to be answered.

Introduction

The Sanitation Service Chain

Urban sanitation systems can be broadly categorized as either physically networked (such as conventional sewerage) or as sanitation service networks, where on-plot latrines, whilst not connected to a sewerage system, are the first component in a service chain. The service chain comprises: excreta capture and storage in a latrine pit or septic tank; emptying of the pit or tank; transport of the contents; sludge treatment (though not common); and end-use or final disposal. This chain of sanitation services is collectively known as Faecal Sludge Management (FSM). Some sewerage networks exist in Sub-Saharan Africa but they are rare and often in a poor state of repair and functionality. The service chain system is therefore the predominant sanitation system in the towns and cities of low and middle-income countries. This has led to profound problems in terms of how to collect and treat the faecal sludge from on-site facilities. The sanitation service chain was developed to conceptualise this ever growing problem and has become a widely used and recognised framework for understanding the effective management of faecal sludge, as depicted in Figure 1.

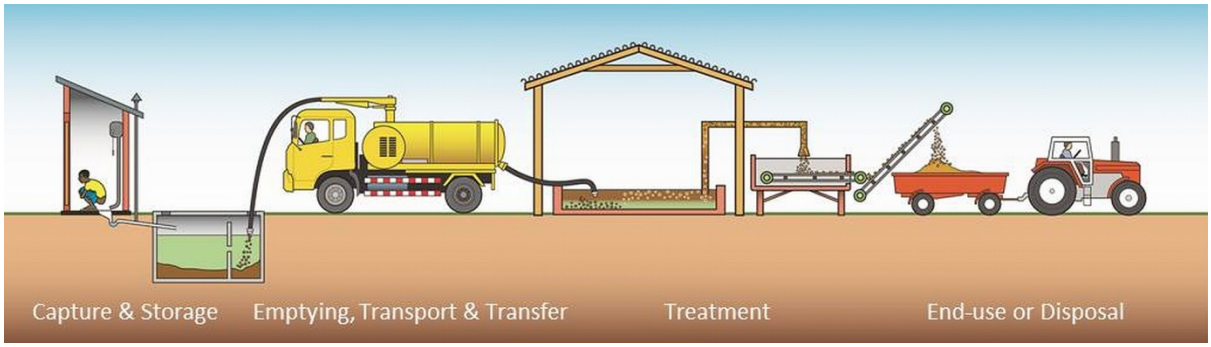

Figure 1: The Sanitation Service Chain (Water Engineering and Development Centre1)

Urban sanitation service chains are complex and fragmented, involving a multiplicity of service providers and typically resulting in unsustainable or inadequate services. Many discrete sanitation interventions such as building latrines or introducing emptying services aim to improve a particular aspect of the urban sanitation chain. However, neither top-down sanitation master planning nor ad-

hoc project based action plans have yet been able to respond effectively to the challenges of urban sanitation.

The purpose of this paper is to present the synthesised findings of the SPLASH Urban Sanitation research programme through the framework of the sanitation service chain. The paper identifies cross-cutting findings from the 5 individual research projects. These are presented both through the stages of the urban sanitation service chain and the overarching framework of the enabling environment. The SPLASH programme was the first of its kind and mirrors the broader shift occurring in sanitation interventions, away from piecemeal approaches with limited consideration of the wider system within which they operate, towards a more systematic analysis of the whole sanitation service chain. Through this research, it has been possible to identify situations where incremental improvements are being made with varying degrees of success. Most importantly, it has identified weaknesses to the sanitation service chains where progress is either slow or extremely limited. It is through these weaknesses that key questions affecting the long term sustainability of sanitation service chains need to be answered.

SPLASH was the name of the European Union Water Initiative's European Research Area Network (EUWI ERA-net), a consortium of 16 ministries, funding agencies, national research and technological development authorities from 11 European countries who came together to agree a research agenda and jointly fund research activities benefitting from a transnational approach. The programme was designed in accordance with good research management practice as developed within the Era-net, key features including: greater symmetry of research partnerships between Northern and Southern institutions to improve relevance, ownership and quality of research, mandating a minimum of 50 percent funding to be allocated to Southern partners; a requirement to incorporate capacity development for Southern researchers and institutions; consultative and participative programme design, and stakeholder engagement plans. The major objective of the SPLASH urban sanitation research programme (2010 to 2014) was to contribute to the understanding and implementation at scale of sustainable sanitation service chains in low-income urban areas in Sub-Saharan Africa by building on the local research partnerships of successful bidders. After a competitive bidding process, 5 international consortia received funding. The results presented here are a synthesis of the empirical outputs from the 5 consortia and draw on a combined 20 years' worth of research from 8 cities in 7 Sub-Saharan African countries.

- 3K-SAN - Kisumu (Kenya), Kigali (Rwanda), Kampala (Uganda)
- CLASS-A - Maputo (Mozambique)
- FaME - Dakar (Senegal), Kampala (Uganda), Accra (Ghana)
- MAFADY - Douala and Yaoundé (Cameroon)
- U-ACT - Kampala (Uganda)

The aggregate data set covers a wide range of both quantitative and qualitative research methods including; 6,692 household surveys across 3 cities (3K-SAN), a randomised control trial across 40 slum areas (U-ACT), technical evaluations of 2,040 household latrines (U-ACT), a willingness to pay survey with 200 households (U-ACT), prototype testing of 3 new latrine designs (MAFADY), construction of faecal sludge drying beds and burning trials in pilot kilns (FaME), bacteriological and physiochemical analysis of water and faecal samples (MAFADY) and over 150 focus group discussions, deliberative forums, community workshops, stakeholder consultations and key informant interviews with stakeholders from all 8 cities. Working programmatically and in partnership ensured a far greater degree of participation and impact than could have been achieved by any single partner.

Why is achieving an urban sanitation service chain such a problem?

The sanitation service chain aims to consider and address both health and environmental issues. The first stages of generation, capture and storage of excreta and or faecal sludge are primarily associated with improving household level health. In order to collect and remove the excreta or faecal sludge safely, latrines or toilets and septic tanks need to be improved through designs that effectively capture and store the faecal sludge until it can be safely emptied. Faecal sludge can only be treated if it has been collected in the first place. The middle and later stages of transportation, treatment and disposal or end-use have a wider environmental focus. A study on FSM by the Water and Sanitation Programme (WSP) in 12 cities in developing countries highlighted that on average, faecal waste from only 22% of households using on-site systems is safely managed. In some cases, whilst the excreta might be safely emptied it is then dumped illegally (WSP2). Any break in the service chain at any stage will cause the faecal sludge to be released untreated into the natural environment, endangering the public health of the city and surrounding areas. The apparent simplicity of the sanitation service chain depicted in Figure 1 hides the complexity of the enabling environment within which the activities in the chain occur.

The most significant challenge in the delivery of urban services is the sheer scale of the problem. The concept of planning is especially difficult in contexts where documents such as city master plans risk soon becoming irrelevant in the face of rapid urban growth. The urban population in 2014 stood at 54% of the total global population, with urban populations expected to grow approximately 1.84% per year up to 2020. A majority of that growth will happen in middle and low-income countries (WHO3). By 2050, 66 % of the world's population is projected to be urban with Sub-Saharan Africa expected to reach 56% urbanisation by 2050. There are a growing number of 'megacities', urban agglomerations with populations over 10 million, but the majority of urban growth is actually in much smaller urban centres with populations up to 5 million. Only around 1 in 8 urban dwellers live in one of the 28 mega cities with close to half living in small settlements of less than 500,000 people (Global Health Observatoy4). Urbanisation in itself is not a negative concept. Neither are 'the urban poor' who as a collective have been shown to make a positive contribution to a city's informal economy (Perlman5).Poorer people in cities and towns however are often adversely affected by failures in infrastructure provision. They have less financial capacity to find safe alternative services and they are also less likely to be able to access services available due to high initial costs of connection (Estache6).

Rapid urbanisation and the resulting challenges in sanitation service provision are not new. They have been tackled and overcome before. Nineteenth century Britain was characterised as a period of unprecedented and rapid population growth in the newly developing industrial towns. Accommodation built in response to this increased demand and the associated services of water and sanitation were extremely inadequate. Residents in the tenement slums of Victorian Britain faced many of the same challenges that are today present in the slums of Sub-Saharan Africa. Poverty was rife, legislation was weak, public finances were limited, the private sector was ill-equipped to serve the urban poor, tenancies were insecure and householders often had to bear the costs of implementing improvements themselves. There are many echoes of the past in the current public health crisis of developing countries, with the same consequences resulting from inadequate hygiene, sanitation and water provision (Fisher7).

Improvements in sanitation and water provision in Britain took almost 100 years, during which a complex mix of political reform, policy legislation, economic drivers of change and growing public demand for better services aligned (Fisher7). For most people, the idea of these types of changes taking more than 100 years is unthinkable. Comments like *'in the 21st century, it shouldn't take so long'* resonate strongly, so we try to increase the speed at which changes take place.

This complex mix of political reform, legislation, demand and economic drivers is referred to as the enabling environment (Rosensweig8) which needs to be dynamic and responsive to each situation as

it changes. Without this flexibility, what once worked well can cease to act as an enabling factor and can instead become a constraint. This is especially true in the face of rapid urbanisation where demand for services continually increases, but the quality of access to services may decrease as resources are stretched further.

A number of frameworks to address strategic urban sanitation development already exist. The Strategic Sanitation Approach (SSA) (Wright9) advocates a demand based, incentive-driven approach to urban sanitation strategic planning. The overall aim of SSA is to achieve the sustainable expansion of sanitation coverage by addressing issues of operational efficiency. Similarly the IWAs Sanitation 21 framework for planning urban sanitation systems highlights the importance of analysing the context within which future urban sanitation solutions will be developed (IWA10). The system addresses the interests of different stakeholders, external factors (e.g. security of tenure and economic priorities) and the capacities required to implement and manage systems.

More recent experience in mapping sanitation services in Indonesia gave greater emphasis to looking at the actual status of sanitation in the city, including non-technical information on the role of the private sector, financing and community demand. The 'map' provides the basis for identifying how to improve existing services rather than necessarily creating new ones (WSP11). Where existing sanitation strategic planning frameworks fall short is in taking adequate account of emerging lessons and implications of the many interventions that will have taken place both locally and in similar environments in Sub-Saharan Africa. This makes it difficult to identify how to improve existing services rather than necessarily creating new ones.

One of the greatest challenges facing urban sanitation professionals is a low evidence base from which to make decisions and drive change, especially when related to activities forming the enabling environment. Our efforts should be based on experience, rather than experiment. The traditional planning steps of 'where are we now?', 'where do we want to get to?' and 'how do we want to get there?' (Tayler12) should in the context of a dynamic urban environment be preceded by the question 'how have we got to where we are now and what lessons can we learn?'.

The research conducted through the SPLASH urban sanitation research programme has used the sanitation service chain process as the primary means of analysing faecal sludge management services in low-income areas of Sub-Saharan Africa. The programme has collected additional data on and reinforced some of what we already know, but shows that the same problems and challenges are repeated in different cities, some of which are specific to low-income residents living in unplanned or informal areas and some of which impact on the city as a whole.

Key challenges from Stage 1: Capture and storage

Between 1990 and 2012, 1.2 billion people globally have gained access to improved sanitation in urban areas. However, the population of urban people without sanitation has actually increased from 215 million in 1990 to 756 million in 2012 because population growth has outstripped the number of people who gained access in real terms (WHO13). Whilst open defecation is still largely a rural phenomenon, it is widely practiced by the poorest people living in urban areas.

The first stage in the sanitation service chain is the capture and storage of excreta. If excreta is not captured at the point of defecation then it automatically goes untreated into the environment. For many years, subsidies were used to support the construction of household toilets and latrines through supply-led programmes. The use of subsidies fell out of favour and supply-led programmes were replaced with demand-led programmes relying on more active participation of the households to construct and use their own facilities. Demand led programmes work on the assumption that demand for better sanitation facilities can be created, through various methods, and supported through marketing campaigns. This approach has had some success in rural areas but the findings

from the SPLASH programme have shown that stimulating demand creation in the urban context is more nuanced and challenging than that of rural settings. Jenkins and Scott (Jenkins14) identified a three-stage household decision process applicable to rural and peri-urban areas: preference, intention and choice. This process has been expanded by the work of the 3K-SAN in Kampala, Kisumu and Kigali into a five stage process: No preference, Preference, Intent, Choice and Installed (Okurut15). Barriers to the success of a demand led approach have received significant attention over recent years and can be broadly categorised into; physical, knowledge, financial, and legal or regulatory constraints.

The physical **availability of space** to construct a latrine on urban plots is usually very limited or non-existent, because the house generally occupies all of the available space. There are also topographical constraints in some cities where water tables are very high, the ground is difficult to excavate or plots are located on steep hillsides, such as identified in parts of Kampala, Uganda, Douala, Cameroon and Kigali, Rwanda. Little can be done to extend the physical size of plots but toilet designs that can be used **within** the household without being connected to mains water or sewerage networks do already exist and are becoming more widely known and adapted to specific local contexts. In some areas where space is still a significant constraint, shared latrines are an option, although typically disregarded because of the challenges surrounding cleanliness and long-term maintenance. The research in Kampala under the UACT consortium has shown that shared latrines, which are commonly found to be in poor states of cleanliness compared to those that are privately owned can be well maintained if shared by no more than four families (U-ACT16). Although 100 percent access to private latrines may be the ultimate goal, shared latrines in the context of Kampala, present an example of a short term trade-off between having private access or no access.

In cases where there are no physical constraints on building a latrine, the reluctance to build can extend from a lack of **knowledge** on the types of latrine available or the perception that materials are difficult to obtain from local markets (Godfrey17). The construction of household latrines is more often than not supposed to be supported by the use of technical guidelines that provide information on how latrines can be built, but the willingness and ability to enforce the use of specific designs is severely limited. Findings from 3K-SAN showed a strong relationship between demand for sanitation and knowledge about the costs and availability of services and markets. However, awareness of the need for a sanitation facility does not necessarily translate into an installed facility; but higher levels of awareness lead to more concerns about the adequacy of sanitation facilities in terms of quality, accessibility, availability, affordability and acceptability. In Kigali, demand for sanitation as expressed through the stages of preference intent and choice is high, while reaching the stage of installation is constrained by people's access to finance, affordability of available options and levels of tenancy (Okurut15)

Identifying indigenous knowledge as part of the assessment and decision-making process when planning to improve sanitation facilities and services can support, or indeed contradict, previously held pre-conceptions and assumptions. A risk assessment tool developed through the research in Mozambique by the CLASS-A consortium has sought to address **knowledge vulnerability** by identifying and making use of indigenous knowledge, through community workshops. These facilitated workshops provide a means for indigenous knowledge about practices and risks held by households and communities to be reported to those working at the municipality and local government level (IWA18). This consultation stage helps to identify the knowledge people already have about their sanitation systems, as the basis for designing and implementing educational or awareness raising programmes, or indeed technical improvements.

The affordability of latrines and toilets is often cited as the most significant barrier to construction. Households in urban areas can be more dependent on cash income than those in rural areas where

there can be other options for paying for goods and services (Wratten19). For households where the primary earners work informally or in very low-paid unsecure jobs, cash income will not necessarily be available when it is needed; especially for high cost items that are several times their monthly household income. The International Finance Corporation reports that less than 25% of adults in Sub-Saharan Africa have access to formal financial services which makes it difficult to make productive investments in a business, their family or dwelling (IFC20). The research from Cameroon showed that even for a very basic latrine that does nothing to protect groundwater resources, the poorest households would have to spend a minimum of 70% of their average monthly family income on construction (MAFADY21).

In terms of increasing the affordability, there are two key approaches; modifying the technology to make it more affordable or increasing access to money which allows people to make a relatively large one-off purchase. Making the latrine more affordable can be done by using fewer or cheaper materials, making the materials cheaper to purchase, using a staged payment modality or a combination of several approaches. Many countries have considered how to make latrines more affordable but in some cases it requires more than a change in materials, it requires much more significant trade-offs between achieving the ideal standards and responding to the local realities.

The research by 3K-SAN has shown that the availability of finance, be it formal, semi-formal or informal, is one of the key drivers in supporting demand creation for latrine ownership or use at the household level. The research has shown that in Kigali where there is a nationally driven programme to support the use of bank accounts by the poorest people, there are lower levels of household deprivation compared to Kampala and Kisumu, despite very low incomes (Okurut15). The research by U-ACT in Kampala found that offering households micro credit for 18 months at 20% interest had the same effect as reducing the investment required to build a latrine by 25% (Günther22). A local outcome of this aspect of the research was the construction of 150 additional ventilated improved pit (VIP) latrines serving 1,500 people (ibid). Increasing the availability of consumer finance is one of the recommendations for developing an enabling environment in which private sector service operators can be successful (IFC23).

By gaining access to finance, households can become active consumers and whilst there may be many alternative services to spend their money on, each household can determine their own spending priorities. Demand creation and behaviour change programmes can work on influencing those priorities, although that in itself is a particularly daunting task. In the research from Kigali, Kampala and Kisumu by 3K-SAN it is interesting to note that levels of willingness to invest in a latrine are generally low, even amongst owner occupiers and resident landlords, who should in theory have greater motivation for making the investment because they would be directly improving their own situations and living conditions. The main constraint to the willingness to invest was identified as affordability, together with the topography and lack of available space to construct a facility (Okurut15).

The research by 3K-SAN has shown that focusing on just one element of demand creation is likely to undermine the sustainability of sanitation services (Tsinda24). Together with research by U-ACT in Kampala, the programme identified variations in the extent of demand and its realization between sections of society. For example, vulnerable households reported higher levels of demand (particularly those with females aged 6-17 and households without parents), as did owners of property compared to tenants. Male heads of households were found to be more likely to initially express a serious interest in purchasing a latrine but not completing the process, whereas female headed households were more consistent in their intention to purchase and actual purchase behaviour (i.e. moving from the intent state to the installed stage).

Research on the different elements needed to support demand creation is ongoing and over time, it becomes possible to build up a more complete picture of the different nuances that influence demand creation in a given context. However, a balance needs to be stuck between adopting highly specific but piecemeal approaches in each settlement and adopting broader city wide approaches to stimulate demand for improved sanitation and ensure capacity to respond to the resulting service requirements.

Key challenges from Stage 2: Emptying, transport and transfer

The emptying and transportation aspects of the sanitation service chain are dominated almost entirely by private sector operators and as such receive very little attention by many city authorities. The exception being when operational licences or permits are supposed to be obtained, dumping or tipping fees need to be paid. There is relatively little known about tanker operators and how they work, which highlights a stark gap in understanding within the sector as a whole. Empirical data available to estimate faecal sludge accumulation rates is currently missing and with it, an understanding of the potential for faecal sludge management services (WSP2).

In many cities, manual emptying of latrines or septic tanks is illegal, but there is limited availability of mechanical tankers to provide pit and septic tank emptying services. General reasons for this mismatch in demand and supply pertain to the availability of equipment in Sub-Saharan Africa, the extent of a secure customer base, financial, legal or regulatory barriers to starting up a small-scale business. During a survey of 30 cities (Chowdhry25) found that the cost and sourcing of trucks was the single biggest challenge for tanker entrepreneurs, with some of those in African cities costing an average of 34,000USD. Where the use of manual emptying is illegal and the availability of tanker operators is limited, there is a huge gap between the ideal service delivery and the real practicalities of ground-level service delivery, as is the case in Kigali, Rwanda.

The MAFADY project, Cameroon, considered the current demand for pit emptying services in Douala and Yaoundé and provided some interesting insights into the operations of small-scale, private sector operators about whom there is still relatively little known compared to other stakeholders in the sanitation service chain. In Yaoundé and Douala, many emptiers are unregistered as the mechanism to issue permits for registered operations is not effectively implemented. There is little incentive to formalise their informal operations, which has serious repercussions for employees who work without contracts, regular salaries, training, health insurance or the necessary personal protective equipment. Co-operative organisations of emptiers in Cameroon have never been sustainable, so they are not represented at the administrative level of the cities and cannot actively participate in decision making processes affecting their businesses (MAFADY21).

The extent of household demand for emptying services has been found to be strongly affected by the availability and cost of service operators. In Douala, Yaoundé and Kigali, this has been found to result in emptying delayed to the point where latrines and septic tanks are overflowing (in Cameroon, only 14% of service customers planned the emptying operation), leading to significant public health risks. In Cameroon, prices for emptying services are set according to the volume of the tanker, the distance between the household and the dumpsite and ease of accessibility to the latrine or septic tank. The prices for emptying are lower in Douala than in Yaoundé because there are more operators available and greater competition between them. A majority of customers expressed satisfaction in the prices charged by the tanker operators; however, most of the customers have septic tanks rather than pit latrines so represent households in the higher income districts of both cities. Due to the higher costs of mechanical emptying, manual emptying is generally preferred by householders both in informal settlements and higher income areas in Douala and Yaoundé because it can remove more of the waste material for a lower cost (MAFADY21).

Key challenges from Stage 3: Treatment for end-use or disposal

The technologies required to make the service chain function are for the most part known, especially at the beginning of the chain where the challenge is more about encouraging households to build systems that can be emptied easily, than in developing new alternatives. The key technological challenge remaining is cost-effective, space efficient treatment processes that make the sludge safe for disposal or further use. The treatment process is complicated by the additional waste found in sludge removed from latrines. The research conducted in Douala and Yaoundé found that it contained amongst other things; sand, clothes, broken bottles, batteries, plastic sachets, plastic bottles, metal, syringes, pharmaceutical products, chemical and industrial pollutants, art materials, oils and detergents (Mougoué26). When formal solid waste disposal options are not available, disposal of the waste into a latrine may seem like a logical option for households although it transfers the problem of waste management away from the household, onto the emptier and potentially to treatment plant operators.

There is a significant difference between disposal through dumping and actual treatment of the faecal sludge. The research by FaME in Kampala, Accra and Dakar and 3K-SAN in Kampala, Kisumu and Kigali showed that existing faecal sludge treatment facilitates in these cities provide way below the required treatment capacity to meet current or future needs. Where the private sector has stepped in to provide services, the council authorities have often stepped back and not upheld their responsibilities in terms of city infrastructure needs. Due to this lack of treatment facilities being available, the most active stage of the service chain following the collection of faecal sludge from latrines and septic tanks is likely to be transportation to a dumpsite. Official dumpsites are themselves quite rare and suffer from chronic mismanagement. In Douala, the faecal sludge dumpsite has been in use since 2005, but in 2009 people started moving into the area and building homes. As a mangrove swamp, it is designated as a “green zone” and therefore illegal to build on, but over 900 families now live within 300m of the site and household encroachment continues. The dumpsite and its supporting infrastructure are poorly managed and not maintained so when the road to the dumpsite becomes impassable, especially in the rainy season, the tankers discharge the faecal sludge directly into the river at the entrance to the site or even along the road itself (MAFADY21). This kind of dumping is, unfortunately, not uncommon, with significant implications for public health.

One of the main challenges facing the operators of dumpsites is the cost. The majority of costs for sanitation services are currently borne by service users (e.g. households or institutions such as schools) when they pay to construct, maintain and empty their latrine or septic tank. The service users cannot be expected to finance the entire service chain, consequently, the possibility of generating revenue elsewhere within the chain is gaining prominence. The research conducted by FaME in Kampala, Accra and Dakar has considered how faecal sludge can be used once it has been properly treated and the market potential for new uses of faecal sludge were identified in each city.

Through field trials of treatment options, predominately drying beds, the research by FaME has demonstrated that there is potential for the use of treated faecal sludge as a solid fuel. However, market demand and hence market value for dried faecal sludge varies greatly between cities. The local market potential for dried faecal sludge as a fuel depends on: faecal sludge characteristics; user perceptions; existing fuels available; local industry requirements; legal arrangements and regulatory restrictions; the use of subsidies; and the local supply of sludge (Diener27). An example of the importance of local market conditions was found in Kampala where there is an established brick production industry. Wastewater sludge can already be used as a raw material in brick production but in Kampala, the raw materials for bricks are readily available in the locality and as such there was limited interest in the potential for the use of faecal sludge in brick production (Diener27).There was

much more interest in the potential to use dried faecal sludge as fuel for the brick kilns themselves. In order to achieve this, there needs to be new technologies developed to bring successful burning trials to full scale testing. This reinforces the knowledge that system innovations cannot be achieved through technological innovations alone, institutional and socio-cultural changes are needed as well (Lopes28).

By starting to understand the complexities of specific market demands for treated faecal sludge, the intention is that financial incentives can be generated throughout the sanitation service chain that promote more efficiencies from capture through transport to treatment. However, it is not recommended to predicate the long term functioning of the sanitation service chain on potential financial flows. They are better treated as unpredictable financial inputs to urban sanitation management given the potentially unstable and fluid nature of markets for treated faecal sludge and financial models developed on that basis.

Key challenges from the enabling environment: cross-cutting issues

The term 'enabling environment' is used here to refer to the wider city wide system in which the sanitation service chain operates and describes the inter-relationships between technical and non-technical elements identified as essential to support sanitation service delivery. They represent the 'big challenges' faced when trying to deliver services in difficult circumstances and will not be solved easily or for individual services (sanitation, water, education, health etc.). In the SPLASH urban sanitation research programme, policy, strategy and direction, laws and regulations, the availability of financing and human capacity were considered in addition to the technologies available. A wide range of stakeholders have key roles in urban sanitation including local and central government, water utilities, private developers, informal private sector, civil society and individual households. All of these stakeholders and the activities they try to achieve are heavily influenced by the enabling environment they live and work in.

Polices and strategies play a part in setting the 'rules of the game' for activities carried out in a specific sector. They are closely linked to financial planning and budgets, with the argument being that if an activity does not contribute towards a policy objective and has not been outlined as an action in a strategy then it is not important enough to warrant the allocation of resources. In many cases, clearly defined policies or strategies that focus on sanitation or FSM services are not available (Scott 29). Poorly defined organisational roles and responsibilities continue to be a central problem to effective programme implementation, leads to an overlapping of operational mandates and a duplication of activities. It also leaves gaps in responsibilities which further increases confusion around service provision. The most striking example of this poor definition of roles and responsibilities and on the ground implementation of activities was highlighted in Cameroon, through the MAFADY project, although the same problem was also found in all of the project countries. In Cameroon there are seven different departments at the national level with a responsibility for the management and remediation of wastewater and excreta, with a further three departments at the district level. The institutional assessment conducted found that there is little co-ordination between them and several areas of overlap (MAFADY21). In Maputo (CLASS-A) it was found that there were very limited levels of institutional responsibility for downstream impacts of urban pollution (from poor sanitation) and none at all for the environmental health impacts (Parkinson30). Despite knowing that the problem exists, detailed institutional assessments are rarely carried out. The lack of clarification and overlapping of responsibilities has disappointingly, almost become an accepted part of the urban services planning debate that is regarded as being too difficult to change.

All projects under the SPLASH programme found the implementation of laws and regulations affecting building standards, regulations and land ownership to be largely ineffective, exacerbated in

part by the poor definitions of roles and responsibilities at national government level. Construction of household latrines falls into a grey area, which is complicated further for residents in informal settlements. The research from Cameroon draws attention to the fact that 80% of the city of Douala is unplanned and less than 20% of landlords own their land titles (MAFADY21). Building regulations exist in some of the countries studied. The Rwanda Building Regulations state that building owners (including households) must convert to a waterborne system of excreta disposal when it becomes possible to connect with a water supply providing a minimum of 75 litres per person per day (Rwanda Housing Authority31) but flush toilets are used by less than 10% of households in Kigali City with VIP or simple pit latrines remaining the dominant choice (Rwanda Environment Management Authority32). Under the same building regulations, all rural [peri-urban] residents of Kigali City are required to have 'at least' a VIP latrine. The regulations clearly state that it is an offence to build a latrine which does not comply with the regulations and that a VIP can be forcefully closed or emptied if it becomes a nuisance or hazard but the extent to which this actually happens is not known. In Kisumu, Kenya, despite the presence of building regulations, a majority of septic tanks are built without reference to engineering specifications or inspection by the city council. The findings from Kisumu showed that existing laws are not responsive enough to changes in new technologies with laws not updated to allow for the construction of composting, non-water based systems despite the fact that composting latrines have been successfully piloted in other areas of Kenya (Adogo33). In Kampala, authorities do not approve or regulate sanitation facilities in illegal settlements because they are viewed as temporary, waiting for eviction or demolition (Adogo33). The underlying problem is a lack of institutional capacity to enforce regulations and building standards and when there is little or no enforcement capacity they can only ever be partially effective. Whilst the use and enforcement of construction and building standards may be unpopular in some cases, having appropriate latrine, toilet and septic tank constructions at the beginning of the chain facilities the operation of the rest of it.

The issue of tenure status is gaining greater influence in the debates around access to services. There exists a whole spectrum of tenure types across cities and the tenure conditions required as a precondition for household expenditure on sanitation are not straightforward to define (Scott34). Under the Human Right to Sanitation, those whose rights have been denied would have recourse to action through judicial, administrative or other appropriate channels. Unfortunately, in many cases, where tenants are occupying land illegally or do not hold formalised tenancy agreements they are considered to be outside normal jurisdiction and can have no recourse to action (Adogo33). These challenges extend beyond the provision of sanitation services and can only be changed by the highest levels of government which makes it unlikely that sanitation alone will be the driving factor for such changes.

In this context of poorly defined roles and responsibilities, a lack of staff capacity across the fragmented institutional landscape and more particularly in the units within government at national and decentralised levels that should be responsible for preventative healthcare and service management also plays a critical role in the success of joined-up, systematic service delivery. As is the case in many sectors, professional capacities of staff are low, which has a significant impact on the ability of those staff to drive implementation on the ground. In Cameroon it was found that staff tasked with the operation and maintenance of treatment facilities receive little or no training on the management of these facilities which results in them being abandoned long before their designed lifespan has ended (Mougoué26). At the city level in Douala and Yaoundé, staff shortages mean that hygiene education and promotion activities are limited to periods of crisis rather than being an ongoing activity (MAFADY21).

The UN Water -Global Annual Assessment of Sanitation and Drinking-water (GLAAS) report of 2014 identified that only 40% of countries surveyed were able to absorb (that is, to utilise) more than 75%

of the external aid for urban sanitation (WHO35) so there is finance available, but insufficient capacity to capitalise on the availability of global funding is a generic problem facing the sector. For example, the GLAAS report highlights that actual budget disbursement for water supply and sanitation frequently fall short of the planned expenditure due, for example, to a lack of efficient financial management processes or limited capacity of public and private sector implementation. In 2012/13, Uganda reported a release of 60% of the actual budget funds. Further details of the underlying issues are fully explained in the GLAAS report (Ibid).

Inadequate or poorly organised funding arrangements are an ongoing problem in the sanitation sector but co-ordinating budgets across multiple institutions or departments can be particularly challenging. The research in Mozambique found that the lack of adequate budgets for the full range of sanitation activities leads to the selective prioritisation of investments at the city level (Parkinson30) which do not necessarily contribute to a successfully functioning system as a whole and a piecemeal approach continues to dominate current sanitation related activities. This was highlighted by the research from CLASS-A in Maputo which found that technical and implementation based recommendations related to broader, city wide sanitation planning including solid waste and storm water management were changed into more nebulous policy recommendations for a future point in time because the budget available was insufficient to tackle everything at once. Whilst this has been previously identified in relation to city-wide planning (Tayler36) it is otherwise rarely recognised as a constraining factor to service provision which has to be addressed.

The research in Kampala, Accra and Dakar conducted by the FaME consortium highlighted that the sanitation service chain breaks down due to both a lack of public or private investment and because where financing is or should be available, it is not allocated to the appropriate service actors and operators (public, private or community based) to make sure that the system remains functional (Gold37). This was supported by the findings from Cameroon which demonstrated that although the potential to levy a sanitation tax exists in legislation; it has not been implemented and consequently cannot be used to finance activities within the sanitation service chain as expected when it was introduced (Mougoué26). Despite intensive efforts under the SPLASH programme, it proved very difficult to collect reliable financial flow data along the service chain. Consequently, it remains unclear how and where available finance is best allocated to ensure that the overall system is functional.

Conclusions on the synthesis of the SPLASH research projects

Urban sanitation service chains are complex and fragmented, involve many different service providers and a range of central and local government departments. We conclude the following points from our cross-cutting synthesis of the individual projects.

- It is important that we have a full understanding of how individual interventions by such stakeholders affect local sanitation service chains.
- The broad planning questions of ‘how have we got to where we are now and what lessons can we learn?’ are not currently considered within the sanitation service chain framework, which focuses more on the ‘where are we now and where do we want to get to’ aspects of planning.
- Given that the sanitation service chain has to operate within the wider city planning context, understanding how a city has reached its status quo is critical to developing the sanitation service chain framework.

The research conducted as part of the SPLASH urban sanitation research programme has primarily continued to focus on the existing processes in place. However, some aspects of the research have started to delve deeper into the questions of ‘how have we got to where we are now’ including; the

full institutional assessment in Kigali, Kampala and Kisumu (3K-SAN), Douala and Yaoundé (MAFADY) to understand roles and responsibilities more clearly, the analysis of the legal frameworks and regulation affecting sanitation services, and the paucity of access to financial services, especially for the urban poor (3K-SAN), the rapid risk assessment tool developed in Mozambique, and starting to analyse local market conditions for treated faecal sludge end-use by FAME in Dakar and Kampala. With this type of evidence becoming available it becomes possible to develop more flexible and responsive sanitation interventions that take into account a dynamic, longer term view and user perceptions which can discuss short term trade-offs in the context of mid to longer term gains. We may have to accept that improvements are not going to happen systematically but instead, understand how it is possible to continue with smaller, more specific interventions that take account of the city-wide context in such a way as to maintain the ultimate goals of public health and environmental protection. Ongoing research is being funded by the World Bank and the Bill and Melinda Gates Foundation, aimed at identifying city-wide faecal waste flows and the service delivery context within which sanitation service improvements can be addressed in systematic and achievable stages.

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