Research Paper

Diagnostics for assessing city-wide sanitation services

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ABSTRACT

This paper presents results of research that has developed a set of diagnostic and decision-support tools for assessing sanitation services city-wide. It highlights features of the tools and illustrates key results from their validation through application in five cities worldwide. Collective use of these tools reveals and explains the complexities of the enabling environment and political economy within which sanitation services are delivered. Results present not only the status quo of services but also reasons for them being so. The tools have proven effective in guiding the collection, analysis and discussion of evidence, as a precursor to detailed feasibility studies, necessary to ultimately plan appropriate city-wide sanitation interventions.

Key words | diagnostics, enabling environment, faecal sludge management, political economy analysis, sanitation service chain, service delivery assessment

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INTRODUCTION

Urbanisation presents both significant opportunities and huge challenges in achieving access to urban infrastructure and services (Allen 2009; United Nations 2018). Urban sanitation development is complex, requiring consideration of broad factors affecting service and infrastructure needs and opportunities, particularly for those without access to even basic services whose lack of property rights, tenure security and official recognition disincentivises investment in, for example, upgrading a toilet (Cotton & Franceys 1988; Scott *et al.* 2013; McGranahan *et al.* 2016).

To achieve Sustainable Development Goal target 6.2 of 'access to adequate and equitable sanitation and hygiene for all' (WHO/UNICEF 2017), requires detailed understanding of the status of sanitation services, to inform actions that can achieve universal access to facilities and safely managed excreta. Collignon & Vézina (2000) represented the various on-site sanitation services delivered by independent providers to residents of low-income settlements in many of Africa's large cities, in a bid to better understand their complexity. The representation of these services within the 'sanitation service chain' provides a valuable overview of services but cannot adequately portray the complexity of urban sanitation functions and management requirements. To function, each service chain needs to be socially, financially and technically sustainable within the wider urban context of city management and governance (Okurut *et al.* 2015; Medland *et al.* 2016).

Recognising that limited attention to the management of faecal sludge from on-site sanitation systems was hindering sanitation improvements in poor urban communities, the World Bank commissioned a global desk-based review of faecal sludge management (FSM) in 12 cities (Peal *et al.* 2014a). The diagnostic tools developed from this study – a faecal waste flow diagram (also referred to as a Shit Flow Diagram, or SFD) and a service delivery assessment (SDA) – present a clear overview of the sanitation context,

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exposing weaknesses in FSM services and proposing ways to improve them (Peal *et al.* 2014b). The study highlighted the value of combining tools to help decision-makers identify strengths and weaknesses of FSM services and the systems supporting them, while also identifying opportunities to refine the tools and use primary research to enable greater data disaggregation (Peal *et al.* 2014b). These and other available tools were also noted as lacking explicit analysis of political dynamics (Kennedy-Walker *et al.* 2015). Without such explicit analysis, investment projects often fail to deliver against outcomes intended by donors (Harris *et al.* 2011). Assessing the political economy of sanitation allows the root causes affecting delivery of urban sanitation services, and their prospects for development, to be presented more openly and responded to (WSP 2011).

This paper presents results of research conducted in 2014–2016 whose purpose was to validate the existing diagnostic tools (i.e. the SFD and SDA) using primary data through field testing, while incorporating political economy analysis (PEA) as an integral part of the process in recognition of how challenging reforming FSM services is. The research also produced new decision-support tools and guidelines, informed through the evidence-based findings, which this paper introduces. Other assessment tools and processes evolving at the time (for example, the Citywide FSM assessment and planning toolkit of the PAS (Performance Assessment System) Project at CEPT University, India (http://ifsmtoolkit.pas.org.in/home) and the FSM Toolbox including situational and stakeholder analysis, financial and technology assessments (www.fsmtoolbox.com/), highlighted the significant gap in understanding how to assess FSM services as integral to citywide sanitation services.

RESEARCH METHODS

Taking forward recommendations from the desk-based study, the World Bank commissioned research to establish a suite of diagnostic and decision-support tools that could guide the identification and means of implementing improved FSM service options. The research process applied the existing SFD and SDA tools in the field, drawing on primary data notably from household surveys, focus group discussions and structured transect walks. Simultaneously a PEA process drew on primary data from key informant interviews and observations of service providers and facilities. Adopting a PEA process as an integral and iterative part of the SDA process would help to better understand *why* sanitation services operate in the way they do. The research process eventually translated the PEA into a '*prognosis for change*' for improving sanitation services. Table 1 summarises the tools used, their objective, status and application to the research.

Studies were conducted in five cities to validate the tools in Balikpapan, Indonesia; Dhaka, Bangladesh; Hawassa, Ethiopia; Lima, Peru; and Santa Cruz, Bolivia.

Table 1 | Tools and their objectives

	Tool	Objective	Status and application
Diagnostic tools	1. Faecal Waste Flow Diagram (SFD)	Represents the proportion of faecal waste that is managed and where the unmanaged portion ends up	Existing: SFD applied in its current format
	2. City Service Delivery Assessment (CSDA)	Assesses the enabling environment[a] for sanitation and quality of services through the sanitation service chain. Indicates areas for action	Existing: SDA modified slightly before use
	3. Prognosis for Change (Political Economy Analysis)	Identifies interests and incentives that can prevent action, with possible entry points to overcome them	Existing: PEA methods applied. Results analyzed as a Prognosis for Change
Decision-support tools	4. Service Delivery Action Framework	Helps to identify actions relative to the enabling environment to deliver improved outcomes	Developed during the research: draws on results of Tools 2&3
	5. Intervention Options Assessment	Helps to identify technical interventions through the sanitation service chain. Can guide programme design	Developed during the research: draws on results of Tool 1

[a]The policy, legal, regulatory, institutional, programming, monitoring and evaluation, capacity and financial factors bearing on sanitation service provision.

Cities were selected to offer a geographical spread, range of population size and environmental conditions. Each city was also connected to past, ongoing or potential World Bank Technical Assistance or city sanitation investment projects. Quantitative and qualitative data were collected on each city's sanitation situation relating to FSM, but within the city-wide sanitation context. The household survey adopted two-stage cluster sampling as a cost-efficient way to create a random sample of the population from within the chosen clusters. Using two sub-samples, the first was designed with 30 clusters to provide representative estimates at the city-wide level, while the second did the same for specific geographic areas identified as being low-income. This is described more fully in Ross *et al.* (2016).

The main indicator for the household survey was the proportion of households using on-site sanitation. Assuming this to be between 60% and 100% for most developing country cities, an expected frequency of this indicator was taken as 80%. The household surveys identified on-site sanitation coverage as: 100% in Hawassa, 89% in Balikpapan, 54% in Dhaka, 51% in Santa Cruz and 7% in Lima (an average of 60%). Cities in Latin America tend to have higher sewerage coverage than in sub-Saharan Africa and Asia (as Lima and Santa Cruz highlight), although heavily skewed by wealth quintiles. In Santa Cruz for example, almost 60% of the population in the three lower wealth quintiles use on-site sanitation (2012 National Census). With population size taken to be 'infinite', margin of error 5%, design effect 2 and a confidence level of 90%, the resulting cluster size was 12. Selecting 12 households at random for 30 clusters in each sub-sample resulted in 720 household interviews per city. The sub-sample in low-income areas produced results of relatively high confidence for the defined geographical area, although with purposive selection of these areas they would not be statistically representative.

Over 2,600 household questionnaires contributed to the primary data set across the five cities. Household survey data were analysed using STATA, while qualitative data from transect walks, observations, focus group discussions held with community members in low-income areas and key informant interviews were analysed using coding and thematic categorisation, counting frequencies, and other descriptive analysis of responses. Secondary data were obtained from consultancy reports and government documents including policies, strategic plans for sanitation improvements, building codes, bylaws and standards. Local survey firms conducted the household survey, focus group discussions and transect walks in each city, while local and international consultant teams conducted key informant interviews, observations and document reviews.

Stakeholder consultation supported data verification and finalising the case studies, with workshops held to present, discuss, adapt and validate the findings before final reports and recommendations were agreed. Allocating sufficient time and resources to facilitate inclusive and comprehensive stakeholder consultation – including consideration of what to do in response – raised stakeholders' awareness, understanding and interest in both city-wide services and sanitation services to poor urban communities. More direct community engagement, essential for later planning tools and processes (Lüthi *et al.* 2010), was not deemed necessary for this pre-feasibility assessment.

Ethics

Ethical approval for the research was issued by Loughborough University's Ethics Approvals (Human Participants) Sub-Committee. Approval was also granted from the Bureaux of Statistics in Dhaka and Hawassa to conduct an independent study. Data collection in Balikpapan, Lima and Santa Cruz was linked to ongoing studies.

RESULTS AND DISCUSSION

Full research outputs comprise: five detailed city reports, the diagnostic and decision-support tools themselves, data collection instruments and protocols, and Terms of Reference for future studies. This section presents an overview of the suite of tools, with some key findings from their application.

While the research sought to emphasise the complexities of FSM services, functionality of all service chains feature in the tools – most notably in the resulting SFD. Figure 1 maps the interrelations between the pre-existing tools (the faecal waste flow diagram, Tool 1; and a modified city service delivery assessment (CSDA), Tool 2) together with the integrated PEA (adapted as a Prognosis for

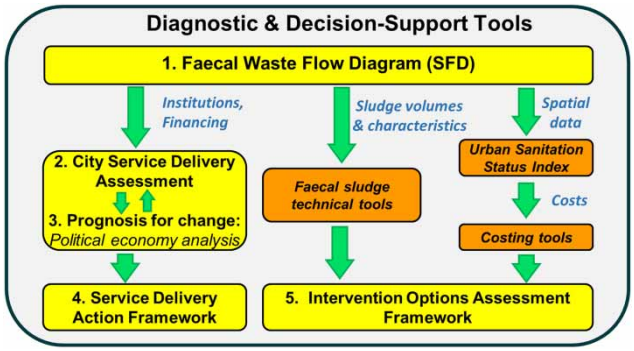

Figure 1 | How the tools fit together.

Change, Tool 3) and tools developed and incorporated into this research (Tools 4 and 5).

Applying these tools together has provided the evidence base for far greater depth of analysis than previously achieved. The strength of analysis and resulting prognosis is guaranteed by comprehensive evidence from primary data sources, validated by consideration of secondary data and triangulation between varied data sets. When considered with results of tools that were being concurrently developed under other initiatives (unnumbered boxes in Figure 1), they achieve a comprehensive assessment of the status quo, as well as provide a basis for recommending future actions. These actions include institutional, systems-based interventions accounting for the broader enabling environment (Tool 4), aligned with intervention options that address technical and financing aspects in support of comprehensive investment programmes (Tool 5).

The ability to disaggregate data into the two sub-samples allowed stark differences between services at city-wide scale and those experienced in low-income settlements to be highlighted using faecal waste flow diagrams (SFDs). For example, in the results from Lima, Peru (Figure 2) over 90% of people city-wide are connected to a sewer. The majority of the 48% of faecal waste which is unsafely managed results from poor functioning of these sewers. In low-income settlements, the SFD highlights both the total absence of sewers and the almost total lack of FSM services, in the form of safely managed emptying, transport and/or treatment of faecal sludge. The result is that 99% of faecal waste is returned unsafely to the local environment. A distinct SFD for low-income areas can reveal the extent of poor services, otherwise 'masked' in aggregated city-wide results.

Using a slightly adapted form of the SDA question and scoring methodology developed by Peal *et al.* (2014a), a city SDA scorecard was prepared for each city. Significantly, this research undertook the CSDA process in each city in direct consultation with key city stakeholders. The resulting scorecard, however, does not explain the *reason* for the current situation, or identify specific barriers needing to be overcome to make improvements. The CSDA was therefore conducted in conjunction with an analysis of the political economy of FSM in the city, to understand and identify three major elements: (i) how key institutions (both formal and informal) function, (ii) the incentives provided to stakeholders by those institutions, and (iii) the power (again,

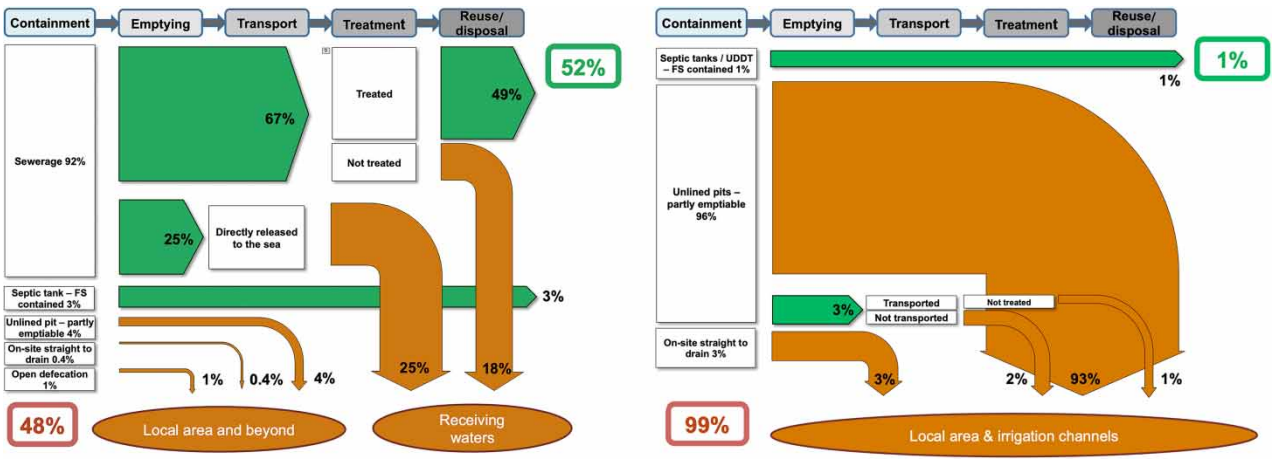

Figure 2 | SFDs for Lima, Peru showing contrasting results city-wide and for low-income settlements.

formal or informal) they have to exert influence over service provision. Assessing the CSDA and PEA findings iteratively enabled an understanding to emerge around the status quo and realistic future options, responsive to otherwise hidden realities. By accounting for underlying political economy factors, proposed interventions, represented as a Prognosis for Change, are more likely to succeed. The process adopted methods used in multi-country PEA studies conducted by the World Bank Sanitation Global Practice Team (WSP 2011) primarily: stakeholder mapping, stakeholder influence analysis and process mapping. Results from applying the methods were used to 'evidence' and inform the eventual Prognosis for Change, while in many cases they did not form an explicit part of the city reports themselves.

In the Hawassa study, a process map was prepared to illustrate the formal and informal processes followed when households need their pits emptying (Figure 3). Highlighting the extent to which the formal processes (central column) are side-stepped in practice (right column) helped to inform recommendations (left column) affecting the reform of service tariffs, licensing private vacuum truck operators and improving access to the existing faecal sludge treatment plant (FSTP). These recommendations were subsequently considered in light of the results from the stakeholder influence analysis, to identify the likelihood of reforms being acceptable to key stakeholders.

In the Dhaka study, a process mapping activity investigated the processes followed during the construction of a new building in the city. It identified and helped to explain

Entry points	Formal process	*Informal processes*
	Household pit fills up with FS	
	↓	
	Household contacts WSE to empty pit	*the WSE truck has a long waiting list, so the household also gets a quote from a private truck company*
	↓	
Improve resourcing of the WSE truck service	WSE arranges appointment within 7 days	*after a few weeks of waiting for the WSE, the pit starts to overflow and the household decides to use the private company*
	↓	
Increase tariff so that WSE is not loss-making and can maintain trucks	WSE truck empties pit and household pays standard rate of 746 birr	*the private company charges 1,500 birr to empty the pit*
	↓	
Install all-weather surface on FSTP access road	WSE truck empties pit at the treatment plant	*during the rainy season, the road may be impassable to trucks and an unknown process happens*

FS = faecal sludge, FSTP = faecal sludge treatment plant,
WSE = Water and Sewerage Enterprise (of Hawassa City Administration),
1 USD = 28 ETB (birr)

Figure 3 | Example of a process map: emptying a household latrine pit in Hawassa, Ethiopia.

both the formal permissions process affecting service connections for new buildings, alongside the more prevalent and informal process with permissions not being granted by the capital development authority (RaJUK) to property developers. One outcome from this informality is the continued absence of correctly constructed septic tanks for new developments. A stakeholder mapping matrix for this process in Dhaka (Figure 4) showed the perceived likelihood of stakeholders' support or opposition to following the *formal* procedures, and their likely influence over the outcome. Preparing this matrix alongside the SDA helped to identify the incentives, influence and interests that certain stakeholders either exert, or need to exert, on current processes. This went some way to explaining why *informal* processes continue to dominate and identifying the challenges that need to be overcome to improve outcomes.

The combined result of integrating PEA tools and data analysis alongside the faecal waste flow and service delivery analysis tools and data analysis, forms a rich situation analysis of a city and its prognosis for change. The narratives were focused around realistic and achievable actions towards improvements, starting from and informed by the status quo.

Additional decision-support tools were developed. These take information and evidence generated by the diagnostic tools and identify appropriate interventions to address highlighted priorities. The Service Delivery Action Framework (Tool 4) recommends institutional actions to be considered based on the combined results of the SDA and PEA. These actions start from the current reality in the city and recognise that progress will be gradual. The Intervention Options Action Framework (Tool 5) recommends appropriate

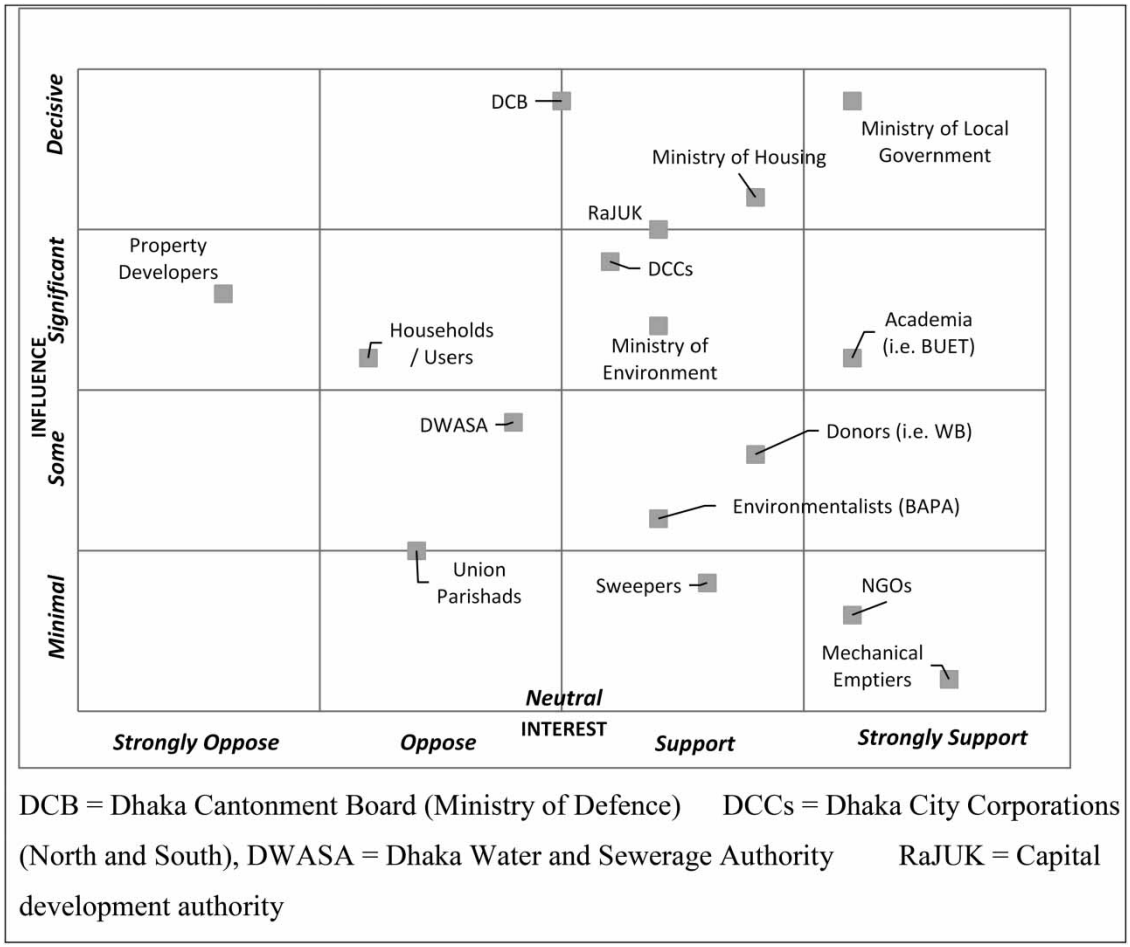

Figure 4 | Example of a stakeholder matrix: new service connections in Dhaka, Bangladesh.

technical interventions to be considered based on the faecal waste flow diagram (SFD), drawing on experience of good sanitation and FSM practices appropriate to the city context. A Service Delivery Action Framework was found to emerge promptly, through carefully facilitated consultation with key stakeholders reflecting on institutional weaknesses and opportunities resulting from the CSDA and Prognosis for Change. The Intervention Options Assessment Framework could also initiate early dialogue around priority needs revealed in the SFD graphic, with possible technical interventions to address them, subject to further detailed investigation. In the Santa Cruz study, recommended actions included encouraging competition amongst the emptying and transport service providers to increase service access to the poor, coupled with enforced technical construction standards and good maintenance practices of on-site facilities. In Dhaka, priority actions for improving the service delivery context included segregating the roles for regulating, issuing licences to and having management oversight of service providers. These would be supported by enforced standards for containment infrastructure that both enable upgrades to existing systems and ensure containment facilities for new buildings are built to those standards. In Hawassa, proposed key actions included identifying equitable and appropriate service level improvements for rapidly densifying settlements in central, industrial and low-income locations, reforming service provider roles to distinguish them between household-level and public services, and improving faecal sludge treatment facilities through location and access at a new site, with better treatment and management oversight. In moving from these analytical conclusions to prioritising investment options, municipal authorities would need to assess costs and other technical aspects such as sludge volumes, characteristics and spatial issues.

CONCLUSIONS

An approach to diagnose the complexity of multiple sanitation service chains operating within a city has been tried and tested, as well as being linked to an achievable way forward in each case. Applying a broad set of data collection instruments has captured information about all sanitation service chains in five cities, with emphasis on FSM services. Extensive analysis of qualitative and quantitative data has enabled contextualised recommendations to improve services in each city, with stakeholder engagement and consultation helping build common ownership of them. Integrating PEA into the process provides a mechanism to capture implicit knowledge, analyse and articulate it clearly. Preparing a Prognosis for Change for each city has helped to channel varying experiences and perceptions of the problems from different stakeholder perspectives into a coherent framework for action. Being strongly evidence-based, resulting recommendations can challenge prevailing opinions, while handling communications around such topics delicately to avoid alienation.

The suite of tools, applied collectively, provides a means to collate evidence as a pre-feasibility activity. Results can enable dialogue amongst key stakeholders such that all aspects of sanitation services within the city will be addressed at detailed feasibility stage. To apply the diagnostic tools effectively in other cities requires time, resources and expertise in urban sanitation. However, they contribute to a growing set of complementary sanitation assessment and planning tools that are maturing within the sector to help engagement with an otherwise seemingly intractable challenge. Further detailed planning processes, such as applied to developing City Sanitation Plans in India or broader urban planning initiatives, are amongst the complimentary tools for this next detailed stage.

Drawing on model Terms of Reference, many of the tools themselves and data collection instruments (Ross *et al.* 2016), the process has been subsequently applied in Port Harcourt (Nigeria), Kigali (Rwanda) and Port-au-Prince (Haiti).

Many cities are desperately seeking pragmatic, workable solutions to improve sanitation services through addressing FSM and sewerage services alike, to realise equitable access to sustainable sanitation services for all. These diagnostic and decision-support tools offer a means to bring clarity in understanding urban sanitation contexts and complexities in low- and middle-income settings. The research demonstrates that applying the tools, analysing results and reaching agreement on the implications, with close stakeholder consultation, is workable and effective.

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