Illustrating the Fate of Excreta: The SFD Methodology in Eight Cities

The Shit-Flow-Diagram (SFD) Promotion Initiative has developed a methodology and tools to estimate excreta flows on a city-wide scale, in a way that ensures credible and transparent results. Shit-Flow-Diagrams are designed to present complex information in an easy to understand fashion. Lars Schoebitz[1], Linda Strande[1]

Introduction

Appropriate urban sanitation planning, that includes a design approach for adequate wastewater and faecal sludge treatment infrastructure, is a key element to protect public and environmental health (see Strande et al., pp. 12–13). This incorporates the assessment of excreta flows that need to be managed, which is quite challenging. Unlike estimating wastewater on a city-wide scale for which reliable methods exist, a reliable method to calculate quantities of produced and accumulated faecal sludge is still lacking.

Background

In their work on comprehensive service delivery assessments (SDAs), Peal et al. developed an approach to estimate wastewater and faecal sludge quantities [1]. This resulted in the first generation of Shit-Flow-Diagrams (SFDs), which represent one element of a SDA. The SDA is used to assess overall faecal sludge management from containment to emptying, transport, treatment and disposal and/or end-use [2]. The authors highlight the challenges in producing SFDs that are comparable among cities and also identified the need to develop a common approach that can be implemented worldwide.

SFD Promotion Initiative

The SFD Promotion Initiative is a collaborative research project established to address the above challenges by developing a methodology and tools for the production of credible SFDs. Figure 1 presents the institutions involved in the project.

Over the last year, field- and desk-based methodologies were implemented in several cities in a variety of global regions (for more information, refer to the project website). The outputs include a detailed report with a four-page executive summary and a SFD for each city. Also, the reports contain a detailed description of the steps taken to produce the SFD, including all calculations, data sources and assumptions that were made. In addition, there is a service delivery context description or analysis, depending on the level of data collection.

The four-page executive summaries, including the SFDs, provide a highly powerful communication and advocacy tool when discussing excreta management among representative stakeholders. Presented here are highlights of the results and lessons learned by Eawag/Sandec while implementing the SFD methodology in eight cities.

Figure 1: Institutions involved in the SFD Promotion Initiative.

Learning from experience

Desk- and field-based assessment

Figure 2 shows the eight cities where the methodology was implemented by Eawag/Sandec. Field-based SFDs were conducted in Dar es Salaam and Khulna, supported by research assistants and local partners. For these, the project team emphasised the engagement of local stakeholders, such as ministries, city authorities, and water and sanitation utilities, to start dialogues about excreta management, receive confirmation of obtained results and to create a sense of ownership. This included key informant interviews, focus group discussions and field observations.

In the other cities, a desk-based methodology was implemented. Both methods rely almost entirely on secondary data; however, the engagement with local stakeholders that was part of the field-based approach provided a highly valuable, detailed understanding about the city context that was also useful for the triangulation of data. The use of the SFD as an advocacy and communication tool began with this field-based stakeholder engagement. Doing this increases the potential that the results would be used in the planning of future infrastructure and legal frameworks to improve sanitation service delivery. In contrast, it was found that desk-based SFDs were more difficult to produce, as access to local stakeholders only through email and phone calls could not replace the personal interactions and observations that result from the field-based approach.

SFD approach

The SFD method is a way to estimate percentages of people that have access to sanitation service delivery at each stage of the sanitation service chain, for example, offsite (sewer) or onsite (faecal sludge) sanitation, and to faecal sludge emptying, transport and treatment. Starting with containment, the SFD method evaluates whether faecal sludge is contained or not contained, based on the potential risk of groundwater pollution. This is estimated

by analysing soil conditions, source of drinking water, and level of drinking water treatment. The type of containment technology used influences whether excreta are categorised as contained or not contained.

For example, if the containment is fully lined (watertight) without an overflow, it is considered safe regardless of groundwater conditions. A pit latrine with lined walls, but with an open bottom, is only considered safe if the risk of groundwater pollution is low. These distinctions highlight the importance of field observations, as such detailed technical information about containment technologies is rarely available from secondary data.

This process continues through the sanitation service chain. Following containment analysis, the percentage of people with emptying services is estimated. Then, the percentage of faecal sludge that is actually delivered to treatment is calculated followed by estimations of the percentage of faecal sludge and wastewater that are adequately treated. Each step requires innovation on the part of the implementer to calculate reasonable estimates.

Results and discussion

The eight cities in Figure 2 have populations ranging from 45 000 to 5 000 000, and have a wide variety of sanitation technologies in place. Because the cities are very different, this enabled evaluation of the applicability of the SFD method in different contexts. Figure 2 provides a summary of safely and unsafely managed excreta for all eight cities, including population numbers and fraction of onsite and offsite sanitation. Details regarding containment, emptying, transport and treatment can be found in the executive summaries and reports accessible on the project website.

In six of the cities, more than 90 % of the population relied on onsite sanitation. Durban had the highest access to sewer-based sanitation, with 56 % of the population connected. Excreta in Nonthaburi and Durban are more than 70 % safely managed, while in Hanoi and Khulna more than 80 % are not safely managed.

An important outcome of making a SFD is the ability to identify areas for priority intervention along the sanitation service chain. For example, if a high percentage of faecal sludge is not contained, this indicates a significant risk of groundwater pollution and, therefore, a significant risk to public health. This situation is particularly evident in Khulna, but also in Dar es Salaam and Kampala, where slums are in areas with high groundwater and permeable containment technologies. In these situations, improvements to the containment infrastructure are required. However, in cities with a low risk of groundwater pollution, according to the SFD methodology, faecal sludge is considered contained and, therefore, safely managed even if not emptied. This situation exists in rural areas of Durban, where urine diverting dry toilets are used and provide an appropriate sanitation solution, and can also be found in medium- and high-income areas of Dar es Salaam and Kampala.

CITY	POPULATION	OFF- / ONSITE		SAFE / UNSAFE
Bignona	44 783	0	100	
Danang	1 007 400	0	100	
Dar es Salaam	5 000 000	10	90	
Durban	3 550 000	58	42	
Hanoi	3 147 000	12	88	
Kampala	2 250 000	8	92	
Khulna	1 500 000	9	91	
Nonthaburi	256 457	0	100	

Figure 2: Summary of safely and unsafely managed excreta in eight cities.

Results of the SFDs also illustrate the importance of faecal sludge treatment infrastructure and the role of the private sector in the emptying, collection and transport of faecal sludge. For example, in Hanoi and Nonthaburi, there is wide access to faecal sludge emptying services through the private sector. But, in Hanoi, there is no legal discharge location for the private service providers; the only option for them is, therefore, to dump the collected sludge directly into the urban environment. In Dar es Salaam, treatment plants exist, but it was still estimated that 56 % of the emptied faecal sludge is not delivered to treatment. The pervasive dumping of faecal sludge in the environment has obvious public health implications that will not be resolved without adequate treatment infrastructure.

Outlook

Now that a SFD methodology has been developed, in the coming year the SFD Promotion Initiative will start a help-desk to provide support for people implementing the method on their own. Quality assurance and control measures will be further developed to enable a consistent review process. Work will also be done to further improve the method to increase the accuracy of results, for example, to be able to more precisely estimate the flows of treated or untreated faecal sludge and wastewater than is currently possible. With increasing experience and results, the methodology will continue to improve and become a standardised tool that can be used globally to produce credible representations of unsafely managed excreta on a city-wide scale. Other possible future adaptations include analysis at a neighbourhood scale for priority interventions, or at a national scale for the monitoring of development goals.

[1] Peal, A., Evans, B., Blackett, I., Hawkins, P., Heymans, C. (2014): Fecal sludge management (FSM): analytical tools for assessing faecal sludge in cities. Journal of Water, Sanitation and Hygiene for Development *4 (3)*, 371–383.

[2] Peal, A., Evans, B., Blackett, I., Hawkins, P., Heymans, C. (2014): Fecal sludge management: a comparative analysis of 12 cities. Journal of Water, Sanitation and Hygiene for Development *4 (4)*, 563–575.

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SFD Project website:
www.sfd.susana.org

Eawag/Sandec website:
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