Predicting the impact of sanitation investment projects on the Sanitation Service Chain (SSC), using excreta flow diagrams (SFDs)

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Context

Onsite sanitation systems are the predominant sanitation option worldwide (Medland et al., 2015). High population density in cities in low-middle income countries means that faecal sludge (FS) from onsite systems cannot be managed safely onsite. This creates a need for safe management of the FS through the sanitation service chain (SSC) (Hawkins et al. 2013). The movement of FS and wastewater through the SSC can be illustrated by an Excreta Flow Diagram (SFD), which provides a strategic overview of the sanitation situation in the city (Blackett and Evans, 2015).

The SFD methodology developed through the Shit Flow Diagram Promotion Initiative (sfd.susana.org/) has been applied in over 40 cities worldwide. As part of this SFD Promotion Initiative, the SFD for Kumasi (Ghana) was developed by WEDC and Kumasi Metropolitan Assembly (Furlong, 2015), which provides the basis for this research. The main use of SFDs has been as an advocacy tool. This research explores the use of the SFD methodology to model the impact over a 10 year period of sanitation investment projects that are currently happening in Kumasi. Due to the nature of SFDs, this impact can be assessed across the whole SSC, allowing stakeholders to see how future investment projects may change the flow of excreta in cities.

Methodology

Three sanitation investment projects in Kumasi were identified and used to develop four scenarios. For each scenario, a list of questions was developed to define the minimum data collection required from secondary data set and key informant interviews. Nine semi-structured interviews were undertaken to collect primary data on current projects in Kumasi and gain interviewees' opinions about the future scenarios. The key informants were asked about all aspects of the SSC.

The data collected was triangulated and the scenarios were developed using population growth and planned or ongoing investment projects in Kumasi as the main variables. A quantitative summary for each scenario was produced and all assumptions were clearly defined. The SFD calculation tool (available at sfd.susana.org) was used to produce a SFD for Year 1 (2016), Year 5 (as current projects will be completed within 5 years) and at Year 10 (2025, to illustrate long term impacts). "Trend graphs" were then developed for each part of the SSC, to show the impact of each scenario on city wide sanitation (Fernandez-Martinez, 2016).

Scenarios

Three investment projects were identified in Kumasi as either ongoing or committed:

a) "A toilet in every compound", with the objective to increase access to compound toilets for 100,000 low-income residents
b) Rehabilitation of the Faecal Sludge Treatment Plant (FSTP): to increase the efficiency of the treatment plant, but not its treatment capacity
c) Public toilets project: to rehabilitate 38 existing public toilets and construct 70 new public toilets.

Based on these projects, four scenarios were developed, as summarised in Table 1.1:

Table 1.1: Scenarios based on the investment projects

Scenario	Projects	Main variables
S1	None: Baseline scenario	• Population growth rate • No investments for 10 years • Infrastructure remains constant
S2	a) "A toilet in every compound" b) Rehabilitation of the FSTP	• Population growth rate • Percentage of population living in compound houses with access to new private toilets • Treatment efficiency of FSTP
S3	c) Public Toilets project	• Population growth rate • Number of public toilets
S4	Scenarios 2 and 3 combined	• Population growth rate • Percentage of population living in compound houses with access to new private toilets • Treatment efficiency of FSTP, and • Number of public toilets

Results & Discussion

For each scenario, stages through the SSC were identified at which the various sanitation systems would not have sufficient capacity to meet future demands. Key results highlight that:

- access to private toilets does not significantly increase in any scenario, creating an increased dependency on the public toilets;
- while the number of existing public toilets cannot meet the future demand (S1 and S2), even considering the rehabilitated and newly constructed toilets (S3 and S4), they can only meet demand until 2022;
- if the number of vacuum tankers operating remains constant (assumed for all scenarios) they will not be able to meet the demand for emptying onsite systems beyond 2017;
- the FSTP is already working over capacity and its efficiency will be reduced in all scenarios, even following rehabilitation

Changes from one scenario to another were observed easily in the SFDs, but changes within the same scenario were more difficult to see. This led to the development of "trend graphs", which clarified the changes at different stages of the SSC over the 10 year period. They can be seen as an extension to the SFD methodology (Fernandez-Martinez, 2016), produced using the same datasets required to generate the SFD and the results of those SFDs.

Conclusions

Trends and changes in SFDs, based on the scenarios over 10 year time period, are not easily observed using the SFD only. Trend graphs, visually representing changes over time at discrete stages of the SSC, show more clearly the impact of a scenario through the SSC. Their use should be considered for wider application when planning investments in a city to identify where, when and under what conditions the systems will no longer have capacity to safely manage FS and wastewater.

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