



IRC

A review of tools and frameworks for integrated waste management planning and assessment

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INTRODUCTION

Greywater, solid waste and faecal waste management have been separately handled over the years leading to negative effects on the public health and environment. The management of waste has been handled separately over the years. This has resulted in poor planning of infrastructure and the management of waste. Rapid urbanization and development in Low and Middle-Income Countries (LMICs) will increase waste production and the need to develop sustainable waste management solutions. Management of waste is important for sustainable WASH services, particularly for the poor and the most vulnerable.

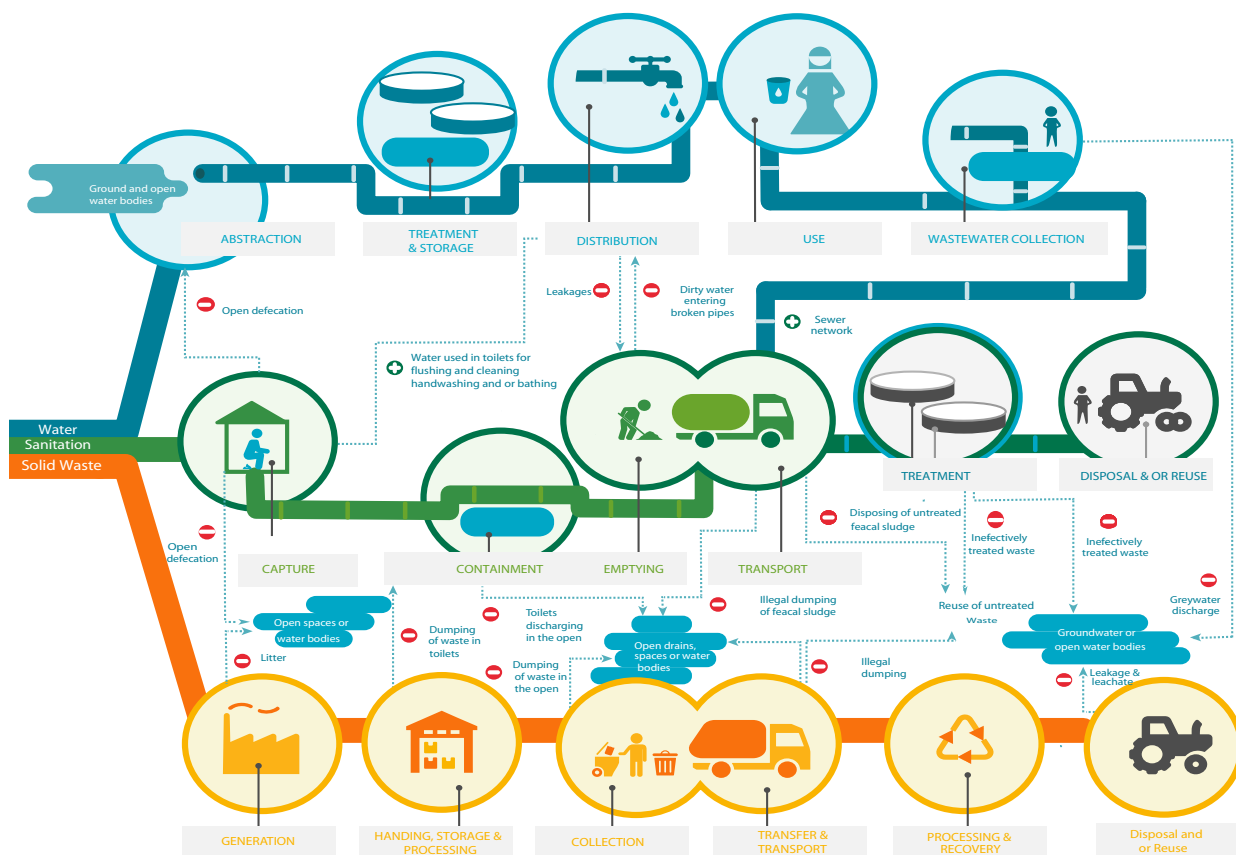
The three waste streams (greywater, solid and faecal waste) cause many overlapping health and environmental problems, which have been overlooked for years. Solid waste leachate pollutes water resources, negatively affecting the water quality. In addition, solid waste can clog open drains where illegal overflows from latrines and septic tanks end up, leading to urban flooding. In areas where open defecation is practiced, faecal waste may end up being washed into nearby water bodies affecting the water quality. Also, water

quality is affected by flows from leaking sewer lines entering broken water supply pipes. Greywater may contain a number of chemical and physical contaminants, which will affect the water quality if discharged in a lake or pond. Greywater may be a saving grace as it flushes the waste in drains out of the neighbourhood. However, if untreated it can change the soil composition and water quality over time.

As seen above, the three different waste streams may end up together without proper waste management (Figure 1). It is therefore important to integrate the planning for these three streams to reduce the negative effects. It is also important for better assessment and planning of urban infrastructure. Therefore, IRC is developing a framework for integrated waste management planning considering all three waste streams: greywater, faecal waste, solid waste.

IRC has developed a Faecal Waste Flow Calculator to determine faecal waste volumes along the entire sanitation service chain, allowing city planners, service authorities, or any other users to determine where the biggest losses are and where interventions

Figure 1: Interlinkages of waste streams (Erick Baetings/IRC)



should be targeted. Additionally, it looks at less easily quantifiable issues such as the existence of policies and legislation, availability and transparency of plans and budgets, and presence and adherence to environmental and safety standards captured with the use of scorecards. Now IRC is working to take it to the next level by including the two other waste streams in an integrated waste management system (covering the broad definition of sanitation). In this light we have conducted a literature review to identify existing tools that incorporate water, sanitation, and solid waste (either any two or all three).

OBJECTIVES

The main objective of this article is to assess the existing tools that are used for assessment/planning of any of the three waste streams and to check if they consider the other waste streams in the assessment/planning process.

Other objectives were:

1. Categorise, and analyse those tools that have been or could be utilised to assess/plan or help in decision-making for water, sanitation, and solid waste management services in an integrated manner.
2. To create awareness about the interlinkages of the three streams and how to assess the key integration challenges

METHODOLOGY

The review focused on tools or frameworks that help service delivery planning/assessment in cities or small towns. The main sources of data were reports, journal articles, and websites. The study looked solely at English publications and the search was mainly conducted on Google Scholar and Research Direct. The keywords used were integrated solid waste and faecal waste tool, solid waste and drinking water tools, faecal waste and drinking water tools, faecal and solid waste tools, solid waste tools, faecal waste tools, sanitation tools, and drinking water tools. The term integration in this context means that there is a combination of one or two things (tools). The nature/purpose of the tools and waste streams of the tools are among the outputs of the review, as shown in Figure 1.

Considering it was a rapid literature review, the tools that were found and discussed, are based on their discoverability by the authors.

ANALYSIS

The table below shows a list of available approaches, frameworks and tools for water (including greywater), sanitation and solid waste management. The first three in the list: Household-Centred Environmental Sanitation (HCES), Community-Led Urban Environmental Sanitation (CLUES) and City Sanitation Plan (CSP) - are actually approaches for water and sanitation service planning in a community, where community refers to a village, small town or city respectively for the three approaches. It is noteworthy that all three consider solid waste as an integral part of water and sanitation service planning. Unfortunately, cases where CLUES has been used are limited, and there is no proper example of HCES use. But CSP is being used in different cities. There is also one planning framework for solid waste, Integrated Sustainable Waste Management (ISWM). Its primary concern is environmental aspects, including water and faecal waste. Approaches are followed by assessment tools and frameworks. For water, there are two (nos. 5 and 6 in the list). Among them is Water Resources Assessment (WRA), a handbook-based tool designed for water resources mapping. The water flow diagram on the other hand maps urban water flow in a quantitative manner and presents the findings in a Sankey diagram. None of them looks at other waste streams in their assessment procedure.

Among the sanitation assessment tools, one is the Shit Flow Diagram (SFD). SFD is mainly a sanitation service assessment tool, but it also considers the groundwater situation. The Waste Flow Calculator is a rapid assessment tool for faecal waste quantification. There are two other complementary tools for sanitation service assessment: the City Service Delivery Assessment (CSDA) and the Urban Sanitation Status Index (USSI).

For solid waste assessment, there are three different tools: the City MSW rapid assessment & collection tool, the Waste flow diagram and the Waste Wise City Tool. All three look directly at solid wastes. The Waste Flow Diagram mainly considers plastic waste for planning, while the Waste Wise City Tool specifically includes the generation of food waste.

There are a few other tools which are neither planning nor assessment tools. They can be categorised as decision support tools. They are WASHCost, the CLARA Planning Tool and the Life-Cycle Cost for WASH and Sanitation decision support tool. The first three look at water and sanitation (faecal waste) while the last one only deals with sanitation (faecal waste).

Tool/Approach	Tool Format	Year Developed	Purpose	Developer	Waste Stream	Description	Remarks
Planning tools							
1. Household-Centered Environmental Sanitation (HCES)	N/A	1999-2005	Planning	Environmental Sanitation Working Group of WSSCC; Eawag-Sandec	Stormwater, faecal waste and, solid waste	HCES is a multi-sector and multi-actor approach accounting for sanitation, water supply, solid waste management and storm water drainage, and emphasising the participation of all stakeholders in planning and implementing Urban Sanitation. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SESP/Household-Centred/HCES_guidelines_en.pdf	There is no implementation manual, just the guideline. Requires commitment and willingness to take the next steps to support such an enabling environment.
2. Community-Led Urban Environmental Sanitation (CLUES)	N/A	2011	Planning	EAWAG	Stormwater, faecal waste and, solid waste	It is a set of planning guidelines based on the lessons learned from piloting the HCES approach and highlights the importance of broad community involvement (beyond the household level) in the planning and decision-making processes. https://www.eawag.ch/en/department/sandec/projects/sep/clues/	It considers all waste streams in the planning process. Potentially time-consuming. Examples of use are limited to a few towns only.
3. City Sanitation Plan (CSP)	N/A	2010	Planning	National Urban Sanitation Policy (NUSP)	Wastewater, solid waste, sewage	It's a holistic and planning framework guide for Urban Local Bodies officials to make informed decisions about sanitation investments. It covers access to toilets, wastewater management (including septage and sewage management, stormwater management, water supply (including non-revenue water), and solid waste management. https://www.borda.org/solutions/city-sanitation-planning/	It considers all waste streams in the planning process. Needs leadership and stakeholder commitment for human and financial resources.
4. Integrated Sustainable Waste Management (ISWM)	N/A	2001	Planning (analytical framework for decision making)	waSte	Solid waste	Considers the entire MSW management chain and integrates processes to operationalise a complete waste management system approach. http://wasteportal.net/en/waste-aspects/integrated-sustainable-waste-management-iswm	It broadly touches the service and stakeholders around water and sanitation.

Tool/Approach	Tool Format	Year Developed	Purpose	Developer	Waste Stream	Description	Remarks
Assessment Tools							
5. Water Resources Assessment (WRA)	Hand book based	1997	Assessment	UNESCO and WMO	Water	Water resources assessment (WRA) is a tool to evaluate water resources in relation to a reference frame, or to evaluate the dynamics of the water resource in relation to human impacts or demand. https://sswm.info/planning-and-programming/exploring-tools/preliminary-assessment-current-status/water-resources-assessment	Conducting a water resources assessment requires considerable time and resources.
6. Water Flow Diagram	Sankey diagram based	2021	Assessment and Planning	EAWAG	Water supply	The tool gives an overview of the local urban water situation in a snapshot by visualising the mayor water flows from source to discharge together with a judgement for every flow, whether the management practices are appropriate or problematic. https://www.eawag.ch/en/department/sandec/projects/swp/translate-to-english-water-flow-diagram	The process is under development. Currently, there is no standardised data collection procedure.
7. Shit Flow Diagram (SFD)	Web -Based, Excel	2014	Assessment	World Bank	Faecal waste (also has some elements of groundwater)	The tool shows where faecal waste goes, the amount contained, and the uncontained portion across the Sanitation service chain. http://sfd.susana.org/	No analysis of volumes of faeces therefore hard to quantify the problem. Considers the groundwater contamination risk issues which is an added advantage.
8. Rapid assessment tool	Excel based	2015	Assessment	IRC Netherlands	Faecal waste	It's a city-wide rapid assessment tool for FSM and blends both quantitative and qualitative data. https://www.ircwash.org/blog/calculating-shit-volumes-can-be-messy-business	The methodology requires a high level of effort when compared with SFD. It calculates the volume of faeces not just the percentage.
9. City Service Delivery Assessment (CSDA)	Excel	2014 (Modified in 2020)	Complimentary tool for assessment	World Bank	Faecal waste	CSDA is a complementary tool to SFD because it provides a situation analysis of the enabling environment. The tool identifies the main obstacles to service delivery based on objective measures or indicators. It has been modified to include onsite and offsite SSCs for citywide sanitation analysis. https://www.incsanprac.com/tools.html	Identifies areas of action, thus can contribute to solid waste and water service planning also.

Tool/Approach	Tool Format	Year Developed	Purpose	Developer	Waste Stream	Description	Remarks
10. Urban Sanitation Status Index (USSI)	Scorecard based	2018	Complimentary tool for assessment	World Bank	Faecal waste	The Urban Sanitation Status Index (USSI) is a tool based on the sanitation service chain that visualises the sanitation status of a city by ward or neighbourhood—i.e. by the lowest administrative city sub-unit. The USSI is based on 20 qualitative indicators assessed via household surveys and key informants interviews. https://www.wsp.org/sites/wsp/files/publications/WSP-Fecal-Sludge-Management-Overview-Conference-Edition.pdf	Its methodology is not public.
11. City MSW Rapid Assessment Data Collection Tool	Excel	2013	Rapid assessment	US EPA and World Bank	Solid waste	The purpose of this tool is to collect municipal solid waste data in order to have a rapid assessment of the main aspects of the solid waste management in any city. https://www.waste.ccacoalition.org/document/city-msw-rapid-assessment-data-collection-tool-english	It is centred on conversion of waste to energy.
12. Waste flow diagram	Excel	2020	Situation Assessment	GIZ	Solid waste	It provides a rapid assessment methodology for mapping the flows of macro waste in a municipal solid waste management system at the city or municipality level, including quantifying the sources and fate of any plastic pollution. https://www.giz.de/expertise/html/62153.html	Focuses mainly on plastic waste leakages
13. Waste Wise Cities Tool (WaCT)	Excel file	2021	Situation assessment	UN-HABITAT	Solid waste	The tool assesses and monitors the proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by the city. https://unhabitat.org/sites/default/files/2021/02/Waste%20wise%20cities%20tool%20-%20EN%203.pdf	Mainly looks at all types of solid wastes and their recycling/ disposal options. There is special emphasis on food and plastic wastes. Importantly, the tool generates a diagram following the service chain thus compatible with water and sanitation service chain which can be an added advantage for integrated waste management planning .

Tool/Approach	Tool Format	Year Developed	Purpose	Developer	Waste Stream	Description	Remarks
Support in Decision Making Tools							
14. WASHCost	Web-based	2008	Planning (support in decision making)	IRC Netherlands	Water and Faecal waste	The tool is used to assess and compare the financial sustainability of different water and sanitation services and share those findings with different stakeholders. http://www.washcost.ircwash.org/en/calculators/	Quality of the results are based on accuracy and detail of the data entered by the user. Only focuses on the financial aspect of water and sanitation services.
15. Sanitation Decision Support Tool (AKVOPELIA)	Web based	2007	Planning (support in decision making)	Akvo foundation	Faecal waste	The tool organises information on different sanitation technologies according to the part of the sanitation value chain they come under. https://sanitationcompass.info/technologies/technologies/	Only gives information on individual technologies and not on how these technologies can be combined to form a system.
16. Life-Cycle Costing (LCC) for WASH		2011	Planning (support in decision making)	IRC Netherlands	Water and faecal waste	The tool was developed for water services in rural and peri-urban areas to support the comparison of costs at the district level consistent with common accounting and finance to be used by governments, donors, and implementing organizations to assess and compare the financial sustainability of different water and sanitation services and share those findings with different stakeholders. https://www.ircwash.org/sites/default/files/Fonseca-2011-Lifecycle.pdf	It is an impact assessment tool not really a service delivery assessment/planning tool. It only helps in decision changing or validating the plan.
17. CLARA Planning tool	Excel	2011	Planning (support in decision making)	Boku (University of Natural Resources and Life Sciences, Vienna)	Water and Faecal waste	It is a simplified sanitation and water supply planning tool that enables the selection of the best solution. It is based on assumptions. https://sswm.info/planning-and-programming/decision-making/situation-and-problem-analysis/clara-simplified-planning-tool	Based on assumptions of the cost functions resulting in uncertainties of costs.

WHAT NEXT?

From the literature review, it is evident that the three waste streams are intertwined and can cause adverse effects if there is poor planning of waste management. It is clear from the list that the planning approaches and frameworks (the first four in the list) broadly consider all three of the waste streams. However, when we look at specific tools for waste stream assessment, we understand that most of such tools are designed for individual waste streams. Few sanitation assessment tools are found which partially consider water issues in the assessment process. The rest only consider the waste stream factors they are designed for. This rapid scan has found no assessment tool that looks at all three streams with equal importance and can identify the points where one waste stream enters into another. Without such a tool, it is difficult to advocate for integrated planning of waste. Fortunately, there are a number of tools for water, sanitation (faecal waste) and solid wastes that can be used to develop a decision support/advocacy tool which can help planners identify the areas where faecal waste and/or solid waste contaminates the greywater/stormwater/groundwater. IRC will carry the lessons forward and liaise/work with the sector to develop such a tool.

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