

Review Paper

City sanitation ladder: moving from household to citywide sanitation assessment

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ABSTRACT

Monitoring sanitation has generally focused on basic access with its implicit links to health impacts. The new thinking on urban sanitation monitoring goes beyond the household level facilities to encompass wider dimensions of equity, public health and natural environment. This requires an assessment of the full value chain from the user interface to storage, conveyance, treatment and disposal or reuse. In developing country context, this also necessitates incorporating other sanitation dimensions beyond excreta management, especially management of greywater, storm water and solid waste as these are often interlinked on the ground. In this context, it is important to revisit the concept of the sanitation ladder, widely used by the Joint Monitoring Programme (JMP), which has focused on household access. This paper suggests a framework for outcome-based citywide assessment of the full sanitation value chain across different sanitation sub-sectors. The ladder is redefined using a city sanitation score to assess city level performance. The suggested outcome-based assessment for different components of the value chain also provides a basis for city level monitoring of overall sanitation performance.

Key words | city sanitation plans, citywide approach, monitoring, sanitation ladder, urban sanitation

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INTRODUCTION

The most widely used measurement of sanitation performance is the Millennium Development Goal (MDG) target related to basic access for households. Monitoring of this target by the Joint Monitoring Programme (JMP) focuses on access and use of improved toilets by households. The JMP has since 2010 also started to provide more details related to access through its sanitation ladder concept. However, the JMP sanitation ladder does not capture the full value chain, particularly related to the functional areas of collection, conveyance, treatment and disposal. A review of the current JMP sanitation definition, taken up by JMP's Urban Task Force, highlighted the need to assess the full value chain (JMP 2011). The next section reviews development of recent approaches that can be used to develop a citywide sanitation assessment framework.

This paper explores a new approach for citywide sanitation assessment, which goes beyond household level access. It incorporates the ideas of a full value chain: user interface, collection/storage, conveyance, treatment and reuse or disposal. It is argued that a citywide perspective is essential to effectively incorporate all functional areas in the value chain and to capture the potential interlinkages amongst various sub-sectors – excreta and wastewater management, sullage, storm water and solid waste. This approach can be used for city level assessment for planning and investment decisions, as well as performance benchmarking and monitoring by higher authorities. The final section of the paper outlines this approach and provides illustrative indicators for application.

REVIEW OF RECENT APPROACHES

This section provides a brief review of the sanitation ladder and the attempts to evolve alternative frameworks. We first discuss the move from measuring access to basic sanitation to a sanitation ladder. The need and attempts to look at the full value chain of sanitation are traced next. A third set of approaches reviewed here aims to combine the ladder with value chain and city sanitation rating.

From basic access to sanitation ladder

The target for attaining basic sanitation under the MDGs is captured as household level access to basic sanitation as defined by the JMP of the UNICEF and World Health Organization (WHO). While initial effort was on a simple

indicator that measured ‘access’ or ‘no-access’ to basic sanitation, later approaches have focused on expanding to a concept of sanitation ladder. JMP (2010) provides disaggregated information on access to sanitation in relation to type of facilities (improved individual toilet, shared facility and unimproved toilet facility, no facility – open defecation). It was referred to as a ladder because each category was seen as an improvement over the lower category.

Kvarnström *et al.* (2011) proposed a sanitation ladder that uses a function-based approach. It distinguishes between basic functions at bottom of the ladder, followed by public health and environmental function at the top (refer to Table 1). Moving up the ladder means that the functions below have also been fulfilled. While this approach is useful, it focuses ‘mainly on individual systems and how individual systems function to keep the surroundings free from excreta’ (p. 9). There are two issues in using

Table 1 | Function-based sanitation ladder

		Function	Indicators	Management needs
Environmental functions	7	Integrated resource management	Indicators will differ and depend on flow streams from the full environmental sanitation system (urine, faeces, greywater, faecal sludge, wastewater as below but also including water provision, storm water management and solid waste management) and context	
	6	Eutrophication risk reduction	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater)	
	5	Nutrient reuse	(i) X% of N, P, K excreted is recycled for crop production, (ii) Y% of used water is recycled for productive use	
Health functions	4	Pathogen reduction in treatment	Indicators will differ and depend on flow stream from the sanitation system (urine, faeces, greywater, faecal sludge, wastewater) and also whether the flow stream will be used productively afterwards or not	
	3	Greywater management	(i) No stagnant water in the compound, (ii) no stagnant water in the street, (iii) no mosquitoes or other vectors	
	2	Safe access and availability	(i) 24-hr access to facility year-round, (ii) facility offering privacy, personal safety and shelter, (iii) facility is adapted to needs of the users of the facility	
	1	Excreta containment	(i) Clean facility in obvious use, (ii) no flies or other vectors, (iii) no faecal matter lingering in or around latrine, (iv) hand-washing facility in obvious use with soap, (v) lid, (vi) odour-free facility	

this approach for city level sanitation assessment. First, public health and environmental functions are often tackled by neighbourhood and city level infrastructure for conveyance, treatment, disposal and reuse. These would require an assessment scheme that goes beyond the 'individual systems'. *Kvarnström et al. (2011)* also note this as they state, 'although it is recognised that sanitation is a community issue and that complete health protection will only come when the entire environment is free from excreta' (p. 9).

Second, while their ladder is comprehensive and includes many functions, the basic functions of 'excreta containment' and 'safe access and availability' are listed at the bottom of the ladder, implying that they are less important than the environmental functions. It can be argued that all functions are important as access also represents convenience and dignity for households through privacy and security. Thus, while the approach by *Kvarnström et al. (2011)* is important in recognizing various functions, further efforts are needed to capture performance across the various levels of a city – house, community, neighbourhood/ward, zone, etc.

Concept of full value chain

From an environmental and operational perspective, it is important to assess sanitation through its full value chain starting with access at household or property level to its final disposal/use. From generation of wastes to final disposal or reuse, wastes travel through 'functional groups' including conveyance, treatment, disposal and reuse (*BMGF 2011*, p. 2). A number of researchers have defined and explored this further.

Tilley et al. (2008) and *Luthi et al. (2011)* define 'sanitation as a multi-step process in which wastes are managed from the point of generation to the point of use or ultimate disposal or reuse' (p. 9). This approach helps to look at sanitation value chain in functional groupings. These groupings – user interface, collection and storage, conveyance, (semi)centralized treatment and disposal or reuse – are conducive to looking at a range of citywide systems as described by them.

In a similar manner, *Tremolet (2010)* also uses the sanitation value chain concept for assessing the possibility of

using the output-based aid for different components of sanitation. She identifies five key links in the value chain: demand creation, collection, transport, treatment and disposal/reuse. The first two focus on household level access, whereas the other three focus on environmental aspects of sanitation. In a recent student project at CEPT University, guided by the authors, assessment of citywide sanitation services was done using the concept of value chain (*CEPT University 2010*). It looked at the types of services, roles of different actors and the extent of services provided by them across the value chain for different sanitation services. This assessment was used as a basis for development of a city sanitation plan.

Incorporating full value chain in sanitation ladder

A number of recent developments in sanitation assessment have attempted to incorporate the whole value chain in the sanitation ladder. WaterAid prepared a framework of sanitation ladder, for discussion at the Urban Task Force meeting of the JMP in Kenya (*WaterAid 2011*). It distinguishes between facilities for collection and storage versus services for transport, treatment and disposal. It also assesses potential service provider and environmental impact for each step in the ladder. In doing this, WaterAid has attempted to combine the sanitation functional grouping with the notion of a ladder. This framework distinguishes between access and waste management services for transport, treatment and disposal.

Potter et al. (2011) introduced a concept of sanitation ladder encompassing the full value chain (refer to [Table 2](#)). It attempts to focus on service levels rather than technologies, though its formulation is more focused on sanitation in rural and peri-urban areas. Further, implementing this framework in practice would require separation of household-level and neighbourhood-/village-level attributes. In the current framework, each service level of the proposed ladder has a mix of household- or village-/city-level attributes.

In a similar manner, JMP's Post-2015 consultation note suggests a sanitation ladder with three levels: (a) no open defecation, (b) adequate sanitation – focused household level and (c) 'safe management of excreta', which includes 'containment, extraction, and transport to a designated disposal or treatment site, safe re-use at the household or

Table 2 | Sanitation service levels for deciding overall service levels

Service level	Accessibility	Use	Reliability (O&M)	Environmental protection
Improved service	Each family dwelling has one or more toilets in the compound Easy access for all family dwellings	Facilities used by all household members	Regular or routine O&M (including pit emptying) service requiring minimal effort. Evidence of care and cleaning of toilet	Non-problematic environmental impact/safe disposal and re-use of safe by-products
Basic service	Cement or impermeable slab at national norm distance from households (per household or shared)	Facilities used by some household members	Unreliable O&M (including pit emptying) requiring high level of user effort. Evidence of care and cleaning of toilet	Non-problematic environmental impact/safe disposal
Limited 'service'	Platform without impermeable slab separating faeces from users	No or insufficient use	No O&M (e.g. pit emptying) taking place and no evidence of cleaning or care for the toilet	Significant environmental pollution, increasing with increased population density
No service	No separation between user and faeces, e.g. open defecation			

Sources: Based on WFP-IRC (2012), p. 5 and Potter *et al.* (2011), p. 22.

community level' (JMP 2012, p. 13). While this approach does look beyond the household level access, it limits itself to 'transport to a designated disposal or treatment site'. It does not attempt to capture the functions related to actual treatment, disposal and reuse, unless these are achieved at the household level itself.

The Government of India (MOUD 2010) carried out sanitation rating of all major cities in India (cities with a population of more than 100,000). The indicators used in rating relate to outputs (50%), processes (30%) and impact/outcomes (20%) indicators. The indicators in this exercise attempt to cover the full value chain, and besides excreta management include other sanitation sub-sectors such as storm water and solid waste management.

The cities are rated on a colour code based on their score, with red (fewer than 33 points) suggesting an emergency-type situation needing immediate remedial action to green (more than 90 points) suggesting a healthy and clean city. While no city in India was in the green category, most cities were in the black category (34 to 66 points) 'needing considerable improvements' (MOUD 2010, p. 37), and only a few cities were in the blue category (67 to 90 points) suggesting 'recovering but still diseased'. The purpose of the rating scheme was to create public awareness and enable cities to prepare 'holistic citywide sanitation plans' focused on elimination of open defecation, safe collection, treatment and disposal (MOUD 2010). However, a

similar concept can be applied for citywide planning and performance monitoring.

EVOLVING A CITYWIDE FRAMEWORK FOR SANITATION ASSESSMENT AND MONITORING

Based on various approaches reviewed above, it is clear that assessment and monitoring of sanitation in urban areas need to look beyond the household to the full value chain for different sanitation sub-sectors within a citywide framework. Secondly, these efforts suggest the need to focus on outcomes assessed against goals of improved sanitation.

Goal-based approach to a citywide framework

Table 3 provides the basic approach, where different functional areas are grouped into two main service components of Access and Waste Management, and how these are related to the three goals of equity, public health and protection of natural environment.

Access refers to the functions of user interface and containment or storage of waste at premise level by households as well as other non-residential users. In policy terms, this largely reflects the private domain of households, institutions and enterprises. However, there is a public policy

Table 3 | Relation between sanitation goals and service components

Goals	Access (user interface and containment/storage)	Waste management (conveyance, treatment and reuse/disposal)
Equity	Universal access to toilets, septic tanks/sewerage connections, bathrooms, rainwater harvesting facilities, solid waste collection	Improved access to waste management services for low-income communities
Public health	Positive public health impact of improved access, which would help in reducing open defecation, greywater discharge, flooding and solid waste dumps	Positive public health impact of improved water quality due to treatment of waste before disposal or treatment of waste for agricultural applications
Environment	Positive environmental impact of reduction in sub-soil water contamination, recharge of groundwater from soak-pits	Positive environmental impact of treatment of waste before being disposed of in water bodies or land applications

element here due to the public health impact of lack of universal access, particularly, in dense urban settings. **Waste Management** includes functions related to conveyance, treatment and reuse or disposal of treated waste. Waste management refers to the wider public domain beyond a household. This has policy implications in terms of appropriate management and governance of wastewater conveyance, treatment and reuse/disposal. There are also issues related to choice of technology of wastewater infrastructure and its financing through public resources.

Good access would impact these goals in various ways: **equity** as assessed in terms of share of total users at the city level, who have such access to sanitation, and **public health** in terms of extent of morbidity from water- and wastewater-related diseases. On the other hand, good waste management would impact the goal of **public health** as well as **environmental protection** in terms of quality of water in water bodies and impact on land resources. The proposed framework outlined below essentially focuses on outcomes that would indirectly influence these goals (and related impacts). The proposed framework does not directly include health or environmental impacts, but the goals provide a justification of outcomes outlined in the proposed framework.

Achieving good sanitation in cities in developing countries requires recognition of the interlinkages between different sanitation sub-sectors. Ongoing studies at CEPT University suggest that solid waste and storm water management also critically influence the success of excreta and wastewater management (see for example [CEPT University 2010](#)). To capture this, the proposed framework for citywide assessment covers all functional areas in the value chain

and all aspects of sanitation including: excreta (black water), sullage (greywater), rain/storm water and solid waste management. **Table 4** identifies outcome areas across the three sub-sectors (excreta, grey- and storm water and solid waste disposal) and the five functional groups in the value chain.

Appropriate indicators need to be identified for each of the 15 outcome areas. Supplemental Material (available online at <http://www.iwaponline.com/washdev/003/134.pdf>) provides an illustrative set of indicators for this purpose. Using such indicators, city sanitation scores (CSS) can be developed for each outcome area, and then summed to capture overall outcome or performance on the two service components. For example, a city that has fully achieved all six outcomes for the two functions of user interface and containment/storage would score 100 points for Access. Similarly, a city that has achieved all nine outcomes of Waste Management across the three functions of conveyance, treatment and reuse/disposal would get 100 points. The relative performance measurement for each service component can be done on the basis of indicators identified for each of the 15 outcome areas.

With these scores, a simple formulation of a city sanitation ladder is possible as illustrated in **Table 5**. The suggested ladder is of four steps, representing a combination of level of services for the two service components: access and waste management scores. At the top of the ladder is the city that has high access as well as high level of waste management service (with a score of more than 75 on both service components). The bottom of the ladder is a city that has no or very minimal access and low or no waste management service (with a score of less than 25 on

Table 4 | Outcomes for citywide sanitation by service components and functional groups

User interface Access	Collection/storage	Conveyance Waste Management	Treatment	Reuse/disposal
<i>Excreta disposal (black water and septage):</i>				
All households/properties have access to/use 'improved' safe toilet facilities, with zero open defecation	All households/properties have appropriate modes for storage/collection of sewage	All wastewater (black water) and septage generated are collected regularly	All collected wastewater (black) and septage are treated to required standards	As much treated wastewater (black) and septage as possible are reused/remaining is disposed of safely
<i>Greywater (sullage) and storm water disposal</i>				
All households have appropriate rain water harvest/collecting facility and bathrooms	All households have an adequate soakpit or a connection/outlet for disposal of sullage (greywater)	All greywater generated and sullage is collected through appropriate and clean systems	All collected wastewater (grey) is treated to required standards	As much as possible of the treated greywater is reused and remaining is disposed of safely
<i>Solid waste disposal</i>				
All households/properties have access to bins to keep segregated solid waste	Segregated solid waste from all properties is collected through a door-to-door service; All streets and public spaces are swept regularly	All solid waste generated is collected regularly and transported to treatment sites	All collected solid waste is treated at required standards	As much as possible of the treated solid waste is reused and remaining is disposed of safely

Table 5a | Ladder of service performance for urban sanitation across service components

Access	Waste management			
	High service (>75)	Medium service (50-75)	Basic service (25-50)	Low or no service (<25)
High access (>75)	High	Medium	Basic	Basic
Medium access (50-75)	Medium	Medium	Basic	Basic
Basic access (25-50)	Basic	Basic	Low	Low
Low or no access (<25)	Basic	Basic	Low	Low

both service components). The intermediate steps of the ladder are based on an appropriate combination of service levels achieved on Access and Waste Management.

Using the framework for assessment and monitoring

The framework can be used for city level assessment for planning and investment decisions, as well as performance benchmarking and monitoring. We argue that the two are linked as planning at local level is influenced by what is

monitored. When such monitoring is done properly and regularly, it can create an effective regime of accountability and influence cities to plan appropriately.

In a citywide sanitation planning context, such a citywide performance assessment will be followed by identification of actions and their financial assessment. For identifying actions, the framework helps to define priorities across the value chain.

The citywide sanitation assessment framework outlined in this paper can also be used for monitoring sanitation performance across cities by a higher level of government or a regulator. Unlike the current global and national monitoring practices, which focus mainly on access through household surveys, a citywide performance measurement would require city level assessment. This can be done through performance benchmarking exercises that are carried out in many cities.

Besides its use for city sanitation planning, this framework also provides a new direction for monitoring progress on urban sanitation. Most current sanitation monitoring tends to be household focused. On the other hand, the performance benchmarking efforts in the sanitation sector are influenced by technology choices, where good

Table 5b | Policy implications of sanitation ladder

Level of service	Description	Possible policy implications
4 High	Cities with high performance on both service components	Ensure sustainability of sanitation services
3 Medium	Cities with medium performance on both service components but still requiring improvements in some areas	Need to move towards universal access and use for all sanitation services and improve waste management
2 Basic	Cities with low scores on both or at least one service component and needing considerable improvements	Priority will need to be placed on the service component where the city lags behind – either access or waste management
1 Low/no service	Cities with no or very limited service on both service components and needing immediate remedial action	Immediate priority may be placed on improving at least basic access and then gradually to waste management

Table 6a | Application of the proposed framework – preliminary results at state level

State/size class of city	Population range	Sanitation assessment		
		Access	Waste management	Level of service
State (Maharashtra)	–	59.2	17.4	Basic
Municipal Corporation	>300,000	57.2	25.9	Basic
Class A	100,001–300,000	61.1	21.9	Basic
Class B	40,001–100,000	60.3	16.7	Basic
Class C	<40,000	59.1	16.1	Basic

Sources and notes: based on results from the performance benchmarking for all cities in Maharashtra (under the PAS Project). For the state analysis, a few adjustments were needed to the set of indicators in the Supplemental Material (available online at <http://www.iwaponline.com/washdev/003/134.pdf>), such as: (a) separate information on access and waste management was not available for greywater and rain water, (b) outcomes for excreta and greywater management were combined and (c) information on household level segregation of waste was not available.

performance is equated with a conventional centralized underground sewerage (see for example Mehta *et al.* 2013). Our proposed framework focuses on outcomes rather than technology. This is particularly relevant in developing countries, where a large proportion of urban population does not have access to sewerage systems.

An application of this approach is being made at city level for sanitation assessment and planning in India under the Performance Assessment System (PAS) Project. It is also being adapted for performance assessment in India. The indicators used for this assessment are listed in the Supplemental Material, available online at <http://www.iwaponline.com/washdev/003/134.pdf>. Table 6a presents preliminary results for four cities in the state of Maharashtra for city-level assessments. Table 6b presents results for state level averages for different sizes of cities.

This assessment clearly shows that while all cities in the state of Maharashtra have relatively better performance on access, their scores on waste management component are

Table 6b | Application of the proposed framework – preliminary results at city level

City name	Population	Sanitation assessment		
		Access	Waste management	Level of service
Selected small cities in Maharashtra				
Wai	36,053	54.2	12.2	Basic
Sinnar	65,251	62.6	16.7	Basic
Ambajogai	74,844	43.8	25.5	Low
Hingoli	85,401	45.6	12.2	Low

Sources and notes: city level assessments carried out under the PAS Project at CEPT University. For this assessment, a few adjustments were needed to the set of indicators in the Supplemental Material (available online at <http://www.iwaponline.com/washdev/003/134.pdf>), such as: (a) lack of separate information on waste management for greywater and rain water and (b) combined treatment of excreta and greywater management for the waste management component.

very poor. This assessment is based on available information from city level performance assessment. Similar results were also observed for the four small cities studied. This is a possible result of the overt public policy focus on provision of toilets – at house level and at community level – and lack

of adequate attention to waste management. Further work will focus on both city assessments and wider performance monitoring efforts in India to highlight implications for urban sanitation policy.

CONCLUSIONS

Current debate in the sanitation sector highlights two important concerns. The first is the need to move beyond the simple concept of household access to sanitation and capture the full value chain of sanitation. The second is to look at urban sanitation within a citywide perspective focusing on wastewater containment/collection, conveyance, treatment and reuse/disposal. The city level assessment framework suggested in this paper helps to capture the links to goals for equity, public health and improved environment. Such an approach helps to determine priorities across sub-sectors and value chain while developing a city level sanitation plan. When set within the context of performance benchmarking, such a framework helps in monitoring of urban sanitation.

ACKNOWLEDGEMENTS

The work on citywide assessment of full value chain for sanitation has been carried out as a part of the Performance Assessment System (PAS) Project, funded by the Bill and Melinda Gates Foundation, at the CEPT University. (See www.pas.org.in for more details on the project). The authors would like to express their gratitude to the PAS Team at CEPT University. Specific inputs to the development of this paper were provided by Chandan Chawla and Aasim Mansuri.

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