DEVELOPING A SANITATION DECISION SUPPORT TOOL

Politically & Socially Adapted for the Indian Context

JOHNS HOPKINS
SCHOOL of ADVANCED
INTERNATIONAL STUDIES

ATHENA
INFONOMICS

DEVELOPING A SANITATION DECISION SUPPORT TOOL

POLITICALLY AND SOCIALLY ADAPTED FOR THEINDIAN CONTEXT

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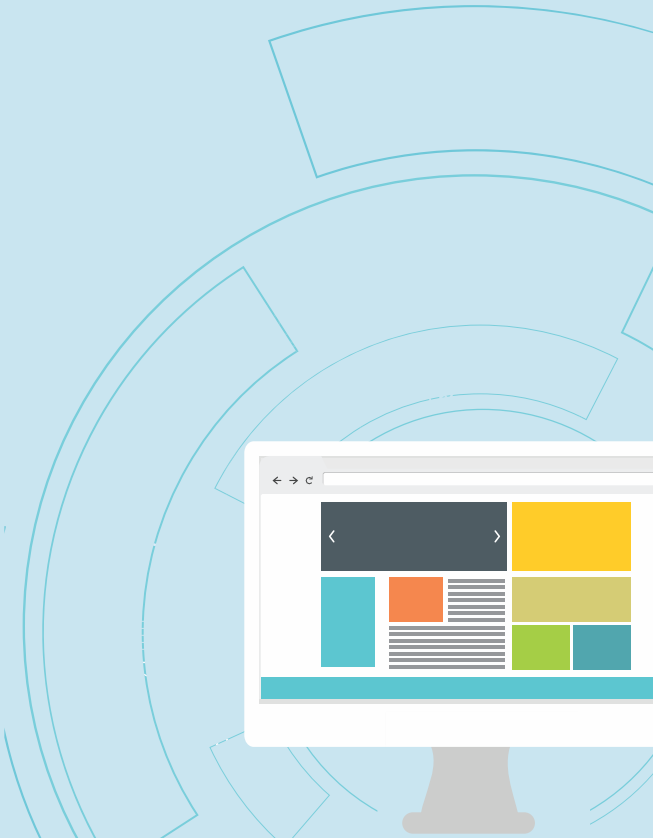
ATHENA INFONOMICS

This report represents the final product of a year-long practicum course undertaken by a team of four students in the International Development Program (IDEV) at the Johns Hopkins University School of Advanced International Studies (SAIS). IDEV offers this course in order to expand students' opportunities to work directly with public, private and non-governmental organizations, and hone their skills through practice.

Athena Infonomicsis a fast-growing policy research and development analytics firm with a focus on strengthening the use of data and social science research to solve development and inclusive growth issues around the world. Athena Infonomics hosted this practicum team to assist in the creation of a decision-support tool to guide sanitation investments in the Indian context. Over the course of this collaboration, Athena Infonomics oversaw and supported the research efforts of the SAIS team, facilitated a two-week field research experience in Chennai and Vellore, including 10 stakeholder meetings, and provided feedback on the development of this report.

05 EXECUTIVE SUMMARY



Executive Summary

The increasing recognition of investment and capacity gaps in Indian cities' sanitation has culminated in the launch of-

a) the Swachh Bharat Mission (SBM) or the Clean India Mission in 2014, which calls for the eradication of open defecation by the year 2019

b) the Smart Cities Mission (SCM), and,

c) the Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

Each of these programmes has financing support for infrastructure creation across urban areas in general, and sanitation (sewerage and septage management) in particular.

Given that the AMRUT considers both underground sewerage schemes (UGSS) and septage as potential options for cities, there is a need for a clear mechanism for option assessment when cities are preparing their sanitation plans. Sanitation represents a sizeable share of the total estimated investment budget for cities and yet historically, investments in UGSS systems have lacked a cogent and efficient investment approach. Thus, it is important to enhance the capacities of cities to make sanitation decisions in an informed and structured way, to ensure contextual decision-making and optimal utilization of funds.

एक कदम स्वच्छता की ओर
Swachh Bharat Mission

This project was conducted by a team from Johns Hopkins SAIS, in collaboration with Athena Infonomics. Its goal is to build capacity in the Urban Local Bodies (ULBs) and provide technical support, by evaluating existing decision-making support tools and offering recommendations for the development of a new decision support tool which could help cities assess the viability of UGSS vs. Septage systems. This enhanced tool will contribute to more robust and realistic Service-Level Improvement Plans (SLIPs), which in turn will translate to improved State Annual Action Plans (SAAPs), thereby enhancing the overall value for money of public expenditure on sanitation.

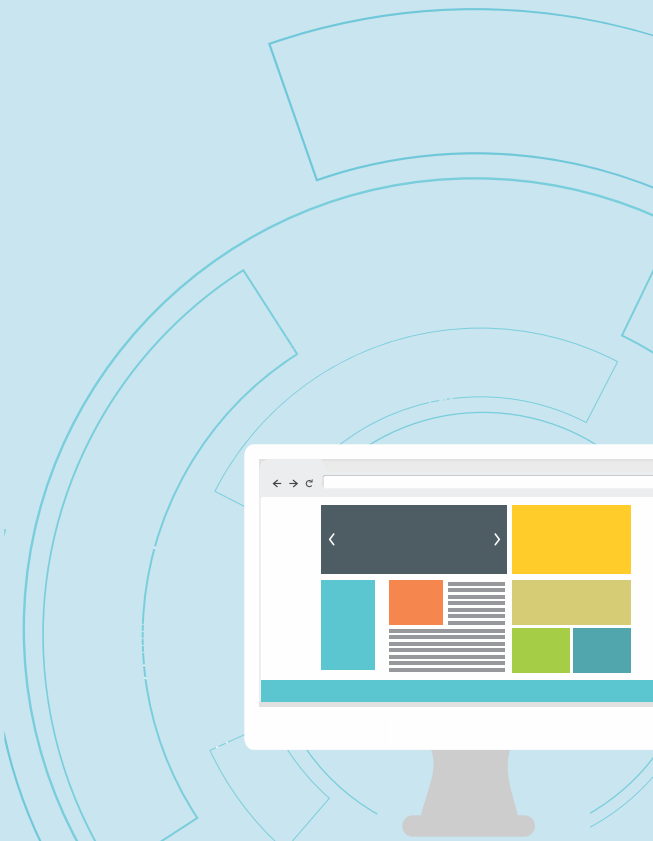
Smart City
MISSION TRANSFORM-NATION

This report includes a review of existing Sanitation Decision Support Tools. It also contains recommendations of ways in which such tools can be better adapted to the Indian context, making it comprehensive and useful for planners. We also provide a detailed analysis of the linkages and relationships among influencing variables, both technical and non-technical. The report also includes suggestions for developing a new Excel-based tool that systematically addresses all relevant factors in sanitation decision making, including technical, financial, political and social considerations.

Atal Mission for Rejuvenation and Urban Transformation

Principal findings from the literature review and the stakeholder interviews in the cities of Chennai and Vellore, India are summarized in the following pages

07 PRINCIPAL OBSERVATIONS & RECOMMENDATIONS



Principal Observations & Recommendations

Land acquisition procedures cause major delays in implementation of sanitation systems	*When public service providers have overlapping domains and varied interests, it can delay the process of land acquisition. Some of the most efficient sanitation projects have planned systems in collaboration with other service providers, taking opportunities to package system upgrades and keep overall costs low.*
A political champion for sanitation is an essential factor for success of the project	*Sanitation projects often have to overcome many institutional and social hurdles. To keep projects on track and the morale of working groups high, a strong leader figure is tantamount to success.*
A decentralized system may serve as a viable option for certain areas, not meriting centralized systems yet, but for those which have graduated from septage	*Many politicians expressed that they would push for 100% sewerage when it may not have been the most appropriate option. Due to public perceptions surrounding UGSS as the benchmark for a well-developed sanitation system, other options that are better suited may be ignored. There are variants that should be given proper consideration before choosing an all-or-nothing UGSS approach.*
Award of smaller contracts for sanitation system construction may remove barriers to entry for qualified but smaller contractors.	*Implementing sanitation systems that are smaller than a citywide UGSS system opens up opportunities to engage new private sector partners. There is limited capacity in India for the management of larger scale projects, so by compartmentalizing, one can ease the bottleneck that presents itself from the dearth of available construction and management firms.*
Public willingness to pay for UGSS services is key to eventual connection and covering of costs	*A financing plan for long-term operations and maintenance costs is necessary to ensure the sustainability and use of any sanitation system. ULBs will need to conduct a thorough willingness-to-pay assessment in their service areas to determine appropriate requirements for user fees.*

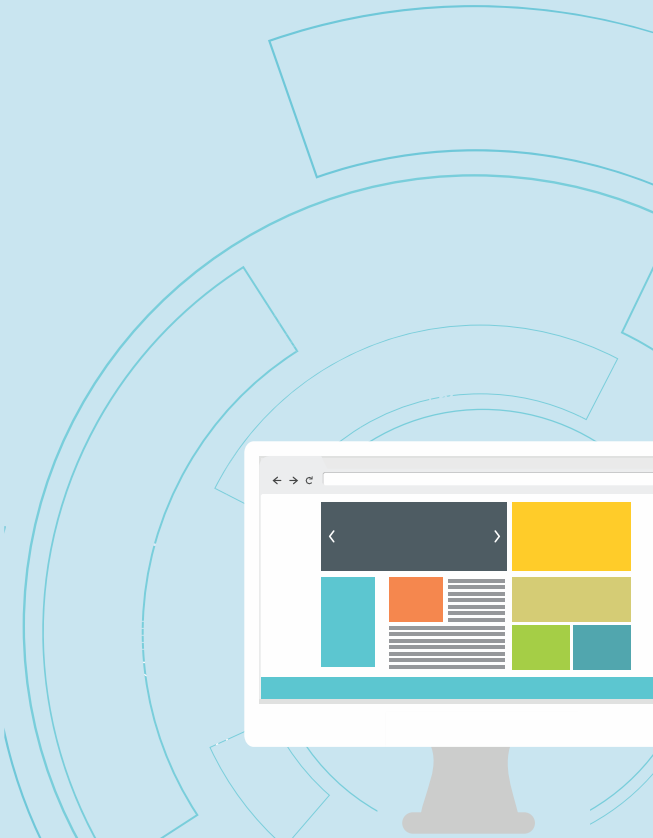
Movement towards PPPs may facilitate UGSS construction in less costly manner	*Public-Private Partnerships provide opportunities for ULBs with limited resources to strategically share the upfront costs of a sanitation system with a private company, enabling more efficient development of new sanitation infrastructure and service delivery.*
Any city-wide sanitation plan should include considerations for rapid population growth	*At the rate at which India's cities are expanding, municipalities will be using resources far more efficiently if planning and building for anticipated future requirements. Sanitation systems are inherently hard to scale after being built, and risk becoming obsolete and overburdened if developed withoutincorporating future growth.*

Acknowledgements

We would like to thank our colleagues at Athena Infonomics for their support of this project and for hosting our team in Chennai and Vellore, especially Vijay Bhalaki, Deepa Karthykeyan, Praveen Ravi, Kowshik Ganesh, Adarsh Mathew and Pramila Annamalai.

A special thanks also to our Practicum Advisor, Dr. Tanvi Nagpal, without whom this experience would not have been possible.

11 INTRODUCTION



Introduction

The purpose of this study is to assess different tools that have been developed internationally to support decision-makers in the choice of municipal sanitation systems. This includes investigation into the types of sanitation systems generally covered, the architecture used in building the tools, the influence of local political economies, the economic as well as social costs and benefits, and how the tools were ultimately adapted to the local context.

Sanitation is principally concerned with safeguarding health and the environment through the proper collection, management, and disposal of human excreta and community liquid wastes. However, people generally value sanitation systems not for their health benefits, but for their positive externalities towards privacy, convenience and sight/smell improvements. There are also macro-level enhancements arising from efficient sanitation systems, including improved productivity and economic growth.

There are many different ways to model costs and benefits of sanitation decisions, using simple Excel-based tools, financial modeling software, or purpose-built online decision making tools. Most tools only model technical variables, as data for qualitative variables such as cultural practices, household attitudes, or even political considerations is limited and difficult to accurately assign values.

Many political-economic factors will either be influencing or restrictive in the success of implementing the decision outcome of the tool, and should be taken into consideration. It is politically important that the tool and the decisions that result from it be owned and strongly supported by the public authorities to emphasize commitment to sanitation decision-making, while leveraging background expertise of external actors. The most salient factors are existing incentives and rewards, transparency of the tool, and level of decentralization.

No single solution is equally applicable to every country and every context. In making a municipal sanitation decision, one should include community members in the discussion, as well as assess local willingness to pay. Each municipality will also have a particular set of preferences and values that will influence the weight that different variables should be given in making sanitation decisions. By revealing and modeling user preference structures, one can tailor the eventual sanitation decision to best reflect true costs and benefits in a given context. This includes considering those residing in informal settlements with limited voice, as sanitation has positive network externalities, ultimately benefitting from the inclusion of every user in the decision process.

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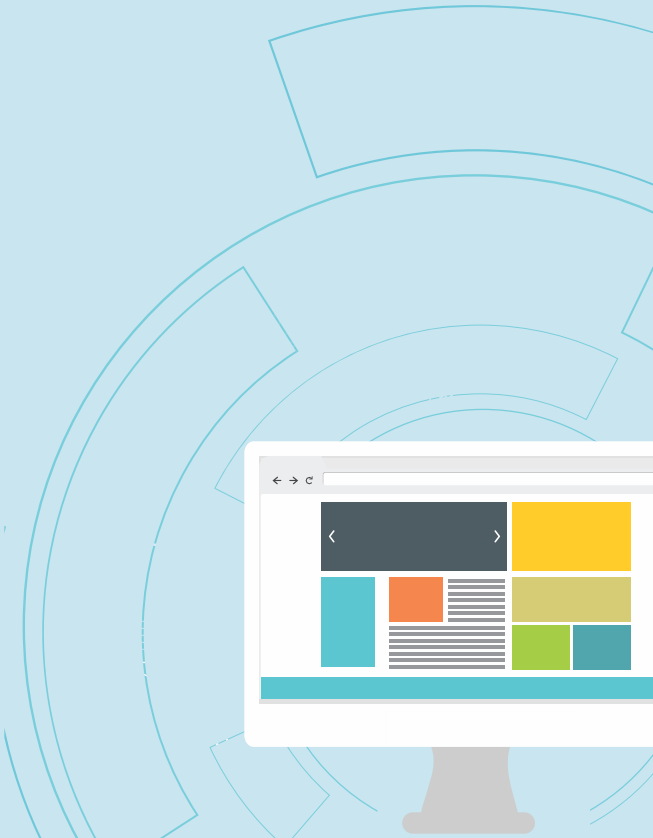
13 LITERATURE REVIEW



Literature Review

Existing Decision Support System (DSS) tools are designed to support a wide range of sanitation solutions, from basic containers requiring manual emptying to flush toilets connected to underground sewers. The most effective tools allow decision makers to tailor the inputs and potential outputs to local needs and preferences.

As examples, WASHCost is a tool developed by the International Water and Sanitation Centre (IRC) that guides the user through an easy-to-use graphical interface as they design a sanitation system for a single house, a small network, or a larger network of customers. The SANEX tool, originally created by Loetscher in 2000 and adapted by Fabrega in 2007,[1] used a Microsoft Access database and Excel outputs to produce a matrix assessing the feasibility of 14 distinct sanitation solutions, including both on-site and off-site options, based on 9 technical criteria.

Sample of Tools Reviewed

Tool Name	Author(s)
WASHCost *Life-Cycle Costing Tool for Sanitation*	*International Water and Sanitation Center (IRC)*
Integrated Urban Sanitation Decision Support Tool	*cSTEP*
A Guide to Decision-making: Technology Options for Urban Sanitation in India	*Water Sanitation Programme (WSP) and Govt of India Ministry of Urban Development, 2008*
SANEX	*Thomas Loetscher, 2002*
Adapted from SANEX	*Ir. David Castellano Fabrega, 2007*
SafiSan	*Water Services Trust Fund, Kenya*

1 D. Fabrega, "Decision Support Tool for the Appropriate Selection of Sanitation Systems"

Factors for Tool Development

Sanitation is traditionally a technical decision based upon variables such as user density, capacity and coverage area. These factors can be seen as either restrictive, meaning that they can eliminate certain options from being viable, or influencing, meaning that they affect the particular design characteristics of the chosen option.

The most critical restrictive variables to consider are the availability of water and the population density. In India, the government sets a baseline of 135 lpcd (liters of water per capita per day) as the minimum acceptable water provision for people using flush systems. If the municipality has limited access to water or is unable to provide each person with this minimum acceptable standard, any plans for sewerage systems should be accompanied by plans to augment the water supply. This will ensure adequate individual water supply, and that the sewer system will have sufficient water to function correctly. If there are no accompanying plans to build water supply, then the municipality should consider mainly non-flush septic systems. If there is sufficient water, then one should assess the density of users in a catchment area, as sewer systems only function effectively when operating at a certain capacity dependent on system design.

Influencing variables affect both the design and the methodology of system implementation based on both technical and socioeconomic considerations. Some of the influencing technical considerations are the content of wastewater, volume of wastewater, space available, etc. The socioeconomic considerations include local attitudes and motivations, consumer knowledge of sanitation options and respective benefits, as well as willingness to pay. Most DSSs only weigh the costs and benefits of technical variables, as there is limited data available for modeling qualitative variables.

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Architecture of Tools

Decision support systems are broadly designed in four phases (see Figure 1 below):

- Analysis and interpretation of the problem.
- Development of a model to quantify metrics for comparison.
- Development and evaluation of alternatives for selection and design.
- Validation and verification of DSS logic.

2 The Sourcebook Project Team, *Philippines Sanitation Sourcebook and Decision Aid*, (2007)

3 M. A. Hamouda, W. B. Anderson and P. M. Huck, *Decision support systems in water and wastewater treatment process selection and design: a review*, (2009)

For each of these phases, the tool can be based on a variety of digital systems. Some decision support tools rely on Microsoft Excel as an inexpensive method of data capture and analysis. Safisan uses Excel spreadsheets to gather data for sanitation decisions, and emphasizes on the use of basic Community Score Cards (CSC) to gain feedback about sanitation service provision. Augmented with Visual Basic macros, Excel can also be a simple solution for creating preference matrices and evaluating feasibility. Others utilize software like Value charts, normally used by financial analysts for valuing stocks, to attach costs to variables in order to rapidly iterate and evaluate different system designs. There are also a host of web-based decision support software platforms that collect system and preference data to perform value analyses. As examples, 1000minds, D-Sight, Analytica, and Expert Choice, all offer different methods of capturing technical data using an online platform. Then, by systematically presenting users with pairs of options (e.g. more system outages and more coverage area, OR less outages and less coverage), the platforms can model revealed preferences and allow users to assess different design configurations.

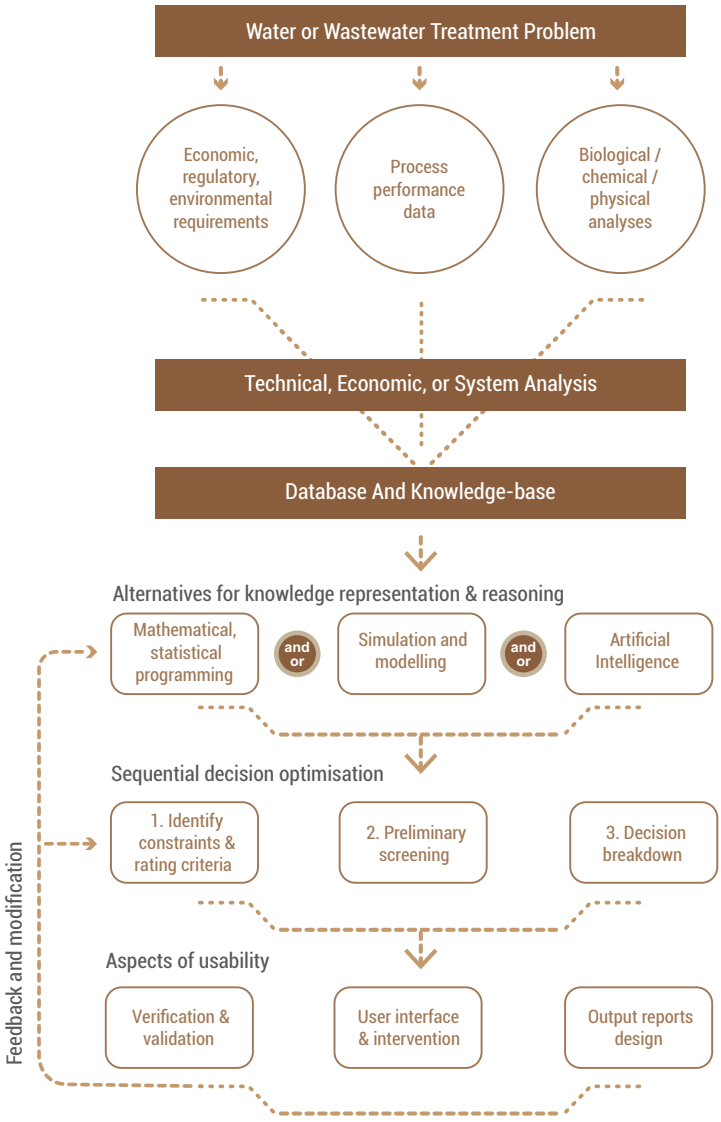


Figure 1: Stages of developing a sanitation Decision Support System

(M. A. Hamouda, W. B. Anderson and P. M. Huck, "Decision support systems in water and wastewater treatment process selection and design: a review" (2009)

Political Economy

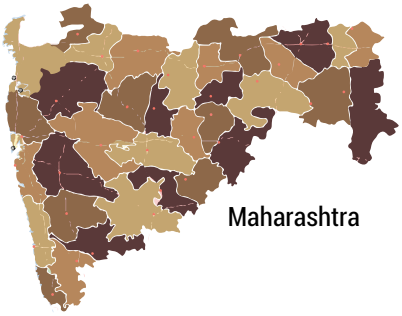
The political economy brings together the social, political, and economic processes along with various participating actors. All of these contribute to determining and influencing the extent as well as impact of sanitation investment and service delivery. The political economy of sanitation can be best examined through supply and demand side perspectives. Influencing, if not restricting, factors depend on the context. On the supply side, governments' sanitation expenditures are determined largely by political, rather than technical or economic constraints, and institutional frameworks determine how efforts at increasing sanitation investment and impact should be approached. On the demand side, behavioral and cultural elements affect demand for or usage of sanitation systems. The following explains how the tool and its implementation may be influenced by these variables, and how the political economy may be leveraged as support for sanitation investment decisions.

On the supply side, governments' sanitation expenditures are determined largely by political, rather than technical or economic constraints

Important to note is the significance of maintaining government ownership of sanitation decisions when external actors play a strong role in the decision-making. The World Bank's Water and Sanitation Program (WSP) found that it is most effective to ensure government ownership, thereby retaining the optics of control and commitment in the sanitation efforts. This is to avoid external influences (from aid agencies, donors, NGOs, private sector) being seen as interference or subversion (Garbarino & Holland, 2011). It is prudent for government decisions to not be seen as donor-driven, giving a "back seat role" to external actors, but utilizing their research and expertise to work towards better sanitation. The use of the sanitation decision tool puts the decision process and generated outcome distinctly in the hands of local policymakers.

The authoritative influence that culture and history has on sanitation can be changed with effort. On the supply side, the use of incentives and rewards for policymakers and government officials in promoting and investing in sanitation can create desire to improve and champion sanitation. Political returns for sanitation investment in Maharashtra have become increasingly apparent and have proven effective - officials committed to sanitation have risen to more senior positions, rewards are given to officers who advocate for and exhibit dedication and results in sanitation, and village-level leaders supporting sanitation are granted greater access to senior decision makers. This has pushed sanitation to the front of the agenda in a resource-competitive environment. The impact on the decision support tool is that support for certain types of investments may either be incentivized or disincentivized. This choice must be looked at in the context of political will and incentives. This helps in understanding whether the choice is indeed politically viable or if it will be introduced amidst restrictive political opposition and, thus, likely fail to be implemented. The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) is an example of a recent sanitation program incentivizing and emphasizing sanitation activities.

On the demand side at the consumer level, the focus in Maharashtra has been giving rewards to communities through subsidies and other recognition tactics. Requirements have shifted from emphasis on household inputs and infrastructure (eg: construction of x number of toilets) to collective outcome and end results (eg: ending village-wide or community-wide open defecation). Both, the supply and demand side emphases, allow for encouragement of effective sanitation champions in government and civil society organizations. These factors will affect decision making and the tool's suggested investment option by making clear if the option will be well-received at the consumer and city level, or whether there is the possibility of facing a push-back. Additionally, the incorporation of concrete infrastructural goals may help encourage tangible results and coverage.



Increase accountability of policymakers towards citizens. On the supply side, legislation and regulation reduce undesirable political economic influence. In terms of demand, mobilizing and empowering poor consumers and communities can increase access to equitable outcomes, strengthening them in the process. Widespread communication strategies can lessen suspicion and resistance towards government efforts. The government can engage private actors and NGOs in these efforts, keeping in mind the importance of government ownership. This feeds into the need for a tool that will use standardized inputs and a visual line of "thought," thereby increasing transparency. The resulting investment decision will also create a goal towards which progress can be monitored. The tool must allow the decision-maker to support the tool's investment decision in a clear, cogent manner to others - evidence must be digestible to policy-makers as well as technocrats. This will provide subjective support for the decision and dispel suspicion of ulterior motives.

Widespread communication strategies can lessen suspicion and resistance towards government efforts.

Institutional complexity of the sanitation sector is a huge obstacle to sanitation investment, cohesive implementation and pro-poor policies. Institutional change on the supply side, such as regulatory reform, can clarify roles and lead to more effective control of sanitation decision-making. In particular, well-managed decentralization has been key to successful sanitation investment. Decentralization keeps politicians and bureaucrats more accountable, and a decentralized budget authority allows pressure on decision-makers directly from civil society and local government to allocate a budget to sanitation. Chiefly important in devolution is well-defined and delineated responsibility, especially between local bodies. The WSP recommends a clearly designated body for sanitation to decrease complexity of sector planning, as well as to increase accountability and institutionalize knowledge. In Maharashtra, decentralization has allowed for the creation of such government entities dedicated to sanitation, which has promoted the institutionalization of sanitation practice and knowledge in the state. The tool's main usage at the state level is appropriate for making an investment decision and then designating an appropriate authoritative body at the municipal level to implement it. The planning and implementation of the investment decision will be placed under appropriate technical bodies.

It should be noted that decentralization goes hand-in-hand with awareness and strong demand among budget holders and citizens. A decentralized authority, as long as it is accountable and open to feedback, while being communicative with the successive levels of government, may allow stakeholders to debate and contest sanitation investment that affects them. During field research in Chennai, the necessity of interconnectedness between government levels became apparent - interviews found that decentralization can, in fact, have a neutralizing and isolating effect on the authorities. Unless representatives retain influence and connection with subsequent levels of government or carry crucial political weight, decentralization can leave ward and city representatives without enough influence or clout to procure resources from the city or state level.

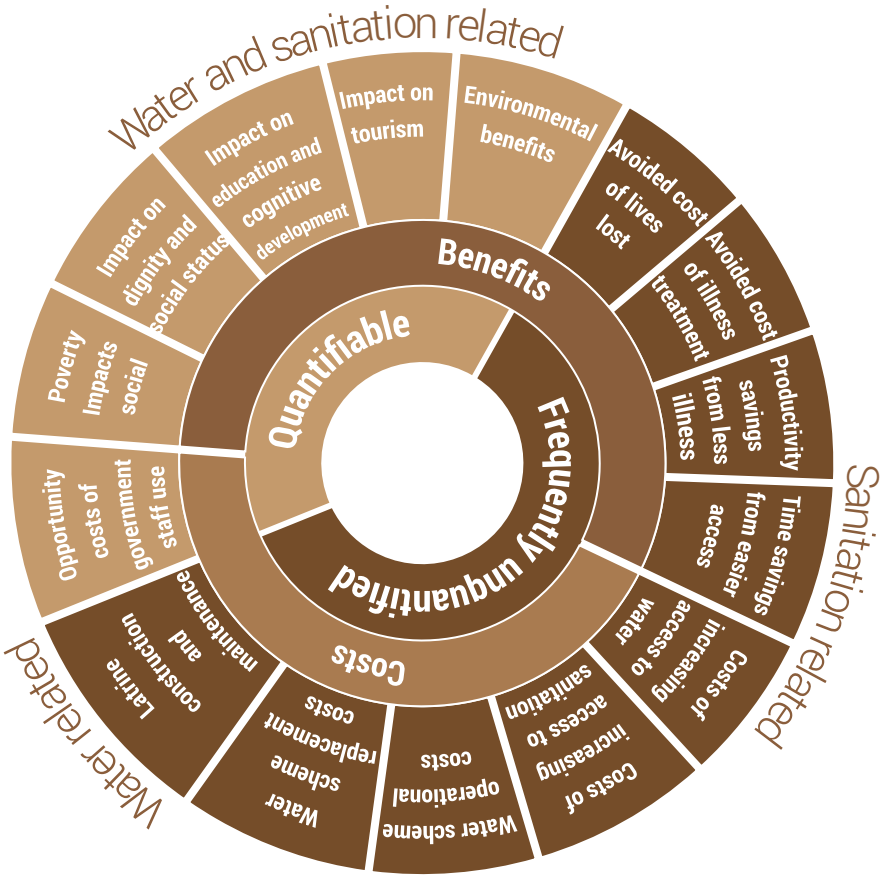
Interviews found that decentralization can, in fact, have a neutralizing and isolating effect on the authorities.

The above described political economy sectors are not traditionally considered in decision-making tools despite the fact that these factors are definitely influencing, if not restrictive. The implementation and utilization of the sanitation system investment - and therefore its success - will be influenced by these factors.

Economic and Social Costs and Benefits

The economics of sanitation is an effective approach in stimulating stakeholder participation and investment in sanitation markets. The rationale behind investing in sanitation systems for both consumers and producers is simple; not only is sanitation an integral part of the Millennium Development Goals (and the new Sustainable Development Goals) established by the United Nations, but investment in its systems has important social benefits as well.

For assessing the economic costs, it is important to look at every step in the sanitation value chain, and address specific issues at each of these levels of sanitation. Tremolet (2012) outlines some of the steps that can be taken to improve sanitation service delivery with the already existing data. These steps include investing more in sanitation, fostering demand for sanitation and correctly estimating the value of various sanitation by-products. In developing countries, there is a distortion in demand and supply of these services because of problems of market failure such as asymmetric information, abuse of monopoly by providers and external effects.



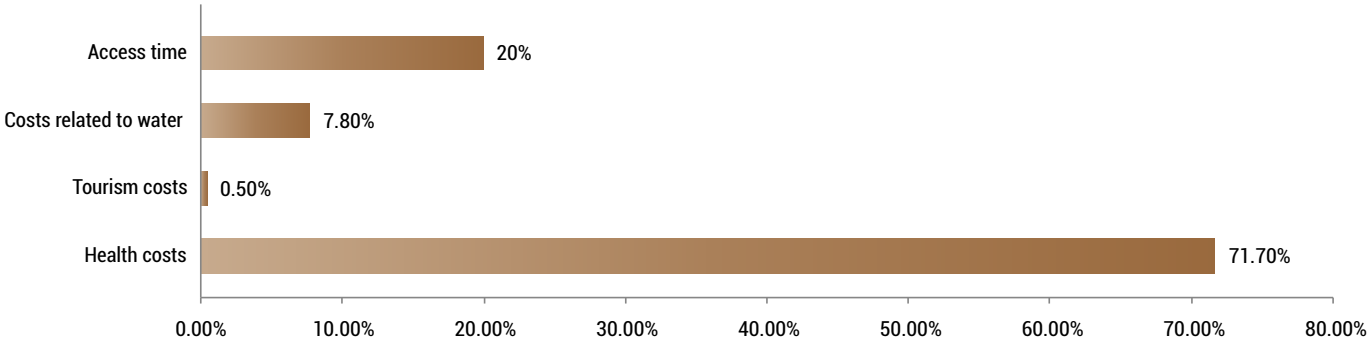
Source: Tremolet, 2010

A cost-benefit analysis will give us a measure to evaluate the need to invest in sanitation projects. One of the biggest challenges in assessing the need to invest in this sector is that some of these costs and benefits are more amorphous, or are deemed unquantifiable. These "softer" costs and benefits are thus often excluded in calculations, hence neglecting some of the positive externalities as well as failing to capture the negative effects and costs that affect sanitation markets. Tremolet (see figure above) points out some of these additional and usually unquantified benefits of a good sanitation system which are associated with social good such as good health, monetary gain through tourism, impact on education and cognitive development. Perhaps, one of the most visible impacts of ridding the practice of open defecation is that it facilitates an environment for tourism and has a positive impact on the dignity of a community.

Moreover, 'access-time impacts' are also being considered in order to evaluate the real cost of inadequate access to sanitation. School and work absence time, time taken to access shared community toilets or open grounds as compared to using a private toilet, are being considered and quantified into economic units (WSP, 2011). A study conducted by the WSP in 2011 tries to quantify some of these factors in the context of India. The authors estimate

4. A.Tyagi (et al), Water and Sanitation Program (WSP), " Flagship Report: Economic Impacts of

that in 2006, the economic impacts of inadequate sanitation were equivalent to 6.4% of India's gross domestic product (GDP). The composition of the costs consisted of access time (20%), costs related to water (7.8%), tourism costs 0.5%) and health costs (71.7%). These costs imply that lack of investment in improved sanitation has a large negative impact on the economic growth of a country.



A critical challenge to investing in sanitation systems seems to be that of ownership- who owns and finances sanitation infrastructure? Many consider sanitation as a 'private good', and yet there are many externalities attached to sanitation systems which make it a 'public good,' rendering financing difficult. Underground systems, in particular, entail high costs to connect households to the main trunk line, a cost that disproportionally affects the poor who often cannot make these investments. However, literature suggests that public perception is biased towards underground sanitation systems, and having on-site sanitation is only seen as a temporary solution or a lesser option. This means that local governments expect to eventually receive funds from the central/state government or donors to "graduate" to UGSS, and thus they will refrain from investing in on-site sanitation. Moreover, in many countries, the topic of sanitation is a 'taboo' subject. Due to this, it is difficult to create demand for sanitation services or to find public officials willing to champion this cause. The findings suggested that public funding in sanitation financing and hardware subsidies had increased effects on access to household sanitation. The report also suggests that public funding for "soft-ware"(sanitation marketing and outreach programs) has an important role in information dissemination and demand creation for improved sanitation as well as bringing about change in sanitation behavior.

Understanding three critical questions -'why invest?', 'who invests?' and 'how much to invest?' are an integral part of any decision support tool for sanitation. Quantifying economic as well as social costs and benefits, followed by analyzing them in the context of these questions will provide a strong economic and social argument for investing in either on-site or sewerage sanitation systems.

why invest?

who invests?

how much to invest?

Inadequate Sanitation in India", 2011

Context Adaptation

The Indian context presents a unique set of challenges and opportunities to the development of a sanitation decision support tool. Official reports revealed that 595 million people, accounting for nearly half of the total India population, still practice open defecation in 2014. Although 100% UGSS coverage of India's cities is a stated political goal, most Indian households still rely on on-site sanitation solutions. UGSS coverage is estimated at around 60-70% of the households in cities such as New Delhi and Chennai. To meet the challenge of providing improved sanitation services to India's rapidly urbanizing population of 1.2 billion people, stakeholders have experimented with a range of different approaches.

The Government of India in collaboration with the World Bank's Water and Sanitation Program (WSP) produced a guide to urban sanitation decision-making in India. This document focused on household decision-making and recognized that the majority of urban homes are likely to require on-site sanitation systems for the foreseeable future.

cSTEP produced one version of an optimized functional framework for a decision making tool based on the Indian context. This approach analyzes ward-level baseline data, defines the system context, and produces ward and city-level breakdowns of cost and other indicators.

595 million people, *accounting for nearly half of the total India population, still practice open defecation in 2014.*

Community Participation

Community engagement has also been used as a means of improving sanitation coverage and use in India. A partnership between the community, municipal corporation and local NGOs in Tiruchirappalli led to an innovative program of community-managed toilets (CMTs) in informal settlements. An assessment of this program's results found significant improvements in the quality of sanitation coverage in slums where CMTs operated. Overall these toilets were managed much more effectively than those under the administration of local government actors.

Initiatives to involve the community in sanitation improvement efforts are also useful in spreading awareness about the value of safe sanitary practices and the growing demand for better facilities. This is especially valuable in India, where local cultural norms often support unhygienic sanitation practices such as open defecation.

5 WSP and the Government of India, "A Guide to Decisionmaking: Technology Options for Urban Sanitation in India" 2008
6 cSTEP, "Integrated Urban Sanitation Decision Support Tool Review of Support Resources in Sanitation," 2014.
7 WaterAid, India, "Tiruchirappalli Shows the Way: Community-Municipal Corporation-NGO Partnership for City-wide Pro-poor Slums' Infrastructure Improvement," 2008

Prioritization Frameworks

Even within the country or region, different municipalities have different sets of priorities for sanitation projects. There is no single solution for infrastructure investment. Rather, decisions should be made with a multidisciplinary approach to create robust solutions. As mentioned in the Architecture of Tools section, one way to effectively tailor the project to a specific municipality is to model preferences. This can either be subconsciously revealed (through making a set of binary choices) or estimated by simply hierarchically organizing or attaching weights to influencing variables based on local needs and values.

Financing

Financing for sanitation infrastructure, maintenance and operations generally comes from a combination of local government funds, outside grants and user fees. In India, Urban Local Bodies (ULBs) depend on higher levels of government to fund the bulk of their local expenditures. The federal government allocates resources to state governments, which in turn provide funding to the governing bodies of municipal corporations, municipalities and town panchayats within their state.

Over the last thirty years, successive administrations have prioritized investing in sanitation to improve health and cleanliness throughout India. In the 1980s, the government of India initiated the Central Rural Sanitation Program (CRSP) to build new toilet facilities throughout the country, focusing on rural areas.

***1980s** - Central Rural Sanitation Program (CRSP)*

8 L. Andres, D. Biller, M. Dappe.A Methodological Framework for Prioritizing Infrastructure Investment. (2015)

Although the program technically increased access to improved sanitation options, it was not successful in raising usage statistics or preventing open defecation. In many areas, the newly built toilet structures were used for alternative purposes, such as storage. The CRSP was reimagined and expanded in 1999 under a new name: the Total Sanitation Campaign (TSC). The TSC sought to incorporate more demand-driven programming, extending financial support for new latrines to individual low-income households and incentivizing local governments to end open defecation.

***1999** - Total Sanitation Campaign (TSC)*

The latest version of India's national sanitation strategy is the Clean India Mission (Swachh Bharat Abhiyan), launched in 2014 by Prime Minister Modi. Swachh Bharat is designed to improve overall cleanliness, encompassing sectors beyond sanitation management. Nevertheless, the primary goal is still to make India an open-defecation-free (ODF) country by 2019. As part of this campaign, the federal government has made funds available for grants to ULBs wanting to improve their local sanitation services. Through programs such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), states submit Annual Action Plans (SAAPs) to the federal government that include Service Level Improvement Plans (SLIPs) for all designated AMRUT cities in the state.

***2019** - An open-defecation-free (ODF) country*

As noted previously, the GOI's primary approach to solving its sanitation problems to date has been to subsidize the construction of new toilet facilities. This has increased access to improved sanitation options, but largely failed to increase usage and change demand behavior. One of the main reasons for this has been the lack of planning and investment in operations and maintenance requirements for facilities. Newly constructed toilets quickly fall into disrepair and become unhygienic and unappealing to users if they are not properly maintained. Therefore, sanitation projects must include a viable plan to cover the long-term O&M costs of providing clean, functional facilities.

In Alandur, a suburb of Chennai in Tamil Nadu, the city successfully implemented a public-private partnership to provide household sewerage connections. The success of this project relied on contributions from consumers to the new system's upfront capital costs. Specifically, the city needed to secure deposits from at least 10,000 households. Prior to the project the municipal authorities conducted a willingness to pay assessment that looked at citizens' willingness and ability to contribute to these costs. They also created different pricing mechanisms for domestic, industrial and commercial sewerage connections. Other cities may be able to replicate this approach to ensure a sustainable project through fostering buy-in from consumers and contracting services to private sector partners.

Considering Informal Settlements

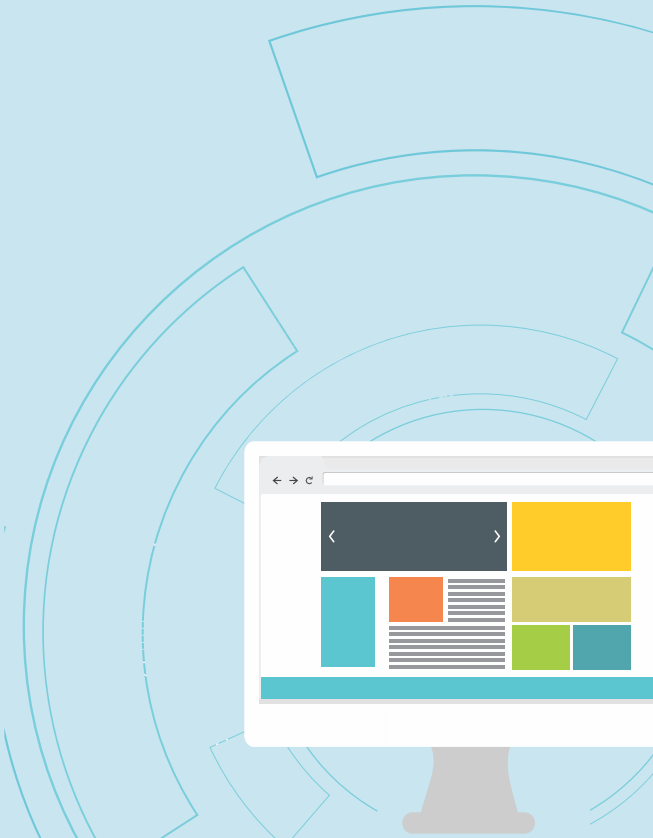
Incorporating informal settlements into a city sanitation plan requires further adaptation of costs, benefits and assumptions. In many informal settlements, public toilet provisions are unsatisfactory: the ratio of toilets to users is too low, and the facilities are inconveniently located. The management and maintenance of the facilities is improperly handled, and users ultimately become dissatisfied with facilities or unwilling to use them due to safety concerns.

In a typical example, a housing project may have 1,000-5,000 households, with an average of 6 members in each household. Wastewater in these areas is domestic in nature, but biological waste may be 25% higher than normal households. This is because these residents often run small businesses out of their homes. They may also rear livestock. Since wastewater is often carried through open storm drainage, solid waste disposal, along with sanitation, becomes a critical aspect in the prevention of clogging. Apart from public health concerns, foul odors and clogged drainage are additional reasons for developing an effective municipal sanitation system in these settlements. Since sanitation relies on positive network externalities, any city wide sanitation plan would be incomplete without considering how to best address the needs of those who have the least access to public sanitation service.

Any city wide sanitation plan would be incomplete without considering how to best address the needs of those who have the least access to public sanitation service.

9 The Sourcebook Project Team, *Philippines Sanitation Sourcebook and Decision Aid* (2007)

26 FIELD RESEARCH



Field Research

During a visit to Chennai and Vellore, we spoke with leaders of municipalities and local institutions. We have outlined some of the key takeaways below:

Land acquisition is often a major reason for holding up theimplementation of sanitation systems.	*When public service providers have overlap ping domains, it can delay the process of land acquisition. Some of the most efficient sanitation projects have planned systems in collaboration with other service providers, taking opportunities to package system upgrades, while keeping overall costs low.*
A political champion for sani tation is an essential factor for success of the project.	*Sanitation projects often have to overcome many institutional and social hurdles. To keep projects on track and the morale of working groups high, a strong leader is tan tamount to success.*
A decentralized system may serve as a viable option for areas not yet meriting central ized systems but which have graduated from septage.	*Many politicians expressed that they would push for 100% sewerage when it may not have been the most appropriate option. Because of public perceptions surrounding UGSS as the benchmark for a well-devel- oped sanitation system, other options that are better suited may be ignored. There are variants that should be given proper con sideration before choosing an all-or-nothing UGSS approach.*
Awarding of smaller contracts for sanitation system construc tion may remove barriers to entry for qualified but smaller contractors.	*Implementing sanitation systems that are smaller than a citywide UGSS system opens up opportunities to engage new private sector partners. There is limited capacity in India for the management of larger scale projects.By compartmentalizing, one can ease the bottleneck that presents itself from the dearth of large construction and man agement firms.*

Public willingness to pay for UGSS services is key to eventu al connection and covering of costs.	*A financing plan for long-term operations and maintenance costs is necessary to ensure the sustainability and use of any san itation system. ULB's will need to conduct a thorough willingness-to-pay assessment in their service areas to determine appropriate requirements for user fees.*
Movement towards PPPs may facilitate UGSS construction in less costly manner.	*Public-Private Partnerships provide oppor tunities for ULB's with limited resources to strategically share the upfront costs of a sanitation system with a private company. Thishelps enable efficient development of new sanitation infrastructure and service delivery.*
Any city-wide sanitation plan should include considerations for rapid population growth.	*With the rate at which India's cities are expanding, municipalities will be using resources far more efficiently if planning and building for future need. Sanitation systems are inherently hard to scale after being built, and risk becoming obsolete if not incorpo rating future growth.*

Interviews

The main objective of our field trip was to assess the situation on the ground in order to truly tailor our research and framework to the Tamil Nadu context. With the assistance of Athena Infonomics, we set up interviews with stakeholders spanning different viewpoints and positions on developing a citywide sanitation strategy. In order to contextualize the situation in Tamil Nadu, we spoke with the various stakeholders (see table below) to understand and consider some of their concerns as well as the current decision-making process at both the planning and implementation levels of the project.

Name	Title
Ms. Janaki Raveendran	*Vellore Municipal Commissioner*
Dr. S VasanthDivahkar	*Vellore Chief Health Officer- Vellore Municipal Corporation*
T. Balasubramanium	*Corporation Engineer- Vellore Municipal Cor poration*
Mr. Raj Cherubal	*Chennai City Connect (Recently appointed Chief Resilience Officer, Chennai Corporation)*

Mr. M Vaitheeswaran	*Sanitation Expert- Directorate of Municipal Administration, Chennai*
SatyarupaShekhar	*City Action Group*
Dr. Ashwin Mahalingam	*Indian Institute of Technology, Chennai*
Mr. S Krishnan	*Principal Secretary, Planning & Development and CEO of Tamil Nadu Infrastructure Board*
Ravikumar Joseph	*Water and Sanitation Specialist, WSP*
Somnath Sen	*Indian Institute of Human Settlements*

Apart from the content of these meetings, the field trip helped us understand the work culture surrounding these decisions. Although many of the local authorities had been willing to meet with the teams, it proved difficult to set up actual interviews.

Land acquisition and right-of-way was a recurring theme in many of the interviews. Much of sanitation infrastructure involves being physically located in the same location as other utilities and infrastructure which are owned and operated by separate departments and bodies within the government. This makes coordination involving land rights and potential remuneration often complicated and lengthy, causing delays with contracts. Mr. Raj Cherubal of Chennai City Connect, an initiative which facilitates stakeholder collaboration in urban planning, suggested that for the sake of efficiency, it was better to contract one private agency for all sanitation services in order to combat right-of-way issues. This would solve issues of coordinating with multiple private contractors (water, electricity, transport) for building and operating sanitation infrastructure and any maintenance work associated with it.

Mr.Raj Cheubal,
Chennai City Connect

For the sake of efficiency, it was better to contract one private agency for all sanitation services in order to combat right-of-way issues. This would solve issues of coordinating with multiple private contractors (water, electricity, transport) for building and operating sanitation infrastructure and any maintenance work associated with it.

To add to that, better inter-agency coordination between different utilities at the local, state and national level would significantly reduce the length of a sanitation project. This view was reaffirmed by the Municipal Commissioner of Vellore Corporation who mentioned that one of the biggest challenges to service delivery for her corporation were time-delays in land acquisition from local, state and national authorities. In terms of sewerage, ownership is a large issue and there needs to be better communication on sewerage repair and construction to citizens. They are often uninformed about the reason for large construction projects in their neighborhoods during utility investment.

One of the biggest challenges to service delivery for the corporation were time-delays in land acquisition from local, state and national authorities

Ms. Janaki Raveendran,
Municipal Commissioner of Vellore corporation

While talking to the Sanitation Expert from the Directorate of Municipal Administration we realized that the general consensus at the municipal level was that there were delays in 100% UGSS because of financing issues. This, despite all parties' firm belief that UGSS was the ultimate goal and all zones in the city would eventually get underground sewerage. However, at the higher level of government, the authorities are more welcoming to the idea of on-site sanitation in peri-urban areas as opposed to 100% UGSS. Mr. S Krishnan, Principal Secretary, Planning & Development, Tamil Nadu and CEO of Tamil Nadu Infrastructure Development Board recognized that given the limited amount of funding, 100% UGSS was not a feasible solution.

Given the limited amount of funding, 100% UGSS is not a feasible solution

Mr. S Krishnan,
Principal Secretary, Planning & Development, Tamil Nadu and CEO of Tamil Nadu Infrastructure Development Board

The option of a decentralized system may be especially useful in the Indian context for the rapidly expanding peri-urban areas. These areas crop up quickly and often septage is the first step, but a centralized system may not necessarily be a viable next step. A decentralized system therefore may be a more natural fit when population density has reached a certain point.

Our interview with the Dr. Ashwin Mahalingam of the India Institute of Technology in Chennai regarding the Alandur PPP and his role in the project proved to be very insightful. This project which introduced UGSS to the Alandur municipality has been hailed as one of the most successful implementations of UGSS in India. Our conversations with both Mr. Mahalingam as well as the Principal Secretary of Planning & Development/CEO of the Tamil Nadu Infrastructure Board definitely placed PPPs on the radar of potential approaches for implementing the decided-upon sanitation investment.

The PPP seems to be a perfect confluence of variables:

- A community leader rallying the citizens' support,
- strong ties between the community groups and a tenured mayor who commanded their respect, while serving as a sanitation champion,
- a large investment fund, and,
- a willing as well as able private entity partner.

While most seemed to agree that the Alandur PPP would be difficult to replicate, it does provide confirmation of the individual elements that help to facilitate sanitation decision-making and investment.

Variables and Decision Matrix

This section outlines the key variables that must be considered when determining the most appropriate sanitation infrastructure investments for a given context. Drawing on existing tools and literature, as well as field research conducted in Chennai, our team has prepared a framework for a decision support system that addresses some of the shortcomings of currently available frameworks. Specifically, it guides policymakers in answering the question: What is the most technically and financially appropriate model that is also supported by ecosystem enablers in a city?

We provided a list of the questions regarding technical and non-technical variables that are factored into our proposed tool.

Technical variables are divided into

1) Restrictive, and,
2) Influencing.

Non-technical variables that affect the feasibility and suitability of sanitation systems in certain contexts include:

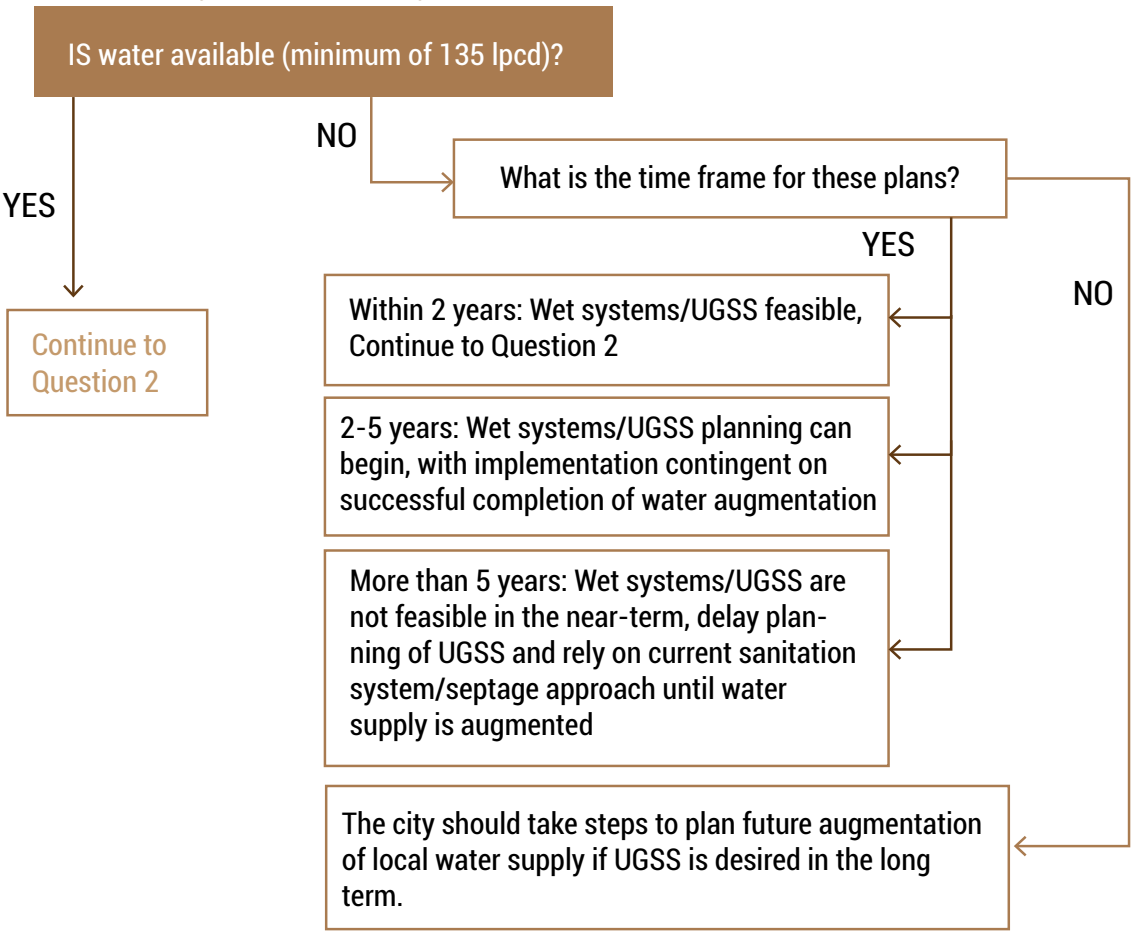
- health factors,
- regulatory requirements,
- social norms and preferences,
- and economic considerations such as funding and impact on the local economy.

Finally, the role of political economy in making sanitation investment decisions is discussed. We have sought to simplify the process for decision-makers by providing a guiding yes/no question for each variable. The answers to each question will help determine which approach to sanitation coverage is most suitable.

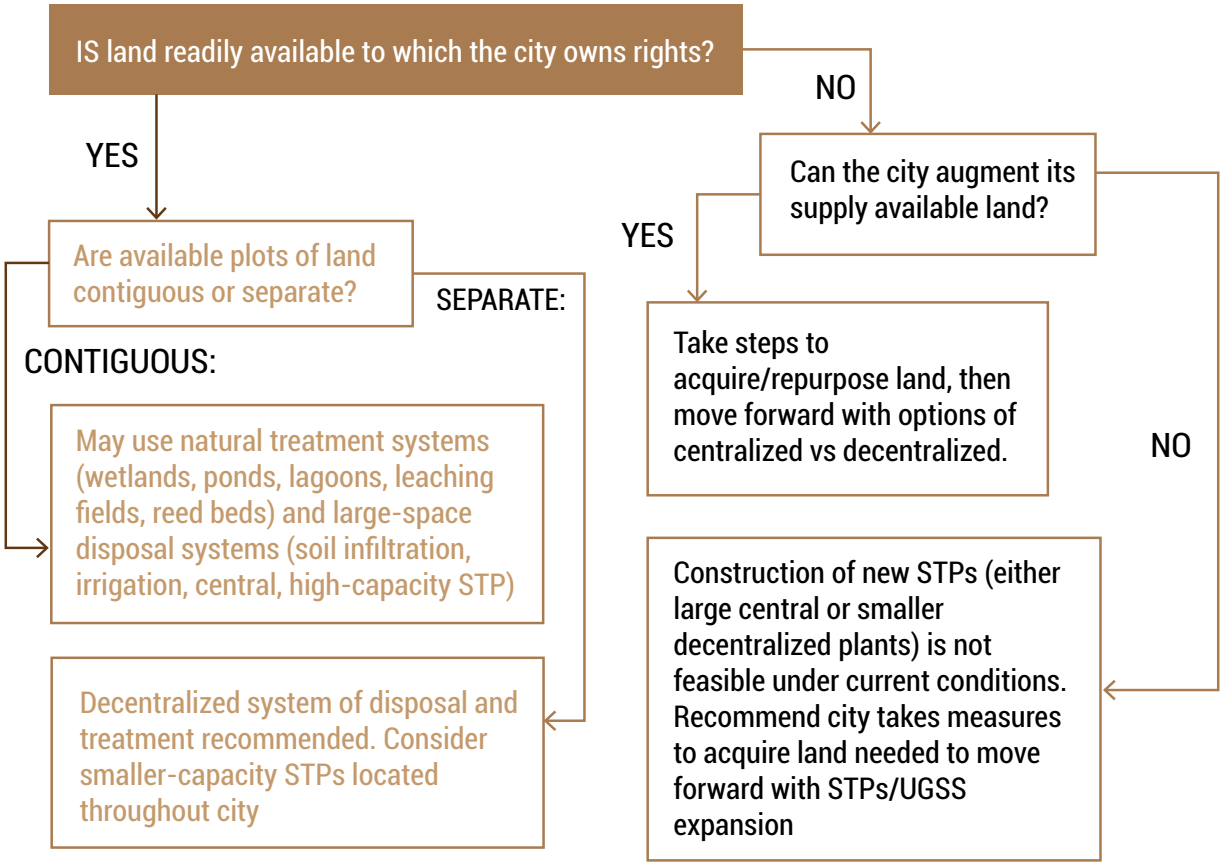
What is the most technically and financially appropriate model that is also supported by ecosystem enablers in a city?

Analysis of Variables

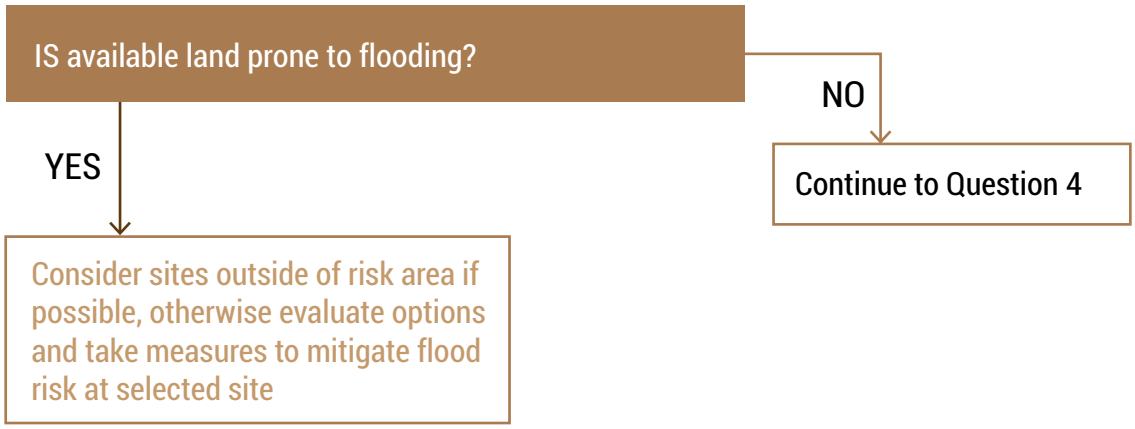
1. Availability of Water Supply



2. Space Limitations

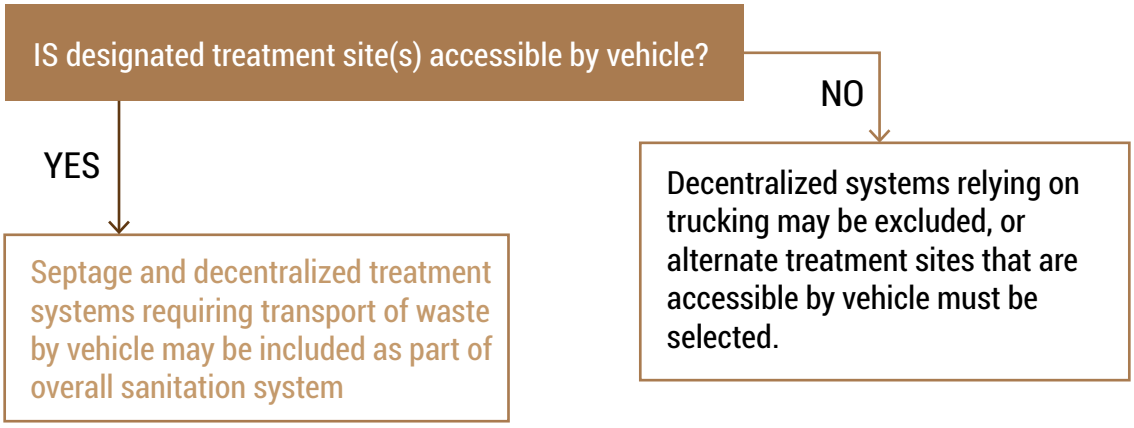


3. Flood Risk

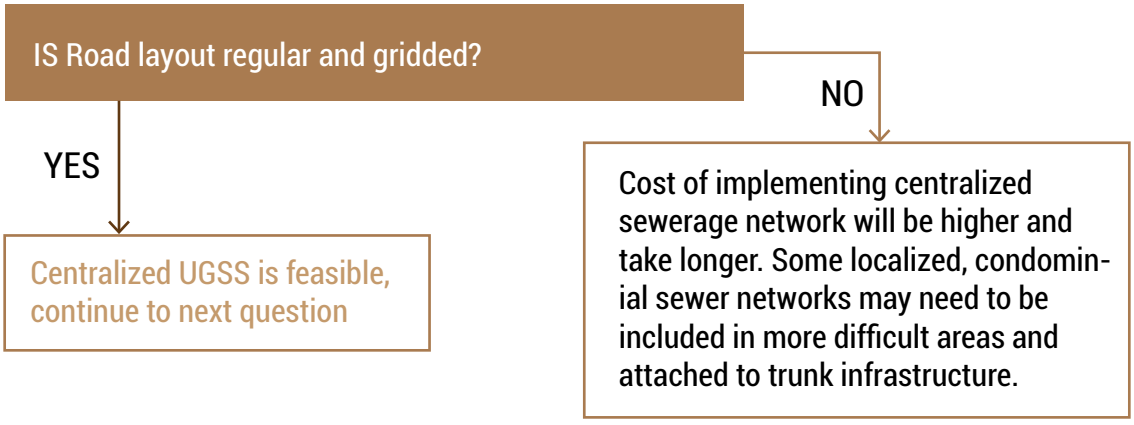


4. Difficult Vehicular Access

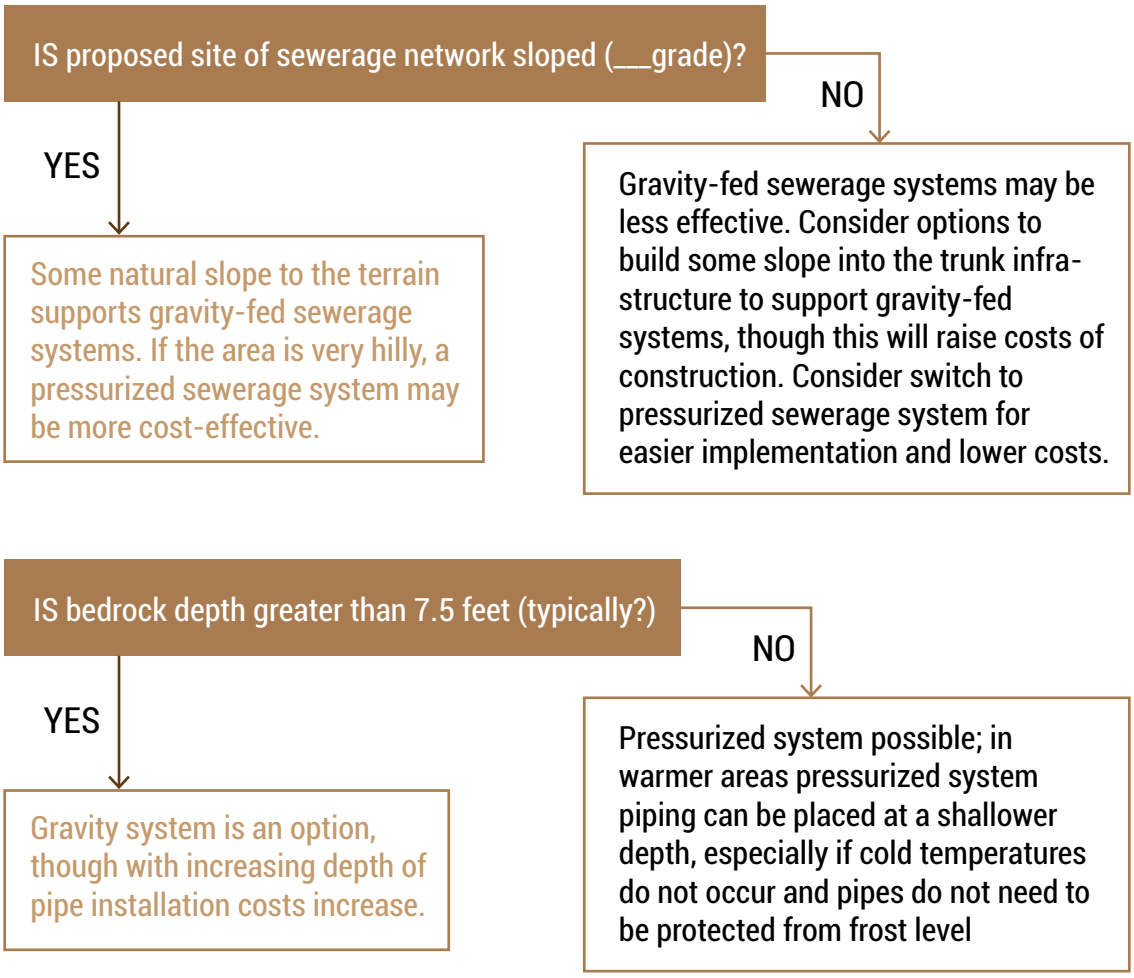
Decentralized systems relying on trucking of sludge may be disqualified



5. Irregular roads

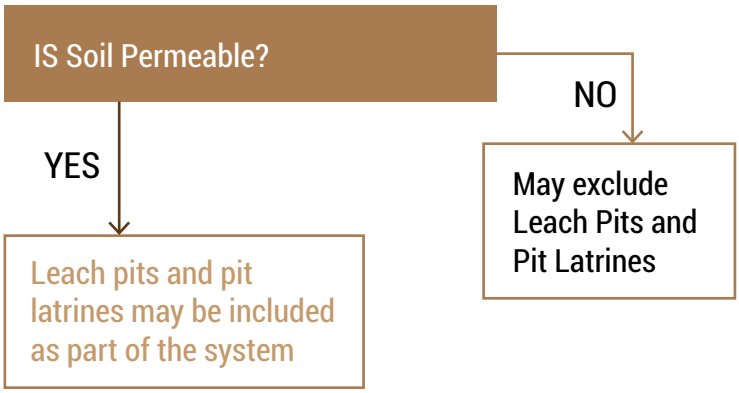


6. Terrain/Topography

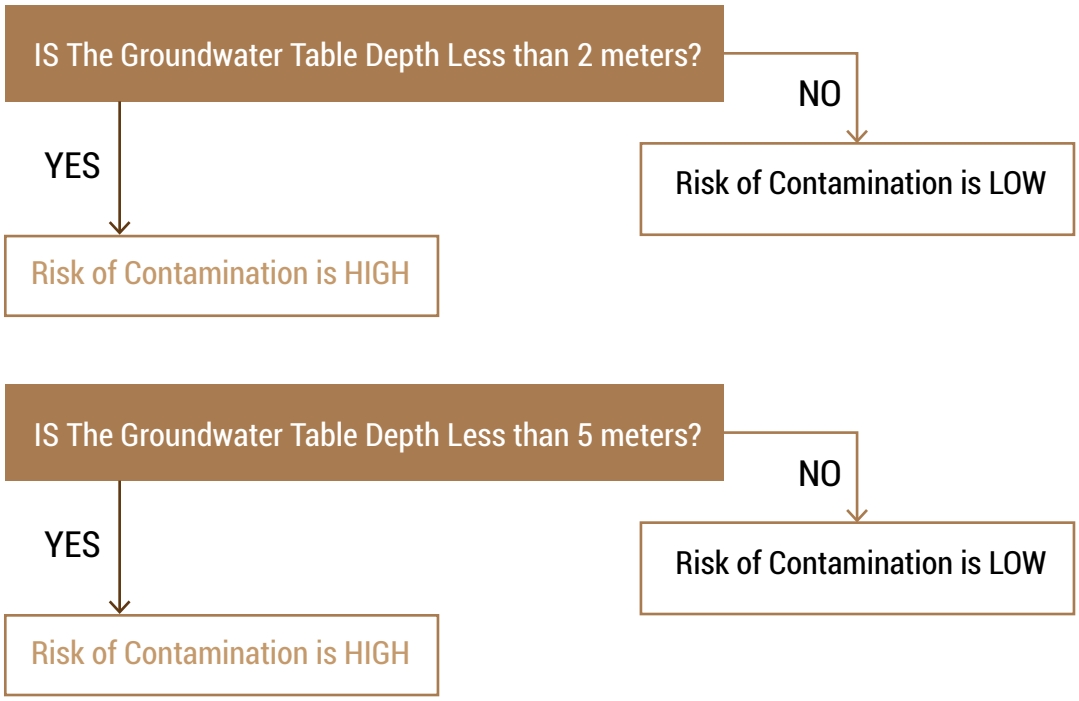


7. Poor soil permeability

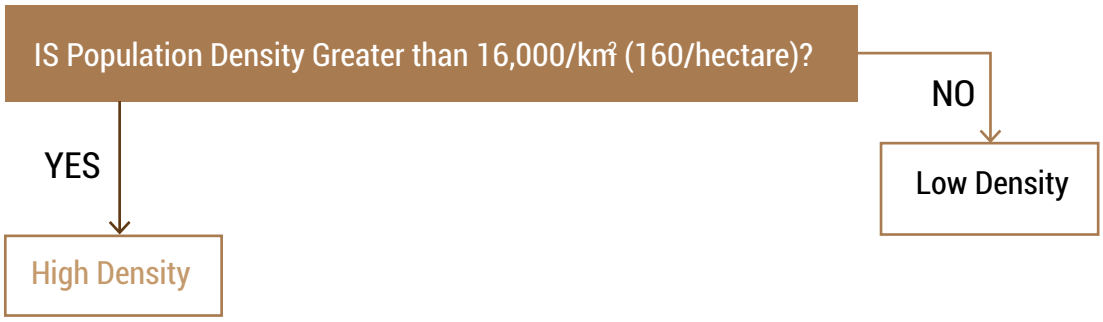
Leaching systems may be excluded. (Leach pits & Pit Latrines)



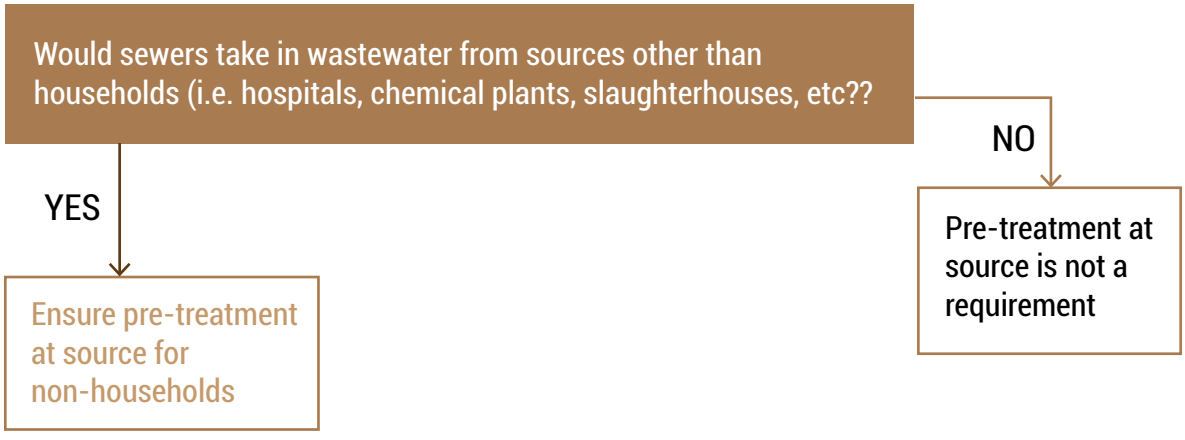
8. Depth of Groundwater Table



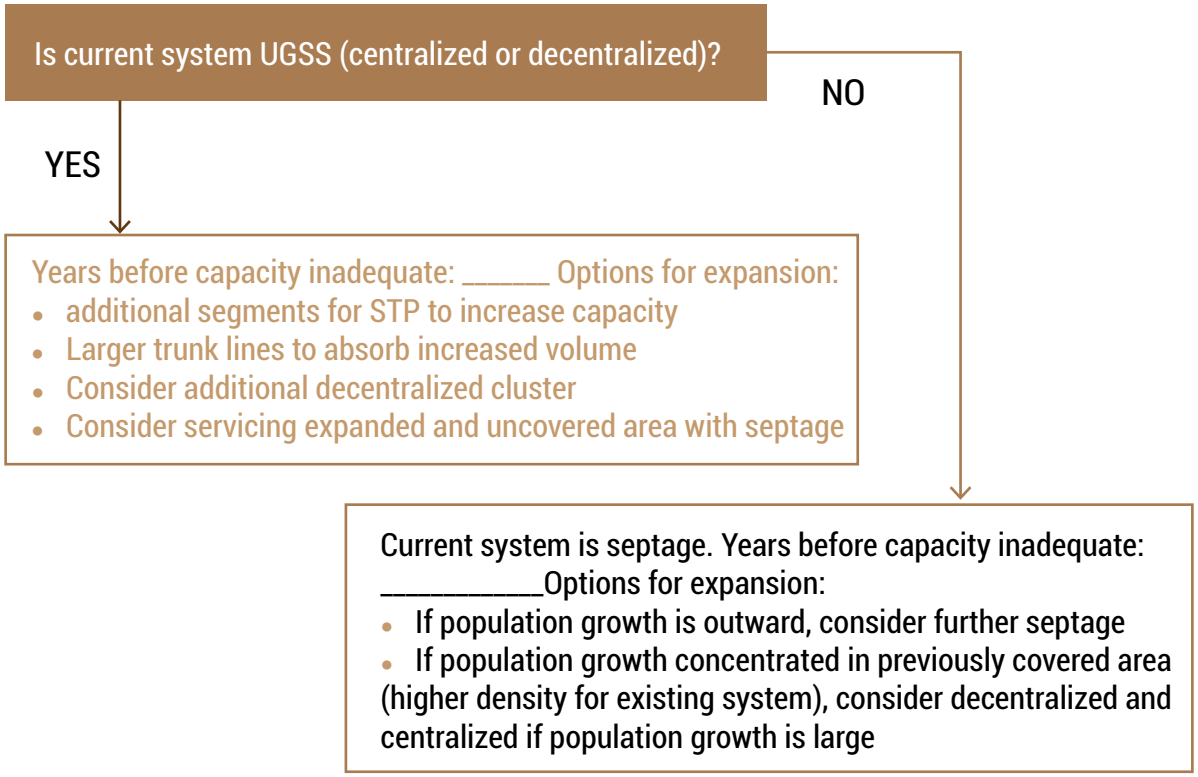
9. Volume of wastewater (Density of Population)



10. Content of wastewater

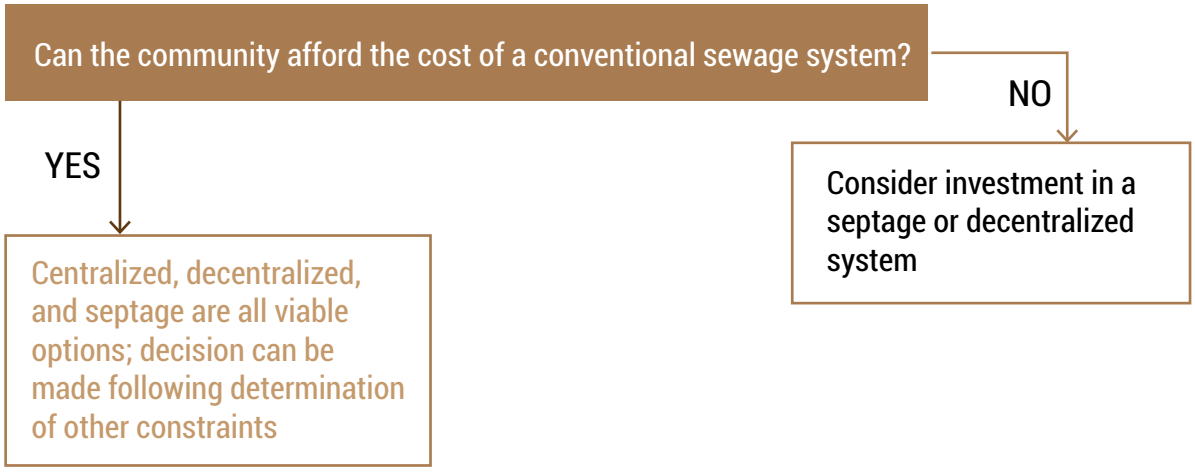


11. City Population Growth Rate

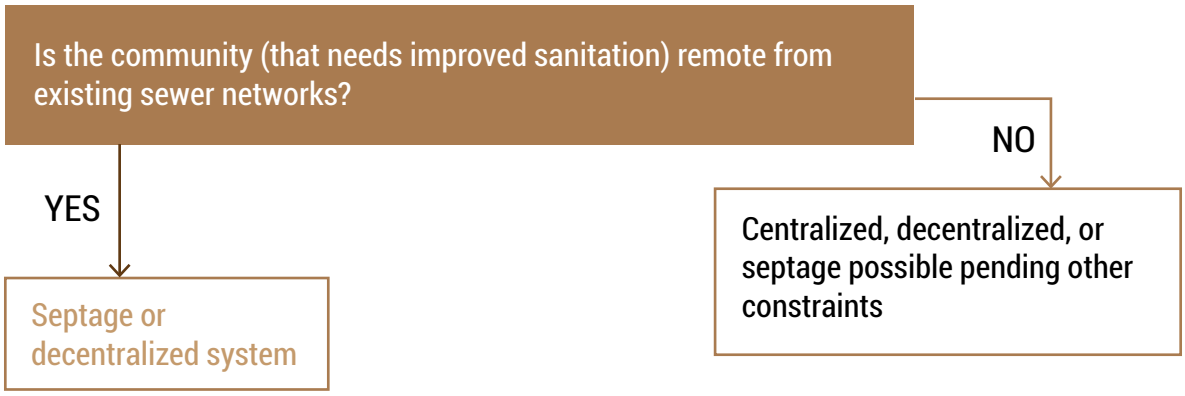


Non-Technical Variables

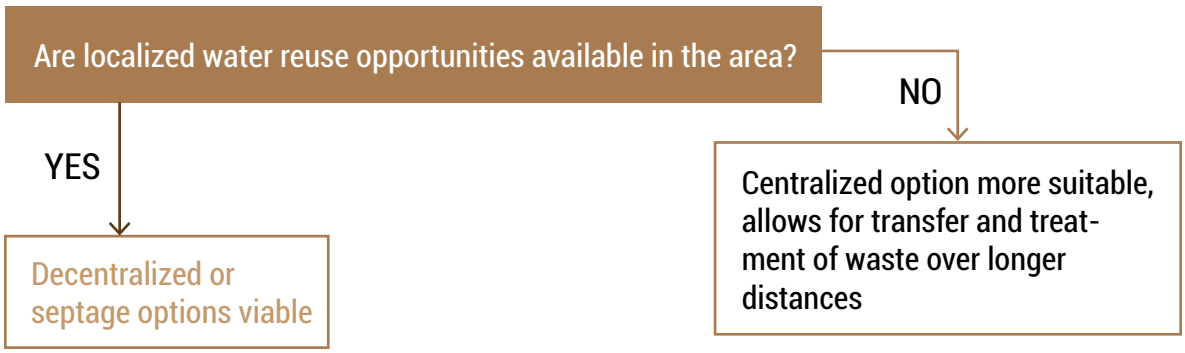
1. Community Affordability



2. Distance from Trunk Lines

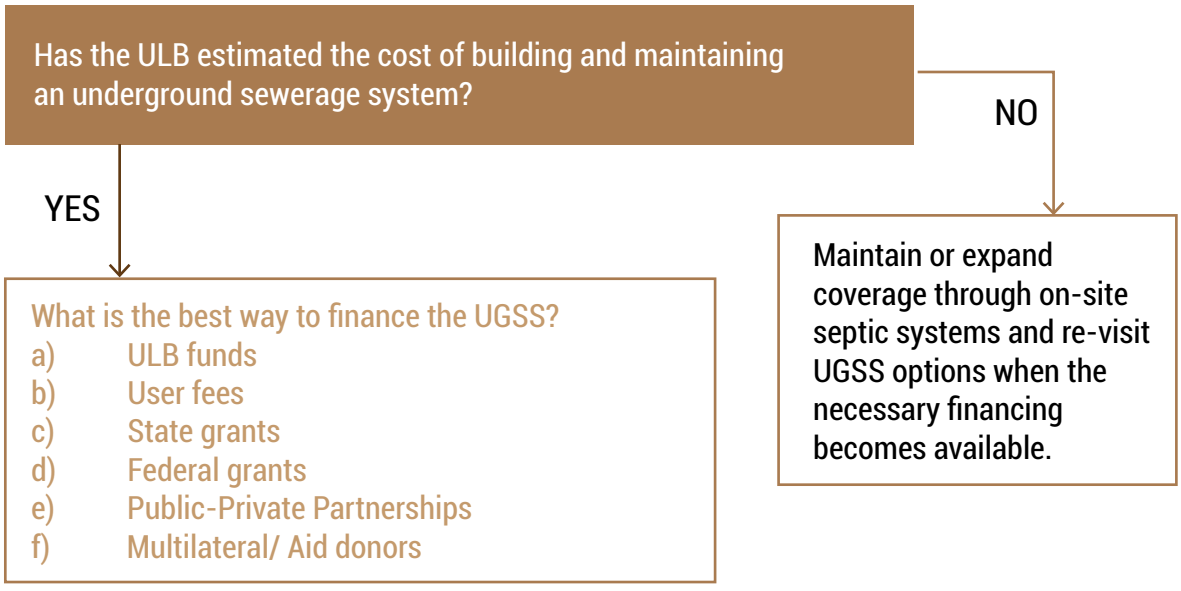


3. Water Reuse

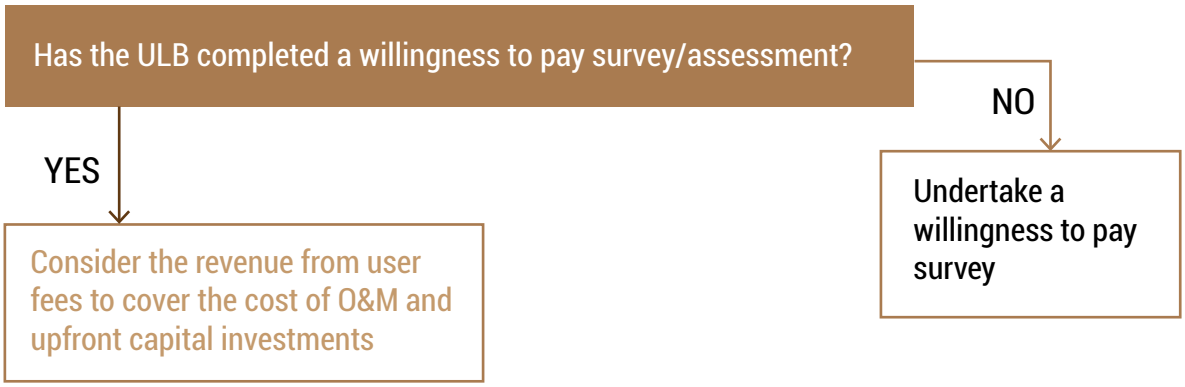


Financial Variables

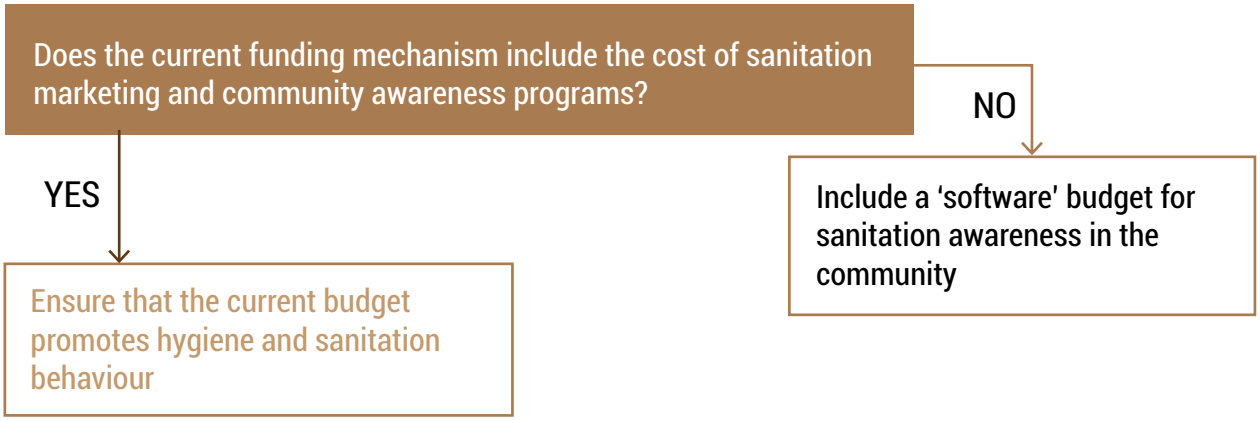
1. ULB Budgeting



2. Willingness to Pay



3. Holistic Budgeting



Additional non-technical variables to consider:

Health Variables

1. Risk of water pollution
2. Risk of food pollution
3. Other Undesirable Effects

Regulatory Variables

1. Compliance with environmental standards and regulation
2. Compliance with engineering standards of design and construction

Social Variables

1. Informal Settlements and low-income housing
2. Social norms
3. Hygiene practices
4. Community participation
5. Education

Political Economy Variables

1. Decision Making Process

Does the current funding mechanism include the cost of sanitation marketing and community awareness programs?

YES → Continue to Question 2

NO → Mild Difficulty - Recommendation: increase government visibility and role in the decision, campaign for awareness about the investment decision and government support for it; speak with community leaders about the importance of the decision as well as community buy-in.

2. Supply Side Incentives

Do supply side incentives for policymakers and government officials exist?

YES → Identify a local sanitation champion and leverage for investment cause; engage this person directly and establish a connection

NO → Medium difficulty - more aggressive action needed: engagement of either politicians at city and ward level and/or communication with community groups to educate on the importance of the sanitation investment decision to both the health and quality of life of the users.

3. Sanitation Incentives

Do programs or rewards exist to incentivize a community to achieve sanitation goals?

YES → Engage community and emphasize the importance of the sanitation investment in achieving these goals and citizen role in working with local governments to obtain them. Encourage citizen buy-in to work towards a shared goal.

NO → Mild Difficulty - meet with local community leaders to speak about the importance of the goals of the sanitation investment, regardless of whether there is an official incentive

4. Perceptions

If the decision is to implement septic system, is an UGGS system seen by local officials and/or the public as superior to a septic system?

NO → Continue to Question 5

YES → High Difficulty - meet with local community leaders and collaborate. This will require significant campaigning to spread understanding about why a septic tank system is preferable and more economical than the traditionally-preferred UGSS.

5. Transparency

Is there transparency in implementation processes, such as in bidding procedures and planning mechanisms?

NO → Expect delays and significantly increased costs;

YES → Impose frequent meetings and updates, with established milestones and timelines

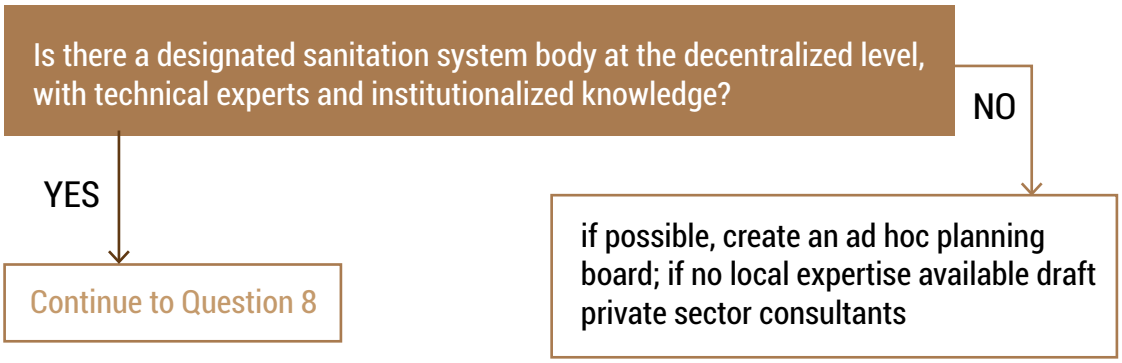
6. Communication

Is communication between community and local governing bodies frequent?

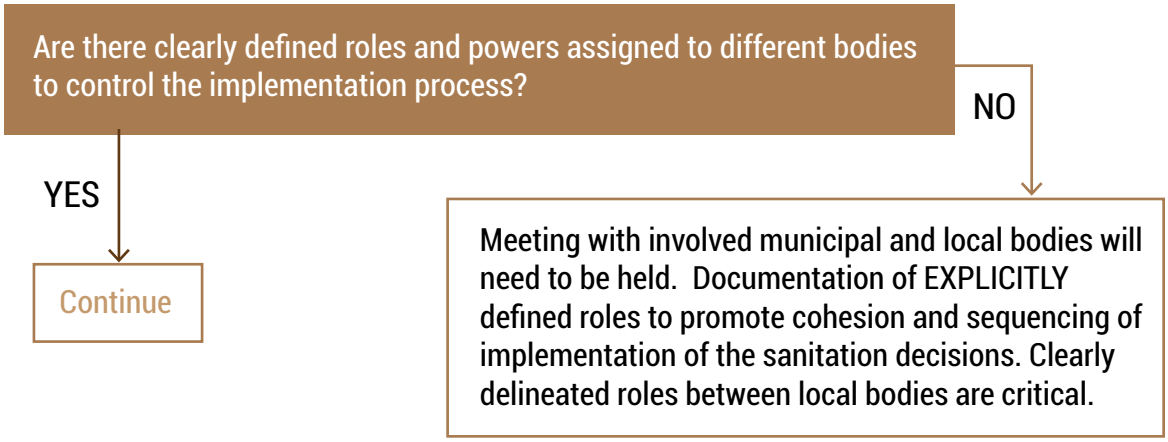
NO → The government can engage private actors and NGOs in these efforts, keeping in mind the importance of government ownership, to accomplish the above suggestion.

YES → Use channels for widespread communication strategies to lessen suspicion and potential resistance towards government efforts; teach of importance of sanitation decision; establish frequent connection between governing body representative and community groups.

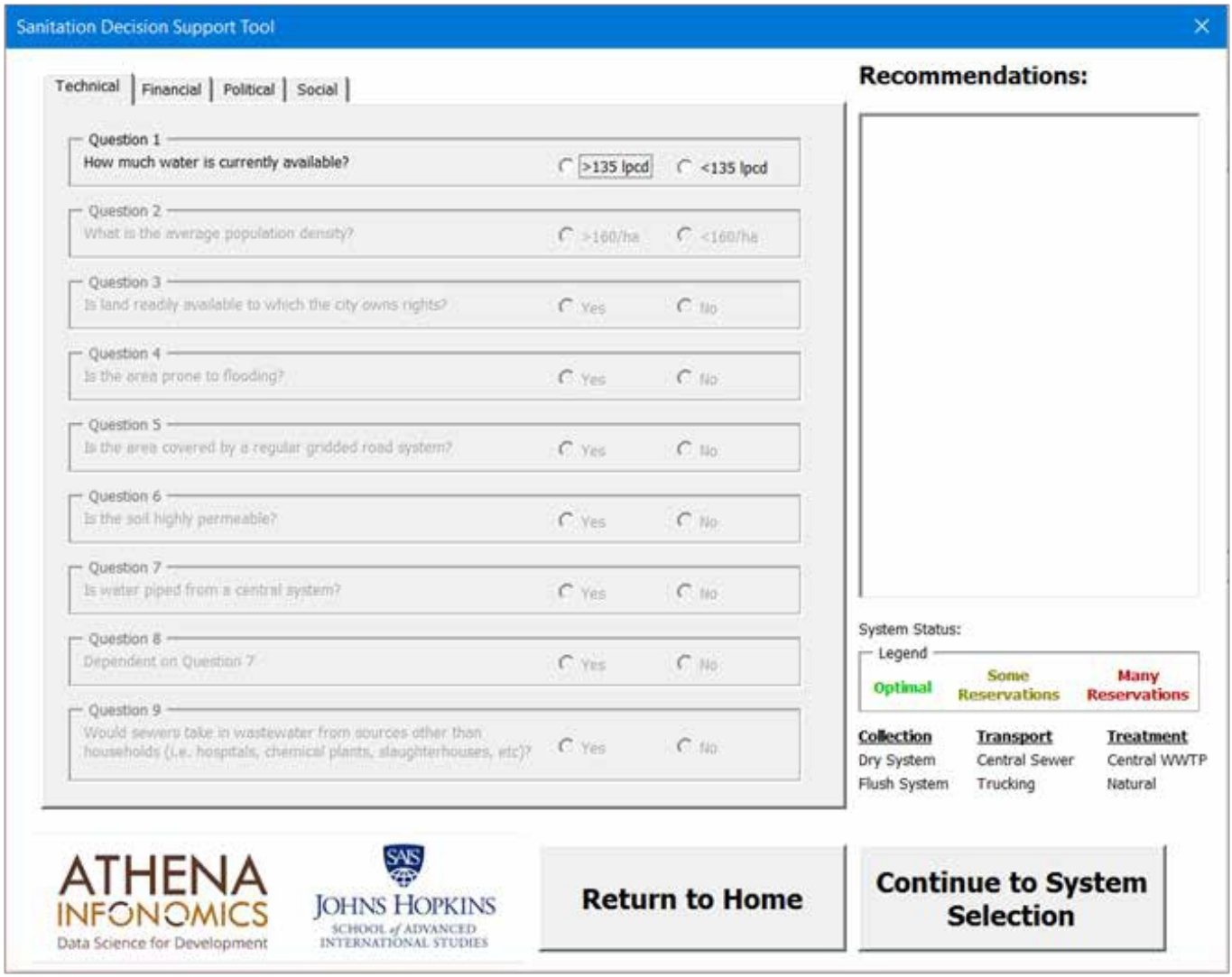
7. Institutional Knowledge

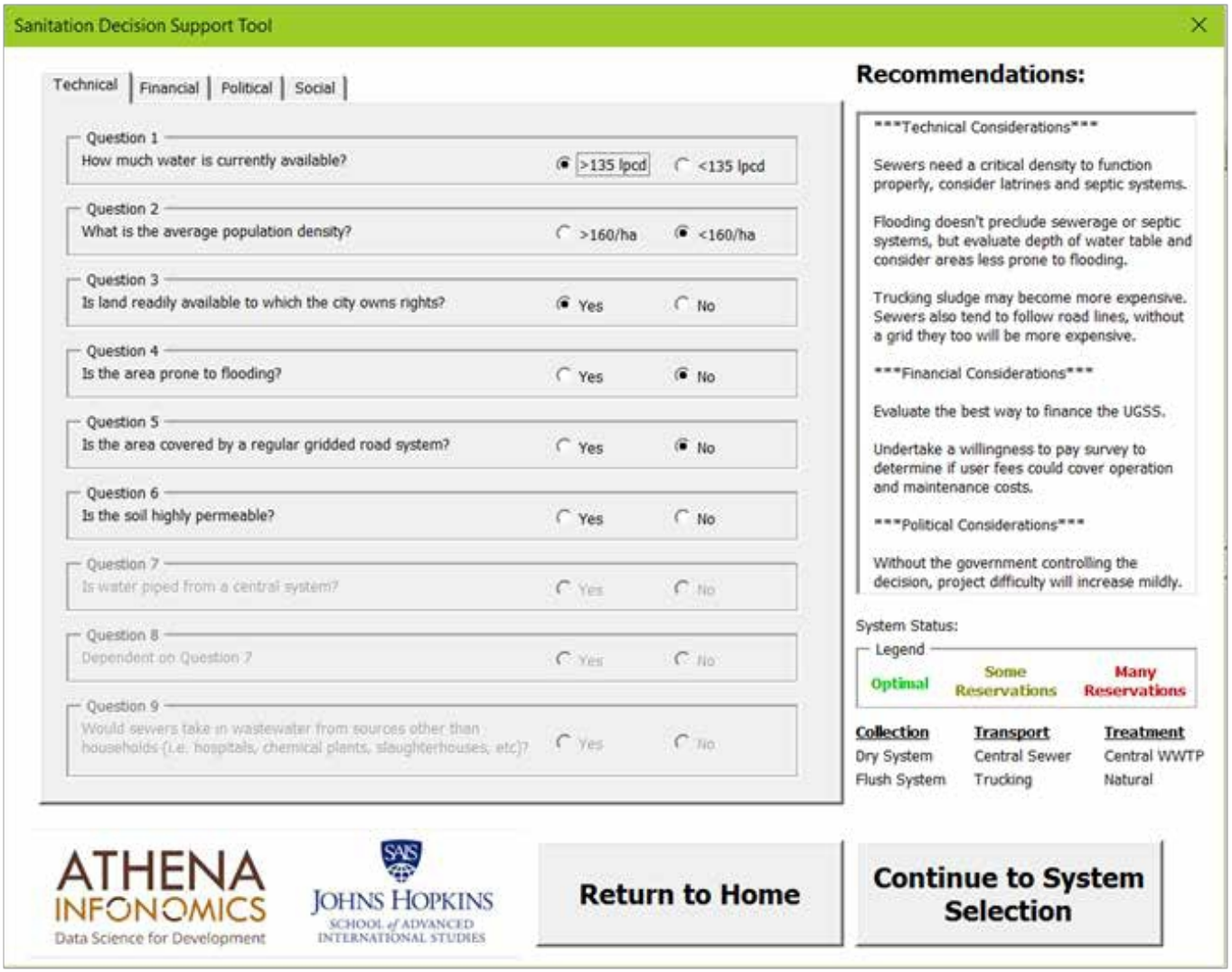


8. Established Roles



As an example of how this data could be captured and processed, our team consolidated the variables into a draft Excel-based tool





The primary stakeholders driving sanitation decisions can answer a series of questions with respect to both the technical and non-technical variables. Answers to technical questions should be weighted so as to contribute points toward each of the available sanitation options. We have designed the tool to cover three options:

1) Expand underground sewerage network,

2) Establish a decentralized treatment system,

3) Adopt an on-site sanitation system (septage).

The tool should be built out so that the responses selected by the user adds points to the three options according to how they are affected by the specific variable. Cumulative responses will result in a coding of each option by a numerical value and a color scheme of –

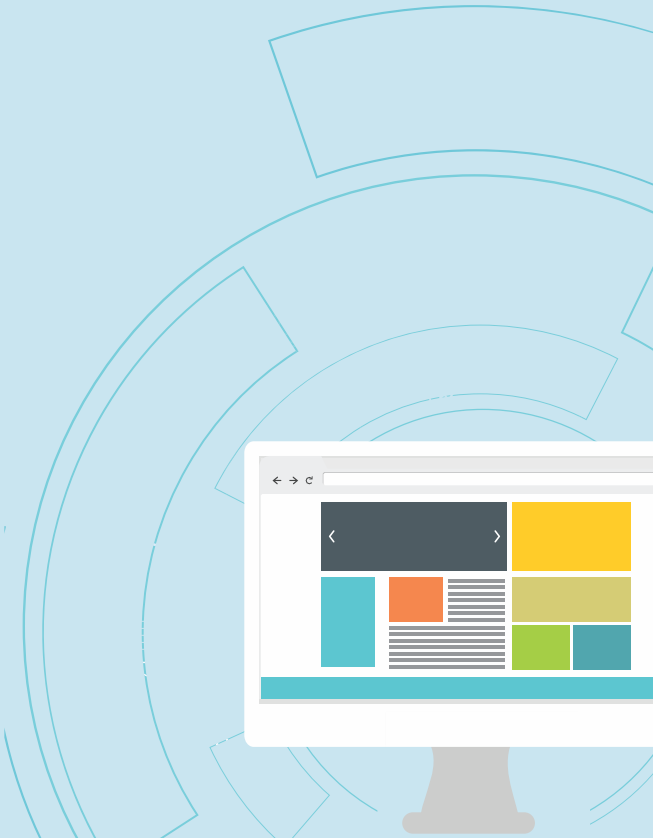
- Green for 'feasible option' under stated conditions,
- Yellow for 'feasible option' under stated conditions only if certain low-scoring variables are addressed, and,
- Red for 'not a feasible option' under stated conditions.

Some responses may rule out a particular option entirely, in which case the negative result will be clearly noted by coding the option as red.

Our tool also includes sections covering non-technical variables that may influence sanitation decisions. The user may respond to questions regarding non-technical factors to help us understand how the local political economy or user preferences might support or undermine investments in the available options. These sections provide additional guidance and encourage policymakers to consider the issue holistically, but carry comparatively lesser weight than the technical variables in determining which system to use. This tool is designed to be adaptable to the needs of decision makers in any context and transparent in how determinations are made about the feasibility of a given option.

This tool is designed to be adaptable to the needs of decision makers in any context

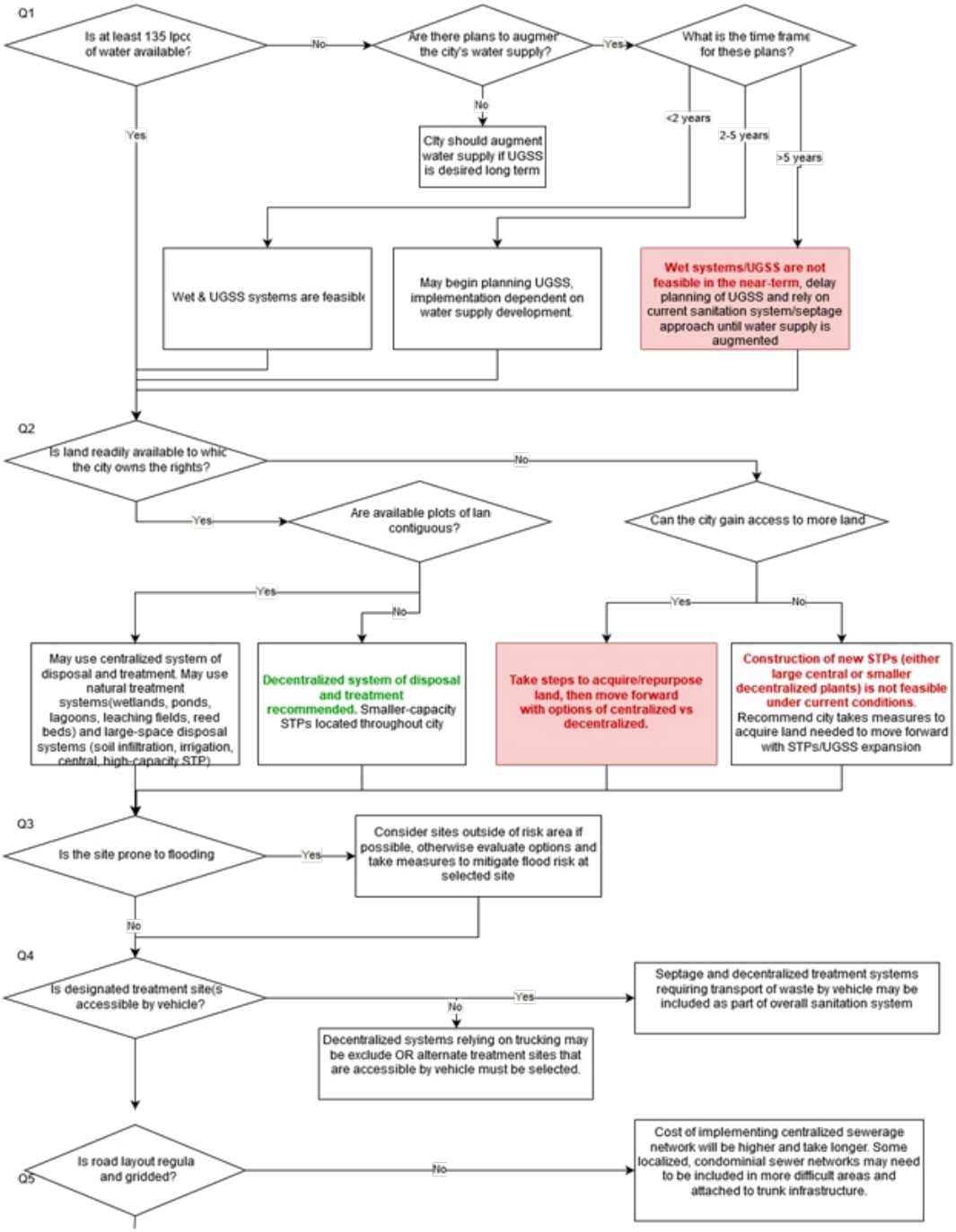
46 CONCLUSION



Conclusion

The market for sanitation investments is not currently lacking in tools intended to advise the decision-making process. The options range from basic guides designed for rural household heads to complex frameworks targeting high-level policymakers managing heavily-populated urban centers.

Decision Tree Mockup



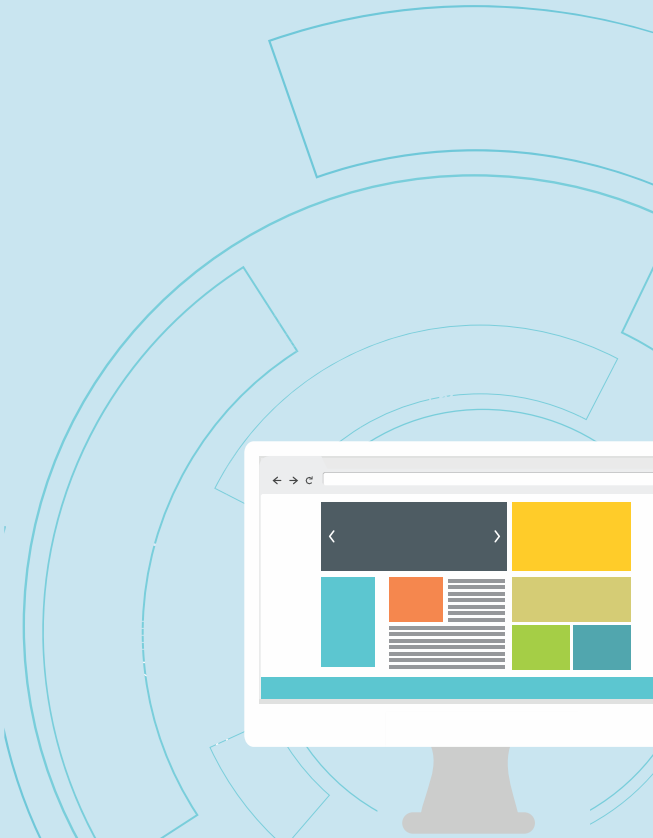
However, two main structural deficiencies should be addressed to improve sanitation tools:

- Few tools have incorporated a feedback mechanism to evaluate their use and impact. Information on how a tool was used in practice by households or policy makers, along with any observed shortcomings, barriers to use, or particularly effective components, has not been systematically sought or reported. This oversight has resulted in the creation of many similar tools whose use remain undocumented, undermining the process of refinement and improvement that would enable a tool to become more efficient over time. A new DSS tool should allow for the input of results of decisions made using the tool to determine whether the outcomes are in fact desirable, and if it should be replicated or improved upon.

- When designing a framework for making sanitation decisions, both technical and non-technical aspects must be considered. Our field research demonstrated that apart from engineering and topographical variables, factors like the local political economy as well as the external costs and benefits should be factored into an effective sanitation DSS tool. These elements are particularly relevant in India, where local politics and bureaucracy directly influence the amount of funding, capacity and political will available to undertake new infrastructure investments. It is vital that the tool can be adapted to the local context. A top-down approach to sanitation strategies is not the best approach for creating demand and supply of sanitation services, especially in India where latrine usage remains low even when they are made readily available. Conducting willingness-to-pay analyses and post-implementation evaluation surveys would provide evidence for assessing needs and identifying the most appropriate system of sanitation service delivery. Through conscientious, holistic planning, ULBs in India can better determine the best near-term options to improve sanitation services for their citizens and advance India toward its goal of ending open defecation.

Through conscientious, holistic planning, ULBs in India can better determine the best near-term options to improve sanitation services for their citizens and advance India toward its goal of ending open defecation.

49 ANNOTATED BIBLIOGRAPHY



Annotated Bibliography

Title	Author(s)	Year	Location	Summary
A compatibility-based procedure designed to generate potential sanitation system alternatives	*Max Maurer*, Ahmed Bufardi, Elizabeth Tilley, Christian Zurbrügg, Bernhard Truffer*	*2012*	*N/A - general tool*	*A compatibility assessment procedure is proposed to determine the set of technically feasible or potential sanitation system alternatives. This is based on a clear* definition of such an alternative containing sub-processes *that include a user interface, storage, conveyance treatment and reuse/disposal. A newly developed compatibility matrix is applied to identify incompatibilities between the options of the sub-processes.*
A decision support system for selecting sanitation systems in developing countries	*Thomas Loetscher*, Jurg Keller*	*2002*	*N/A - general tool, some reference to pilot cases in Indonesia*	Detailed description of a specific tool and how it was *designed and implemented - case studies are brief and implementation was too recent for this particular article to provide impact assessments, but I'll look for more recent data on this tool*
A Decision Support System for the Design and Evaluation of Sustainable Wastewater Solutions	*Brent C. Chamberlain, Giuseppe Carenini, GunillaÖberg, David Poole, and Hamed Taheri*	*2012*	*World*	*Describes a decision support tool for sanitation system* based upon two computer models. The first analyzes local *constraints for system design, the second aids decision making through qualitative prioritization.*
A Guide to Decisionmaking: Technology Options for Urban Sanitation in India	*Water and Sanitation Program & Government of India Ministry of Urban Development*	*2008*	*India*	*Describes the different approaches (UGGS/sewerage or septic) that are desirable due to given contextual factors, while also acknowledging the problems that may arise when this decision is implemented in a city context. Includes both recognition of the different issues facing poorer sections of the community as well as describes potential decisions in this context as well. Includes guidance* on implementation, financial issues, and technical details. *Pays special attention to addressing sanitation decisions in poor sections of the city in order to create an overall functional sanitation system*
A Methodological Framework for Prioritizing Infrastructure Investment	*Andres, Luis Alberto; Biller, Dan; Herrera Dappe, Matias;*	*2015*	*The World Bank*	*Examines options for making investment decisions to address sanitation infrastructure gaps in the context of limited public budgets, while using a multidisciplinary approach. Advocates the use of non-traditional variables just as strongly as more traditional variables such as physical* and financial constraints in order to integrate softer and *harder to measure variables that may impact the decision making process or the outcome of the investment's* efficiency just as strongly as traditional constraints. *Emphasizes the importance of political negotiations and influences on the outcome of the decisions.*
A Review of Decision-Making Support Tools in the Water, Sanitation, and Hygiene Sector	*MeenaPalaniappan, Micah Lang, Peter H. Gleick*	*2008*	*N/A - general tool*	*Assessment of 120 existing support resources, including books, manuals, and websites. Also an evaluation of the 18 support resources that most closely resembled decision-making tools. Finds that existing support resources fail to adequately serve WASH practitioners. Most common items missing from these tools were: an effective user interface; consideration of social implications;* regional specificity; information on costs and financing; *hygiene approaches; project replicability; and evaluation and monitoring.*
Alandur Sewerage Project- A success story of public-private partnership arrangements	*Dr. MukeshMathur*	*2002*	*Alandur Municipality, India*	*This PPP project was carried out in Alandur. The most important aspect was that a part of the capital costs for the sewerage system were a contribution from the citizens. The project would only work under the stipulation of the municipality securing deposits from at least 10,000 households. Prior to the project they did a 'willingness to pay' survey which looked at citizen's commitment to contribute to O&M costs. They also had different pricing mechanisms for domestic, industrial and commercial sewerage connections.*

Cities, sewers and poverty: India's politics of sanitation	*Susan E. Chaplin*	*1999*	*India*	*This paper discusses the political circumstances which help explain why the insanitary living conditions of such a large section of India's urban population have been ig nored, and contrasts these with the circumstances which explain suc- cessful sanitary reform in Britain in the second half of the 19th century.*
Cost-based decision support tools for water and sanitation	*Catarina Fonseca, AmélieDubé and JeskeVerhoeven*	*2011*		*Explores some of the DSTs (decision support tools) that have been developed for low income settings ; cautions against adopting these tools that require disaggregated info/data inputs because these are often not available.*
Decision support systems in water and wastewater treatment process selection and design: a review	*M. A. Hamouda, W. B. Anderson and P. M. Huck*	*2009*	*N/A - Review of Tools*	*This paper explores a systematic approach to developing decision support systems, which includes the analysis of the treatment problem(s), knowledge acquisition and* representation, and the identification and evaluation of *criteria controlling the selection of optimal treatment sys tems. The objective of this article is to review approaches and methods used in decision support systems developed to aid in the selection, sequencing of unit processes and design of drinking water, domestic wastewater, and indus- trial wastewater treatment systems.*
Decision Support Tool for the Appropriate Selection of Sanitation Systems	*David Castellano Fabrega*	*2007*	*Tool tested in Cape Town, South Africa*	*Research of existing decision support tools intending to facilitate the selection of suitable sanitation systems is presented. In order to assess the appropriateness of the* five decision tools identified they were confronted with *six evaluative criteria (user-friendliness, transparency, flexibility, versatility, interactivity and level of detail). From this research, the authors create their own DSS tool involv- ing: A Microsoft Access database is organized through a Visual Basic application in order to simplify and clarify the user interface as well as to protect the data entry in the system. On the other hand the database includes the features of a range of sanitation systems as well as their principal characteristics. In the model, based on an Excel screening tool, these characteristics are used as limitations for the later suitability assessment against the* specific conditions of the selected settlement.
Development of a Decision Support Tool for On-site Wastewater Treatment Systems in Jamaican Com munities	*Andrew M. Snauffer*	*2007*	*Jamaica*	*Analyzed the technical inputs in onsite sanitation decision making at the national and parish levels. A lot of focus on the environmental impact of decisionmaking; groundwater vulnerability; describes a variety of weighting tools and sequences to make decisions; assessed groundwater rechargeability on various levels*
Development of a multi-func tion software decision sup port tool for the promotion of the safe reuse of treated urban wastewater	*Dolores Hidalgo, Rubén Irusta, Lidia Martinez, Despo- Fatta, Achilleas Papadopoulos*	*2007*	*N/A- general tool*	*Presents a multi-criteria, multi-user software tool that* guides authorities to the most efficient solutions for reus- *ing treated wastewater for agricultural purposes.*
Economic Impacts of Inadequate Sanitation in India	*Water and Sanitation Program*	*2011*	*WSP India*	*This paper measures the impacts of improved sanitation* through economic costs and benefits. The Water and *Sanitation Program at the World Bank has undertaken an economics of sanitation initiative (ESI) at a multi-country level, and this paper provides evidence to decision-makers to invest in sanitation infrastructure and services.*
Financing Household On-Site Sanitation for the Poor	*WSP Sanitation Global Practice Team*	*2011*	*N/A*	*Financing hard infrastructure for sanitation for impov- erished households in developing countries is costly and unviable for these cash-strapped regions.This paper argues in favor of on-site sanitation systems instead of sewerage for poor households in countries like India.*
Indicators for the sustainability assessment of waste water treatment systems	*Annelies J. Balkema, Heinz A. Preisig, Ralf Otterpohl, Fred J.D. Lambert*	*2002*	*N/A*	*Overview of sustainability assessment methods and currently used indicators. Proposes a general assess ment methodology and a complete set of sustainability indicators, yielding insight into the trade-offs made when selecting sustainable wastewater treatment systems.*

Integrated Urban Sanitation Decision Support Tool ***Review of Support Resources in Sanitation***	*cSTEP*	*2014*	*India*	*Describes an "ideal" functional framework for a decision making tool. Has an India tool case breakdown that has ward-based results (very useful); includes different steps : 1. Ward analysis- demographics, physical characteristics, institutional/economic characteristics,social/cultural characteristics; 2. system context- define the system; 3. ward/city level indicators - breaks down costs, time taken for operations*
Introductory Guide to Sanitation Marketing	*WSP Toolkit- Jacqueline Devine and Craig Kullmann*	*2011*	*N/A- general tool*	*This is a toolkit published by the WSP on Sanitation Mar keting, a process where social and commercial marketing practices are used to bring about social and behavioural change. This is a very useful report because it not only covers all aspects of sanitation marketing strategizes, but also includes a very comprehensive summary of case studies. This would be a good report to review for the DSS toolkit*
Monitoring Systems for Incentive Programs: Learning fro Large-scale Rural sanitation Initiatives in India	*Water and Sanitation Program & Total Sanitation Campaign*	*2010*	*India*	*This paper elaborates that a community wide achieve- ment of sanitation outcomes is essential for public health benefits. The paper outlines the importance of incentives to local governments for sustainable collective sanitation outcomes such as awards for achieving Open Defecation Free (ODF) status.*
National Urban Sanitation Policy	*Government of India Ministry of Urban Development*	*2008*	*India*	*The policy document states the vision, goal and frame works for a national urban sanitation policy. It defines sanitation concepts for cities and outlines the different awards available at the city level for totally sanitized cit- ies. In addition, the policy categorizes cities into red, black, blue and green codes depending on the rating mechanism developed for sanitation levels of cities.*
Philippines Sanitation Sourcebook and Decision Aid	*The Sourcebook Project Team*	*2007*	*Philippines*	*The Sanitation Sourcebook aims to stimulate effective demand for sanitation services by presenting tools for* *strategic decision-making using more affordable sanitation options. Aims to create informed investment decisions by local governments to ensure more sustain- able outcomes.* *Environment-friendly and affordable decentralized solu- tions.*
Public Funding for Sanitation: ***The many faces of sanitation subsidies***	*Barbara Evans, Carolien van der Voorden and Andy Peal*	*2009*	*Water Supply and Sanitation Collabo- rative Council, WSP*	*The paper explores different public funding mechanisms for sanitation, the current debates surrounding subsidies and sanitation funding, types of sanitation subsidies and ways of improving the policies surrounding subsidies. This is a good resource for looking at the effectiveness of sanitation subsidies. There are also some short case stud- ies of sanitation subsidies applied in countries in Africa and Asia which present both cases-subsidies which have worked and which have not worked.*
Sanitation 21: ***A Planning Framework for Improving City-wide Sanitation Services***	*Jonathan Parkinson, Christoph Lüthi and Dirk Walther*	*2014*	*India*	*The document sets out key principles and process guide- lines to help city stakeholders develop appropriate and affordable solutions to sanitation problems, taking into account technology issues, management arrangements, institutional challenges and demands for improvement from different stakeholders. The framework is structured around the following five stages: STAGE 1: Build institu tional commitment and partnership for planning STAGE 2: Understand the existing context and define priorities STAGE 3: Develop systems for sanitation improvement STAGE 4: Develop models for service delivery STAGE 5: Prepare for implementation*
Sanitation Marketing in Cambodia	*Jan Willem Rosenboom, Cordell Jacks, KovPhyrum, Michael Roberts and Tamara Baker*	*2011*	*Cambodia*	*The project aims at assessing the sanitation marketing pi- lot which aims at making sanitation affordable and making desirable latrines available through market channels on both supply and demand sides.*
Sanitation Markets: Using economics to improve the delivery of services along the sanitation value chain	*Sophie Tremolet*	*2012*	*N/A- general tool*	*The "sanitation economics" approach used in this paper uses economic principles, approaches and tools and considers each aspect in the sanitation value chain as a separate 'sanitation market'. This paper also argues that there needs to be additional investment in sanitation as it has positive economic gains.*

Septage Management in India	*Centre for Science and Environment*	*2011*	*India*	*Access to improved sanitation in urban India has risen but the management of onsite sanitation systems such as septic tanks remains a neglected component of urban sanitation and wastewater management. Septage, which is a fluid mixture of untreated and partially treated sewage solids, liquids and sludge of human or domestic origin, flows out of septic tanks and enters waterways or is generally disposed into nearest water body or low lying areas. This leads to serious health and environmental implications.* This necessitates a well-defined regulation, guidelines, and *management strategy for septage in the country. The septage management approach, discussed in this report, is an effort for assuring that septage is managed in a responsible, safe, and consistent manner across the states*
Strategic Planning for Municipal Sanitation: ***A Guide***	*GHK, WEDC, WSPSA*	*2000*	*N/A - general tool*	*This guide discusses municipal sanitation generally, but in its C3 Decision section it provides four support tools. These tackle i) methods for choosing sanitation system, ii) how to qualitatively order the systems by most appropriate, iii) costing the appropriate options, and iv) estimating consumer willingness to pay.*
Tamil Nadu Urban Sanitation Policy (draft)	*Commissionerate of Municipal Administration, Govt of Tamil Nadu, Municipal Administration and Water Supply Department*	*2012*	*India, Tamil Nadu*	*Presents a vision for Tamil Nadu's urban sanitation policy, outlining key policy issues and goals.* *Key Policy issues include: lack of awareness, social and occupational aspects of sanitation, fragmented institutional roles and responsibilities, lack of an integrated city-wide approach, limited technology choices, reaching the poor and unserved, lack of demand responsiveness.*
The Political Economy of Sanitation: How can we increase investment and improve service for the poor?	*Sabine Garbarino & Jeremy Holland - WSP Sanitation Global Practice Team*	*2011*	*Brazil, India, Indonesia, Senegal*	*The report presents a brief assessment of lessons learned from the retrospective political analysis of four case studies. It highlights how a better understanding of the risks and opportunities associated with institutions and stakeholder interests in the sanitation sector can be used to better support more pro-poor sanitation investment. In a sector whose default mode can be very technical, donor and lender involvement can facilitate practical operational guidance for political economy analysis of more pro-poor service delivery.*
Tiruchirappalli Shows the Way: Community-Municipal Corporation-NGO Partnership for City-wide Pro-poor Slums' Infrastructure Improvement	*WaterAid, India*	*2008*	*Tiruchirapalli, India*	*Study of a pro-poor sanitation upgrade in the slums of Tiruchirappalli over the course of 6 years. Finds that community managed sanitation is far more effective than municipality led, but recognizes the need for the government to play a role in the sanitation development.*