USAID
FROM THE AMERICAN PEOPLE

EFFECTIVE ENABLING ENVIRONMENTS FOR INCLUSIVE URBAN WATER AND SANITATION PROVISION

Desk review of the policies, regulations, institutional arrangements, and other associated factors for effective urban water and sanitation service delivery

AUGUST 2023

This report is made possible by the support of the American People through the United States Agency for International Development (USAID). The content of this report is the responsibility of Tetra Tech and Aquaya, and does not necessarily reflect the views of USAID or the United States Government.

ACKNOWLEDGEMENTS

This report was authored by John Trimmer, Haleemah Qureshi, and Caroline Delaire, with support from Edinah Samuel, Faith Chepngeno, and Irene Atieno from the Aquaya Institute.

The authors would like to acknowledge valuable support, guidance, and feedback from Rachel Peletz, Ranjiv Khush, Jeff Albert, Ryan Mahoney, Daniel Smith, Jesse Shapiro, Alison Macalady, Tanvi Nagpal, Miriam Otoo, Liz Jordan, the Iris Group, SEGURA Consulting, and all other members of the URBAN WASH team. Additionally, the case studies within this report benefited greatly from 17 key informant interviews, and the authors thank the interviewees for their generous contributions of time and insight.

Authors: John T. Trimmer, Haleemah Qureshi, Caroline Delaire

Preferred citation: USAID Urban Resilience by Building and Applying New Evidence in Water, Sanitation, and Hygiene (URBAN WASH). (2022). *Effective Enabling Environments for Inclusive Urban Water and Sanitation Provision.* Washington, D.C.: USAID URBAN WASH Project.

Prepared for the United States Agency for International Development by the Urban Resilience by Building and Applying New Evidence in WASH (URBAN WASH) project, under the GSA's One Acquisition Solicitation for Integrated Services (OASIS Unrestricted) Indefinite Delivery Indefinite Quantity Contract, contract number GS00Q14OADU138 and order number 7200AA21M00012.

Tetra Tech Contacts:

Liz Jordan, Chief of Party
liz.jordan@tetratech.com

Miriam Otoo, Deputy Chief of Party
miriam.otoo@tetratech.com

Zach Borrenpohl, Project Manager
zach.borrenpohl@tetratech.com

Tetra Tech
1320 N. Courthouse Road, Suite 600, Arlington VA 22201
Tel: (703) 387-2100, Fax: (703) 414-5593
www.tetratech.com/intdev

Cover photo courtesy of Tetra Tech.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ADB	Asian Development Bank
AMC	Ahmedabad Municipal Council (India)
AMCOW	African Ministers' Council on Water
AURA IP	Water Regulatory Authority Public Institute (Mozambique)
AWSB	Athi Water Services Board (Nairobi, Kenya)
CBS	Container-Based Sanitation
CEPT	Centre for Environmental Planning and Technology (Ahmedabad, India)
COVID-19	Coronavirus Disease of 2019
CSO	Civil Society Organization
CWIS	Citywide Inclusive Sanitation
ESAWAS	Eastern and Southern Africa Water and Sanitation Regulators Association
EWRA	Egyptian Water Regulatory Agency
FSM	Fecal Sludge Management
fsQCA	Fuzzy-Set Qualitative Comparative Analysis
GDP	Gross Domestic Product
GESI	Gender Equality and Social Inclusion
GNI	Gross National Income
JMP	Joint Monitoring Programme
KPI	Key Performance Indicator
LIA	Low-Income Area
LWSC	Lusaka Water and Sanitation Company (Lusaka, Zambia)
MWA	Metropolitan Waterworks Authority (Bangkok, Thailand)
NCWSC	Nairobi City Water and Sewerage Company (Kenya)
NGO	Nongovernmental Organization
NRW	Non-Revenue Water
NWASCO	National Water Supply and Sanitation Council (Zambia)
PCA	Principal Component Analysis
PPP	Public-Private Partnership
PPWSA	Phnom Penh Water Supply Authority (Phnom Penh, Cambodia)
S-SES	Sanitation Social-Ecological System
SES	Social-Ecological System
SFD	Shit Flow Diagram
SODECI	Water Distribution Company of Côte d'Ivoire
UNDP	United Nations Development Programme
UN-Habitat	United Nations Human Settlement Programme
UNICEF	United Nations Children's Fund
URBAN WASH	Urban Resilience by Building and Applying New Evidence in WASH
USAID	United States Agency for International Development
USD	United States Dollars
WASH	Water, Sanitation, and Hygiene
WASREB	Water Services Regulatory Board (Kenya)
WHO	World Health Organization

WRM	Water Resources Management
WSP	Water and Sanitation Program of the World Bank
WSUP	Water and Sanitation for the Urban Poor

GLOSSARY OF TERMS

TERM	DEFINITION
Citywide inclusive sanitation (CWIS)	An approach to urban sanitation that aims to ensure universal access to safely managed sanitation through a range of contextually appropriate solutions, including onsite and sewered, as well as centralized or decentralized strategies, via a focus on service provision and its enabling environment rather than on building infrastructure.
Container-based sanitation (CBS)	A service approach to sanitation where human excreta is deposited in sealable, removable containers that are regularly collected and transported to treatment facilities for safe disposal or reuse.
Fecal sludge management (FSM)	Approaches for the storage, collection, transport, treatment, and safe end use or disposal of fecal sludge deposited in onsite sanitation facilities.
Peer-reviewed literature	Publications, typically appearing in scholarly journals, that have undergone a process of peer review, in which outside experts evaluate the work and determine if it merits publication.
Gray literature	Materials such as reports, government documents, or working papers that are produced outside of the conventional scholarly publishing and peer review process.
Social-ecological systems (SES) framework	A framework, initially developed by Dr. Elinor Ostrom, that emerged out of the study of common-pool resources such as forests and fisheries, with particular emphasis on conceptualizing links and relationships related to governance approaches that enable collective action and sustainable resource use.
SES categories	Five categories that make up the modified SES framework used in this work: (i) governance; (ii) actors; (iii) service delivery approaches; (iv) social, economic, and political context; and (v) environmental and resource context.
Principal component analysis (PCA)	A technique for reducing the dimensionality of datasets with many variables for easier analysis and/or visualization.
Service provider	Any entity, including utilities, local governments, and private operators, that delivers water and/or sanitation services to residents.
Resilience	The ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth.
Gender equality	The equal enjoyment by women, girls, boys, and men of rights, opportunities, resources, and rewards; equality does not mean that women and men are the same but that their enjoyment of rights, opportunities, and life chances is not governed or limited by whether they are female or male.

TERM	DEFINITION
Social inclusion	The process of improving the ability, opportunity, and dignity of people and groups disadvantaged on the basis of their identity to take part in society.

PREFACE

The Urban Resilience by Building and Applying New Evidence in WASH (URBAN WASH) project is a centrally funded activity of the United States Agency for International Development (USAID) Bureau for Resilience and Food Security. It is a global five-year (2021–2026) research and learning program implemented by Tetra Tech in collaboration with Aquaya Institute, FSG, Iris Group, SEGURA Consulting LLC, the Stockholm Environment Institute, and WaterAid. It is led by a team of experienced researchers and urban water, sanitation, and hygiene (WASH) experts and is supported by an external Advisory Board composed of WASH and urban resilience innovators and thought leaders.

The goal of the program is to promote sustainable, equitable, and climate-resilient WASH and water resources management (WRM) policy and programming in urban and peri-urban areas by strengthening evidence-based decision-making among partners and host governments at the local, regional, state, and national levels. To achieve this objective, the URBAN WASH project will perform tasks and complete deliverables under the following three interrelated components:

1. Component 1: Establish and support strategic engagement and partnerships to ensure local application and broader relevance of research and use of evidence.
2. Component 2: Generate high-quality evidence through implementation research to increase the sector's understanding in three main areas:
    a. Enabling environment (i.e., viable urban WASH and WRM policies and regulations, and institutional arrangements) for improved drinking water quality and city-wide sanitation *(Focus Area 1)*,
    b. Approaches for sustainable small-scale and informal service provision *(Focus Area 2)*, and
    c. Sustainable approaches to improve source water protection and diversification for resilient water supplies *(Focus Area 3)*.
3. Component 3: Provide on-demand technical assistance to USAID missions and technical bureaus to support urban WASH and WRM programming, including research, evaluations, and assessments.

Among the first URBAN WASH activities is the production and dissemination of in-depth desk reviews focusing on the enabling environment for improved water and sanitation provision, role of small-scale and informal service providers, and source water protection and diversification.

EXECUTIVE SUMMARY

Achieving and sustaining equitable access to safe drinking water and sanitation services remain key challenges in many urban areas of low- and middle-income countries. The World Health Organization (WHO)/United Nations Children's Fund's Joint Monitoring Programme estimated that less than 58 percent of urban residents in low-income countries had access to safely managed drinking water services in 2020, while only 21 percent had access to safely managed sanitation (WHO/UNICEF 2022). Inclusive water and sanitation service delivery depends on the interplay among various public and private actors operating across different scales, geographic areas, and stages of the service chain. As a result, recent initiatives such as citywide inclusive sanitation have explicitly recognized that comprehensive urban service provision in low-income countries often requires a diversity of strategies to meet the needs of different segments of the population.

This study sought to understand the policies, regulations, institutional arrangements, and contextual factors that supported progress toward universal and inclusive urban water and sanitation service delivery. It was guided by two research questions.

- *Research question 1:* What policies, regulations, and institutional arrangements have been historically instrumental in driving inclusive improvements in piped water access and citywide sanitation in lower-income countries?
- *Research question 2:* To what extent do the characteristics identified from historical examples of success play into current efforts toward improving services in lower-income cities?

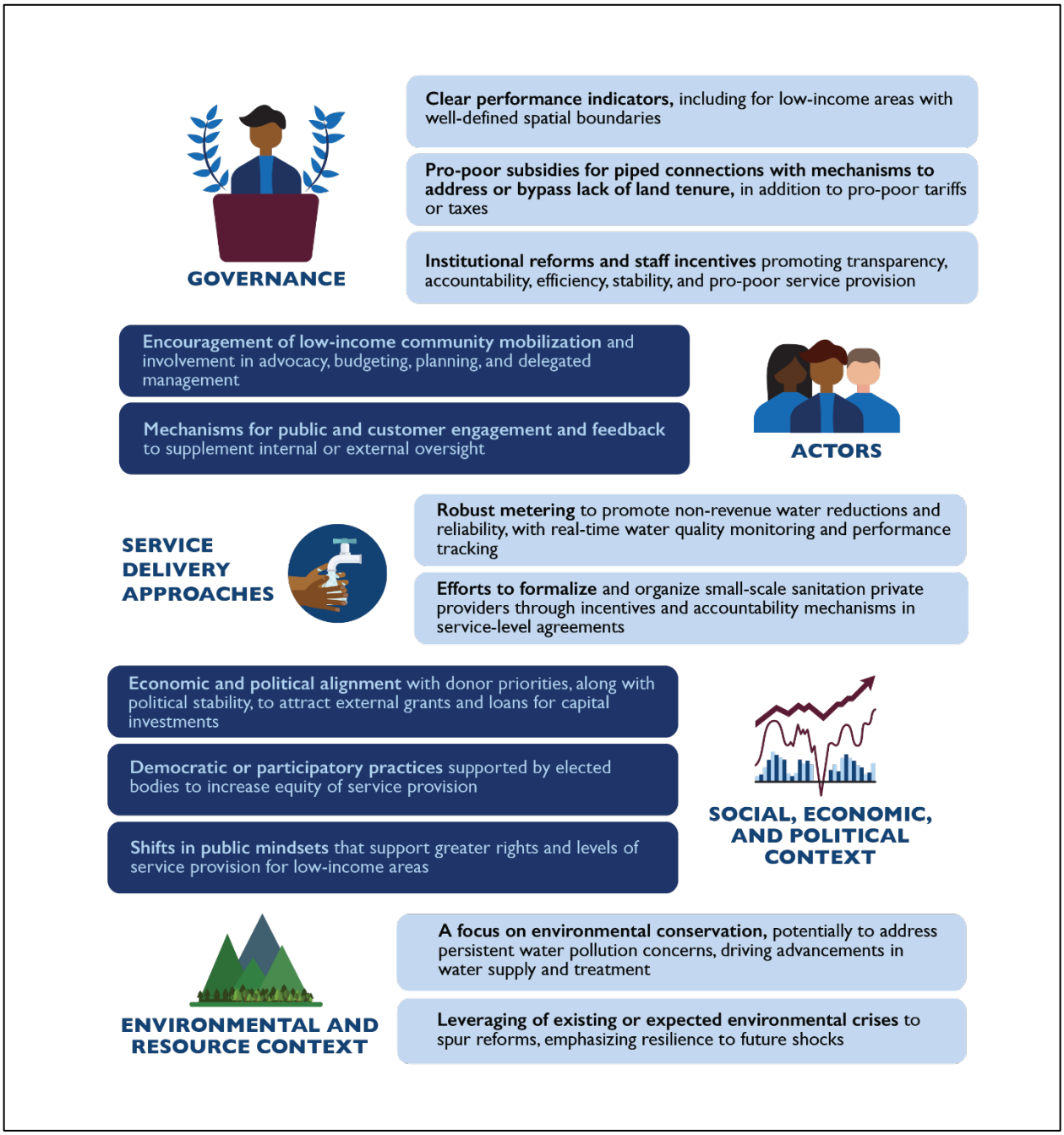
The research included two components: (i) a **literature review,** to establish the existing state of knowledge regarding effective enabling environments for urban water and sanitation, from which the team identified *widely accepted components* and *unresolved debates*; (ii) **comparative case study analyses** of (a) six success stories in water service provision and (b) five cities advancing toward the goals of citywide sanitation. As improvements in access often coincide with increases in national income, we aimed to identify cases that began improving water service provision or sanitation approaches prior to major increases in national income level (i.e., before reaching upper-middle income status). From these comparative analyses, the team derived a set of characteristics that drove or contributed to progress, employing a modified version of the social-ecological systems framework to structure the analysis.

The 11 cases illustrate that different actors can initiate progress and provide momentum for improvements, suggesting potential primary entry points for programming. Recognizing that improved services often come as a result of multiple drivers and actors, this study has categorized the cases into **three different types of progress**:

- *Utility-driven progress (Bangkok, Phnom Penh, Porto Alegre, Nairobi):* Utilities with autonomy and strong leadership proactively drove progress through measures such as institutional reforms, efficiency improvements, increased metering, appropriate user fees (or tariff) increases, and public engagement.
- *Regulator-supported progress (Abidjan, Cairo, Lusaka, Maputo):* Independent regulatory institutions provided strong monitoring and coordination of the sector, contributing to greater quality control, performance monitoring, additional investments, and the development of regulatory frameworks tailored to local practices.
- *Municipality-driven progress (Ahmedabad, Faridpur, San Fernando):* The local government directly provided water and sanitation services and drove improvements using integrated measures such as holistic slum upgrading programs, taxes to fund operations, and public-private partnerships.

Additional factors beyond the types of actors and institutional models involved, such as alignment with donor priorities, support from elected leaders, performance indicators, and explicit pro-poor support, were also critical in enabling progress across these cases. **The Urban Resilience by Building and Applying New Evidence in WASH (URBAN WASH) project identified 12 general characteristics contributing to a favorable enabling environment for inclusive urban water and sanitation services** (Figure 1).

Figure 1. General characteristics contributing to inclusive urban water and sanitation services



Recommendations for Future Research. While this comparative analysis provided new insight into some knowledge gaps identified in the literature review, several key topics for future research remain:

- **Governance:** *What inclusivity approaches can effectively increase access to piped water connections across various governance contexts?* Studying connection subsidy programs in contexts beyond these cases would help to better understand their impacts on equitable service provision and barriers to broader implementation. Furthermore, there may be important lessons to learn about removing land tenure requirements from the electricity sector, which is often ahead of the water sector in removing or bypassing such requirements for connection to services.
- **Actors:** *What institutional arrangements and incentives can effectively integrate small-scale suppliers into service provision frameworks and ensure that they provide safe services to low-income residents?* There is a need to better understand what types of incentives are most effective for encouraging organization, formalization, and improved water quality among small-scale providers. URBAN WASH has identified strategies used by cities to expand services by leveraging small-scale suppliers, but evidence gaps remain regarding how these partnerships can be achieved and how they impact equitable service provision. In particular, future research should explore how local governments, nongovernmental organizations, or external agencies can sustainably facilitate effective engagement across service providers.
- **Service delivery approaches:** *What are effective strategies for operationalizing newly developed fecal sludge management (FSM) regulatory frameworks and monitoring progress toward increasing access to safely managed sanitation?* Since FSM regulatory frameworks are still relatively new in many contexts, their operationalization and resulting impacts remain to be seen and deserve to be studied in the future—in particular, research should focus on how these regulatory frameworks are linked with pro-poor support mechanisms, how to sustainably scale up services, and effective systems for benchmarking and monitoring of progress.
- **Social, economic, and political context:** *How can cities most effectively access and utilize domestic public resources to increase financing options for local infrastructure investments and service delivery?* While tax revenues and municipal bond markets are commonly used to support infrastructure development and pro-poor access in higher-income countries, more should be done to elucidate feasible strategies for their implementation in lower-income settings.
- **Environmental and resource context:** *What policy measures or institutional arrangements can encourage integrated planning to combat pollution and effectively serve low-income areas while mitigating the adverse effects of unplanned urban expansion?* Further research is required to understand policies or institutional arrangements that could promote approaches to link water, sanitation, and land use planning. Examples might include source water protection and diversification policies and initiatives, potentially combined with improvements in FSM services, to protect the quality of drinking water sources needed to address the challenges and service demands associated with urban expansion.

In addition to these specific research questions, this study's focus on successful examples limited opportunities to identify and learn from counterfactual cases characterized by low performance. Accordingly, future work could also focus on testing the impacts of each characteristic identified here, for example, through the application of fuzzy-set Qualitative Comparative Analysis (fsQCA) across a larger number of cases, including both successful and unsuccessful examples.

The findings from this report highlight diverse policies, regulatory approaches, and institutional frameworks that can promote inclusive water and sanitation services in different contexts. The variety of ways in which cities may improve water and sanitation services

depend on existing institutional arrangements and technological infrastructure, as well as the characteristics of the local social, economic, political, and environmental context. Onsite sanitation systems and FSM in particular often require tailored frameworks and involve a greater variety of actors along the service chain, due to the complexity of these service regimes. **The characteristics defined in this study provide a general foundation on which urban decision makers can encourage locally appropriate types of progress.**

1.0 INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

Achieving and sustaining equitable access to safe drinking water and sanitation services remains a key challenge in many urban areas of low- and middle-income countries. The World Health Organization (WHO)/United Nations Children's Fund's (UNICEF) Joint Monitoring Programme (JMP) estimated that less than 58 percent of urban residents in low-income countries had access to safely managed drinking water services in 2020,[1] while only 21 percent had access to safely managed sanitation (WHO/UNICEF 2022). Furthermore, these average levels mask wide disparities in access across wealth categories. For example, in urban areas of Ghana, 59 percent of the richest quintile had access to at least basic sanitation in 2017,[2] compared with only 11 percent among the poorest quintile. Similarly, while 95 percent of the richest urban residents in Uganda had access to at least basic drinking water service in 2017, only 53 percent of the poorest residents did.

Inclusive water and sanitation service delivery depends on the interplay of various public and private actors operating across different scales, areas, and stages of the service chain. For example, a city's utility-operated sewer network may only serve the upper and middle-class, while low-income areas (LIAs) typically use onsite latrines emptied via private companies employing vacuum trucks or manual methods. In some cases, these service patterns reveal the persistence of colonial era arrangements, in which utilities were tasked with serving only a small, privileged portion of the city's population (Post and Ray 2020). Often, they result from rapid urban expansion into peripheral and/or informal settlements (Drabble et al. 2021; Satterthwaite et al. 2019). As a result, recent initiatives such as citywide inclusive sanitation (CWIS) have explicitly recognized that comprehensive urban service provision in low-income countries requires a diversity of strategies able to meet the needs of different segments of the population (Gambrill, Gilsdorf, and Kotwal 2020).

This study seeks to understand the policies, regulations, and institutional arrangements that make inclusive water and sanitation service delivery possible. Given the multiplicity of actors involved, policies that clearly define roles, responsibilities, and accountability mechanisms are likely a key element of the enabling environment (Drabble et al. 2021; Gambrill, Gilsdorf, and Kotwal 2020; Norman and Cheruiyot 2021). Prior analyses in former low-income countries such as Thailand and India have suggested that multi-sectoral coordination, the translation of policies into clear implementation plans, subsidies, and monitoring were instrumental in driving progress (Korea Water and Wastewater Works Association 2016; Northover, Ryu, and Brewer 2016), along with increased economic resources to invest in infrastructure. These historical success stories often extended the enabling environment elements beyond the laws and policies in place. Further research is needed to better understand the role of other factors such as implementation and enforcement, the relationships

---

[1] "Safely managed drinking water" is defined as drinking water from an improved source that is accessible on premises, available when needed, and free from contamination. Improved drinking water sources include piped water, boreholes, protected dug wells, protected springs, rainwater, and packaged or delivered water. "Safely managed sanitation" is defined as the use of improved facilities that are not shared with other households and that dispose of excreta safely either in situ or through offsite treatment. Improved sanitation facilities include flush/pour flush toilets connected to piped sewer systems, septic tanks, or pit latrines; pit latrines with slabs (including ventilated pit latrines); and composting toilets.

[2] "At least basic" water or sanitation includes basic and safely managed levels of access. Statistics specific to safely managed access were not available for different wealth quintiles. Basic water access is defined as drinking water collected from an improved source, where roundtrip collection time is less than 30 minutes. Basic sanitation is defined as the use of improved facilities that are not shared with other households.

between the actors involved, the technological and non-technological aspects of the service provision approaches being employed, and the broader social, economic, political, and environmental context in which these elements exist (Drabble et al. 2021; Norman and Cheruiyot 2021; Sinharoy, Pittluck, and Clasen 2019; WaterAid 2016c). Identifying a list of characteristics that have historically enabled or driven success, either universally or for certain urban contexts, would help decision makers diagnose which elements may be missing or may be bottlenecks in their specific cities.

This study also examines the extent to which these historical characteristics apply in ongoing innovative efforts to improve inclusive water and sanitation services. Several urban areas of low-income countries are pioneering reforms to water and sanitation provision, with particular focus on models and approaches that go beyond traditional utility services (Gambrill, Gilsdorf, and Kotwal 2020). For example, stakeholders in Lusaka, Zambia, and Maputo, Mozambique, have engaged in CWIS workshops focused on developing a shared vision for onsite sanitation and fecal sludge management (FSM) (Drabble et al. 2019). Lusaka has also put in place a "delegated management model" to expand piped water provision in LIAs, while Maputo has begun enacting and implementing policies to support and regulate FSM services (Blackett and Hawkins 2017). In such models, the utility delegates day-to-day service delivery responsibilities to local community management teams. Understanding how these efforts relate to lessons learned from historical examples will be critical in defining best practices for these and other contexts moving forward.

Specifically, the research questions are as follows:

- **Research question 1:** What policies, regulations, and institutional arrangements have been historically instrumental in driving inclusive improvements in piped water access and citywide sanitation in lower-income countries?
- **Research question 2:** To what extent do the characteristics identified from historical examples of success play into current efforts toward improving services in lower-income cities?

1.2 STRUCTURE OF THE REPORT

To answer the research questions and evaluate the hypotheses, our findings are organized across two sections:

- A literature review to survey the existing body of knowledge on what constitutes an effective enabling environment for improving urban water and sanitation services; and
- Comparative case study analyses of (i) six cities that have been **historically** successful at improving citywide access to water (and sanitation to a lesser extent), and (ii) five cities currently advancing toward the goal of inclusive services, particularly sanitation. These comparative analyses allowed us to identify characteristics contributing to an effective enabling environment.

Section 2 summarizes our methods for the literature review and comparative analyses. It includes a description of the social-ecological systems (SES) framework (McGinnis and Ostrom 2014; Ostrom 2009; Trimmer, Miller, et al. 2020) employed as a guiding conceptual framework for both the literature review and the case studies. **Section 3** presents findings from the literature review on established factors playing a role in successful urban water and sanitation provision. **Section 4** presents findings from the comparative analyses of historical and pioneering cases. **Section 5** provides a conclusion, briefly synthesizing findings and offering recommendations for future research.

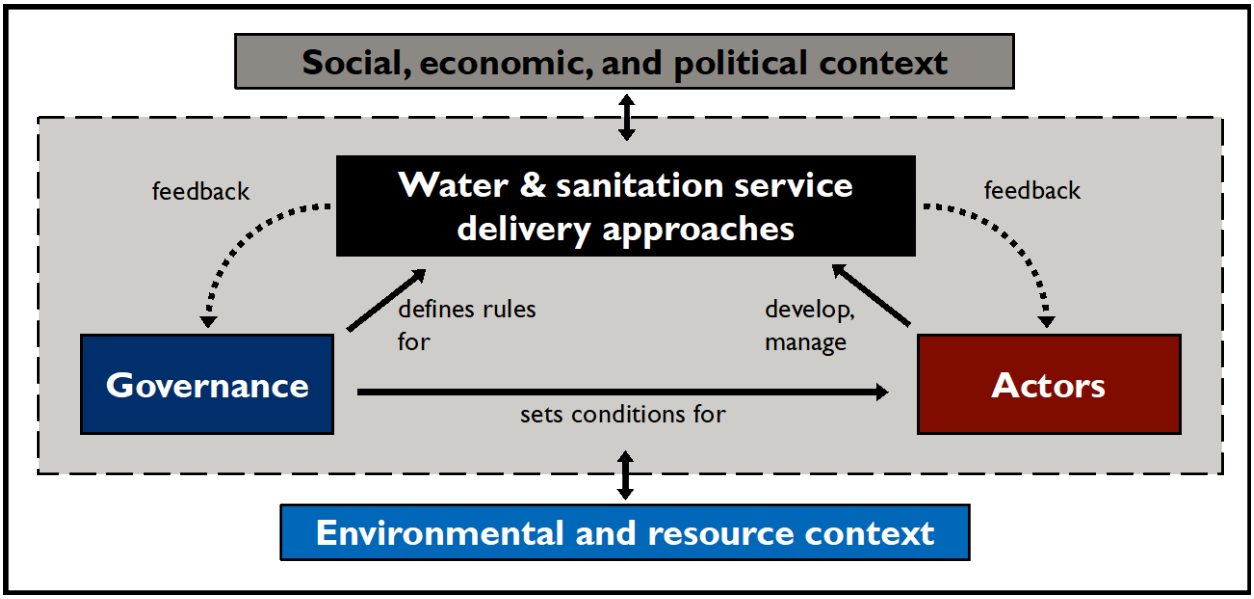
2.0 METHODOLOGY

2.1 THE SOCIAL-ECOLOGICAL SYSTEMS FRAMEWORK

Water and sanitation systems are complex arrangements of resources, services, technologies, actors, and governance structures that interact within a broader social, economic, political, and environmental context (McConville et al., 2019, 2022; Trimmer et al., 2020). Studying such systems benefits from using a framework that conceptualizes links and relationships between different components, while also offering the flexibility to be applicable in a variety of contexts (McGinnis and Ostrom 2014; Ostrom 2009). The SES framework emerged out of the study of common-pool resources such as forests and fisheries, with a particular emphasis on local, small-scale governance approaches that enable collective action to maintain and use these resource systems sustainably (Ostrom 2007; 2009). Over more than a decade, the SES framework has been revised, adapted for use across multiple sectors (e.g., agriculture, recreational fishing, energy), and applied in various contexts (Hinkel et al. 2015; McGinnis and Ostrom 2014). This framework provides a broader view than many other frameworks focused on service provision, as it encompasses numerous contextual elements including the status and protection of natural resources.

Recently, the SES framework has been adapted and applied to sanitation, with a particular focus on possibilities for resource recovery and reuse (Trimmer et al., 2020; Trimmer et al., 2020). This version, known as the sanitation SES (S-SES) framework, provided a starting point for our research. The team further simplified it to focus on the characteristics and interactions of governance frameworks (rules and conditions such as laws, policies, and regulatory mechanisms), actors (service providers, regulators, policymakers, consumers, and other key stakeholders), and water and sanitation service delivery approaches (Figure 2). In a given context, feasible and appropriate approaches to water and sanitation provision depend upon the rules and conditions defined by governance frameworks and the roles and capacities of local actors, as well as the broader social, economic, political, and environmental context.

Figure 2. The Social-Ecological System (SES) framework, applied to water and sanitation, and simplified to focus on governance, actors, and contextual characteristics



Adapted from Trimmer, Miller, et al., 2020.

Together, these categories encompass the different characteristics that may drive or hinder progress toward improved urban water and sanitation service provision and regulation. The team used the S-SES framework in both the literature review and comparative case study analyses to define and categorize these characteristics, and to illuminate their relationships either within or across categories.

In addition to the categories within the simplified S-SES framework, the team paid attention to two **crosscutting themes**, particularly within the comparative analyses:

1. *Resilience*: Resilience relates to the ability of individuals and systems to recover from shocks and stresses, while adapting and transforming themselves to withstand future events (USAID 2015). Shocks can include economic, political, or environmental events. Our case study analyses documented shocks that impacted water or sanitation services in study cities and the structural changes that increased resilience in response to these shocks.
2. *Gender Equality and Social Inclusion (GESI)*: GESI analysis aims to identify, understand, and explain gaps or disparities that privilege particular groups of people based on gender identity or social characteristics (e.g., income level or physical ability) across dimensions such as laws, policies, cultural norms, and decision-making patterns. Although many laws and policies can have implicit GESI impacts (e.g., service connections that require land tenure might impact men and women differently), our analysis is limited to capturing GESI elements that have been explicitly discussed in the water and sanitation literature of our case study cities.

2.2 METHODOLOGY FOR THE LITERATURE REVIEW

The team identified literature using search terms such as "citywide sanitation," "citywide inclusive sanitation," "urban sanitation," "water policy," "urban water," "urban drinking water quality," and similar phrases, while also identifying additional relevant resources referenced in key papers and recommended by experts. The team reviewed over 60 references on topics related to the enabling environment for urban water and sanitation**.** These resources included both peer-reviewed and grey literature, representing a variety of geographies, with over 80 percent of documents published since 2012. Please see Appendix A for more detail on the process used for sourcing literature.

The team reviewed literature and categorized factors within the simplified version of the S-SES framework (McGinnis & Ostrom, 2014; Ostrom, 2009; Trimmer, Miller, et al., 2020). The team differentiated factors into two broad classifications, representing their place within the current state of knowledge:

1. *Widely accepted components*: Factors that have been well-defined in the literature, with broad agreement regarding how they contribute to the enabling environment; and
2. *Unresolved debates*: Factors whose contributions to strengthening the enabling environment remain uncertain or unresolved in the literature.

These lists of factors provided the team with a starting place regarding what elements to focus on within the comparative case study analyses. However, as is described below, the team also allowed additional considerations to emerge from the cases.

2.3 METHODOLOGY FOR THE COMPARATIVE CASE STUDY ANALYSES

The team conducted two comparative case analyses—one on historically successful cities and one on cities pioneering new approaches—to study the arrangements and mechanisms that can promote improvements in water and sanitation service delivery. Because one of the goals involved identifying characteristics that emerged inductively from the analysis (as opposed to evaluating a pre-defined set of

features), the team focused particularly on examples of success, rather than including both successful and unsuccessful (counterfactual) cases. A different approach that included both and used techniques such as fuzzy-set Qualitative Comparative Analysis (fsQCA) (Tribbe et al. 2021) would have required a larger number of cases to evaluate, limiting the historical and contextual depth of the analysis of each individual case. Accordingly, the team focused on limited—but still diverse—sets of successful cases to identify emergent patterns, which can be further tested through future study.

2.3.1 CASE STUDY IDENTIFICATION, ELIGIBILITY, AND SELECTION

The team took three steps to select 11 cases:

(i) Shortlisting candidates from literature review and expert interviews,
(ii) Screening candidates for eligibility, and
(iii) Selecting candidates that captured diverse contexts.

The team screened historical cases using subregional data from the WHO/UNICEF JMP (WHO/UNICEF 2022) to confirm that cities were performing well in regard to providing water and/or sanitation access. In addition, the team used World Bank income classification data to confirm that cities were not classified as upper-middle income during the periods that water and/or sanitation improvements took place (World Bank n.d.). Meanwhile, pioneering candidates were screened out if the literature did not provide sufficient evidence that cities had been taking actions at scale (e.g., beyond piloting of FSM and CWIS principles) to improve water and/or sanitation in LIAs. Using Principal Component Analysis as a visualization aid, the team selected a total of six cities in the historical category and five in the pioneering category, with the goal of capturing a diverse range of geographic, economic, political, and environmental contexts (Tables 1 and 2). For more details on the process used for case study identification, eligibility, and selection, please refer to Appendix A.

Table 1. Key characteristics of six selected historical cases

Location	Population in 2018[a]	Average annual growth, 2013–2018[a]	% Access to piped water on premises[b]	% Access to basic sanitation[b]	National income level[c]	National water stress in 2018[d]	National urban informality[e]	National gov. WASH budget in 2016, USD per capita (% of GDP)[f]
Bangkok, Thailand	10,156,316	2.6%	100%	94.7%	Upper-middle	23.0% (medium-high)	24.5%	$19.80 (0.33%)
Cairo, Egypt	20,076,002	2.2%	100%	100%	Lower-middle	141.2% (high)	3.1%	N/A
Ahmedabad, India	7,680,935	2.6%	89%[g]	63.8%	Lower-middle	66.5% (high)	34.8%	$2.53 (0.15%)
Phnom Penh, Cambodia	1,952,329	3.2%	69%	87.2%	Lower-middle	1.0% (low)	45.6%	$1.43 (0.11%)
Abidjan, Côte d'Ivoire	4,920,776	2.8%	90%	60.4%	Lower-middle	5.1% (low)	61.1%	$7.63 (0.51%)
Porto Alegre, Brazil	4,094,398	0.8%	99.5%	86.5%	Upper-middle	1.4% (low)	15.2%	$45.30 (0.38%)

[a] Population and annual growth were taken from statistics on urban agglomerations in the United Nations World Urbanization Prospects (United Nations 2018). Note that their boundaries of urban agglomerations were based on population density thresholds, and they may have differed from administrative boundaries.

[b] Unless otherwise noted, access to piped water on premises and sanitation were from the latest available JMP survey data for the subnational regions in which cities were located (accessed April 2022) (WHO/UNICEF 2022).

[c] Income levels correspond to World Bank classifications (World Bank n.d.).

[d] Water stress is defined as the proportion of available freshwater resources being withdrawn. It is the ratio between total freshwater withdrawn and total renewable freshwater resources, after accounting for environmental flow requirements (UN FAO 2021).

[e] The share of urban population living in slum households per country, based on 4 out of 5 household shelter deprivations defined by the United Nations Human Settlement Programme (UN-Habitat) as indicators of informality: lack of access to improved water, lack of access to improved sanitation, lack of sufficient living area, and quality/durability of structure. The fifth deprivation, security of tenure, is not included due to data limitations (UN-Habitat 2021).

[f] Annual water, sanitation, and hygiene (WASH) budget of the national government, expressed in United States dollar (USD) per capita and as a percentage of national gross domestic product (GDP), in 2016. This year was the most recent with data from all countries containing selected cities, except for Egypt. No data was reported for Egypt in any year in the database (GLAAS n.d.).

[g] Access to piped water on premises for Ahmedabad was taken from (CEPT University 2011), as the subnational region (Gujarat State) is not representative of the city.

Table 2. Key characteristics of five selected pioneering cities

Location	Population in 2018[a]	Average annual growth, 2013-2018[a]	National income level[b]	National water stress in 2018[c]	National urban informality[d]	Pioneering approach(es)	National gov. WASH budget in 2016, USD per capita (% of GDP)[e]
Maputo, Mozambique	1,101,771	0.1%	Low	1.8% (low)	76.9%	Institutional changes, marketing campaigns, subsidies and loans for water connections, and regulatory framework for private FSM operators.	$0.02 (0.01%)
Lusaka, Zambia	2,523,844	4.9%	Lower-middle	2.8% (low)	63.3%	Expansion of the sewer system, major investment in sanitation (both onsite and sewered), and a delegated management model for water supply in LIAs.	$1.95 (0.15%)
Nairobi, Kenya	4,385,853	3.9%	Lower-middle	33.2% (medium-high)	46.1%	Water and sewer connection loan programs, subsidized water consumption, construction of condominial sewers.	$7.40 (0.51%)
San Fernando, Philippines	125,640[e]	0.6%[f]	Lower-middle	28.7% (medium-high)	44.3%	Scheduled desludging provided by city through sanitation surcharge.	$1.95 (0.07%)
Faridpur, Bangladesh	121,632[f]	2.0%[g]	Lower-middle	5.7% (low)	47.6%	Organization of pit emptiers into cooperatives that provide desludging services.	$3.40 (0.28%)

[a] Unless otherwise noted, population and annual growth were taken from statistics on urban agglomerations in the United Nations World Urbanization Prospects (United Nations 2018). Note that their boundaries of urban agglomerations were based on population density thresholds, and they may have differed from administrative boundaries.

[b] Income levels correspond to World Bank classifications (World Bank n.d.).

[c] Water stress is defined as the proportion of available freshwater resources being withdrawn. It is the ratio between total freshwater withdrawn and total renewable freshwater resources, after accounting for environmental flow requirements (UN FAO 2021).

[d] The share of urban population living in slum households per country, based on 4 of 5 household shelter deprivations defined by UN-Habitat as indicators of informality: lack of access to improved water, lack of access to improved sanitation, lack of sufficient living area, and quality/durability of structure. The fifth deprivation, security of tenure, is not included due to data limitations.

[e] Annual WASH budget of the national government, expressed in USD per capita and as a percentage of national GDP, in 2016. This year was the most recent with data from all countries containing selected cities, except for Egypt. No data was reported for Egypt in any year in the database (GLAAS n.d.).

[f] Population in 2020 and annual growth from 2015 to 2020 for San Fernando were derived from censuses taken in the Philippines, as this location was not included in the UN World Urbanization Prospects dataset. Statistics were summarized on www.philatlas.com.

[g] Population in 2011 and annual growth from 2001 to 2011 for Faridpur were derived from Bangladeshi censuses, as this location was not included in the United Nations World Urbanization Prospects dataset. Statistics were summarized on www.citypopulation.de.

2.3.2 CASE STUDY ANALYSIS

For each case study city, the team reviewed detailed literature and conducted one to three key informant interviews. Key informants included staff of utilities or regulatory agencies, government ministry officials, academics, in-country staff of donor agencies or implementing organizations, and consultants (Table 13).

Interviews took place on the phone in English or French and lasted 30–90 minutes. For each city, the team developed: i) a timeline showing the history of the water and sanitation sector with key policies, institutional arrangements, and external shocks; ii) an institutional map characterizing the roles, responsibilities, and relationships of key actors (Rahman et al. 2011); and iii) a narrative of 5–15 pages covering different aspects of the modified S-SES framework (Table 3). In addition to key legislation, policies, and reforms, the narratives characterized any contextual events (social, economic, political, environmental) that played an important role, as well as challenges associated with promoting inclusive services. These three elements (timelines, institutional maps, and narratives) served as inputs for the comparative analyses.

For most historical cases, our analysis focused on improvements in water service provision (including coverage, reliability, and financial sustainability), as sanitation progress tended to lag behind. For most pioneering cases, the team focused on improvements in sanitation, as many cities' recent or current efforts have concentrated on addressing difficulties with effective FSM.

Table 3. Examples of topics examined for each case study city, categorized according to the S-SES framework

Governance structures	Actors	Service delivery approaches	Social, economic, and political context	Environmental and resource context
• Laws and policies governing service provision • Regulatory mechanisms • Coverage areas of policies and regulations • Use of data and information in decision-making • Flexibility to adapt to new	• Service providers, regulators, and policy makers • Responsibilities and relationships • Leadership personnel • Characteristics of urban residents • Presence of champions	• Characteristics of existing approaches and service chains • Access levels, reliability, affordability of current and historical systems • Financing and cost recovery strategies	• Legal status of LIAs • Marginalization of certain groups • Role of collective action in decision-making • Politicization of WASH services • External funding sources	• Groundwater table depth • Water scarcity • Soil stability • Climate change risks • Effects of environmental or resource shocks

Governance structures	Actors	Service delivery approaches	Social, economic, and political context	Environmental and resource context
information on performance • Policies explicitly addressing gender and social inclusion	• Role of community-based organizations • Formal or informal roles related to gender and social inclusion	• Health impacts and risks	• Urban development and resilience policies	

2.3.3 COMPARATIVE ANALYSES

The comparative analyses compared and contrasted cases with the goal of understanding characteristics that contribute to success in inclusive urban water and sanitation. The team tabulated case information relating to each literature review finding, conducting separate analyses for historical cases and pioneering cases. Through a process of **inductive theory building** (Cox 2015), the team formulated common elements into a set of characteristics that consistently encouraged historical improvements in water and sanitation service delivery. The team also applied a process of **congruence testing** (Cox 2015), examining whether the theories and characteristics resulting from the historical analysis also applied among pioneering cases.

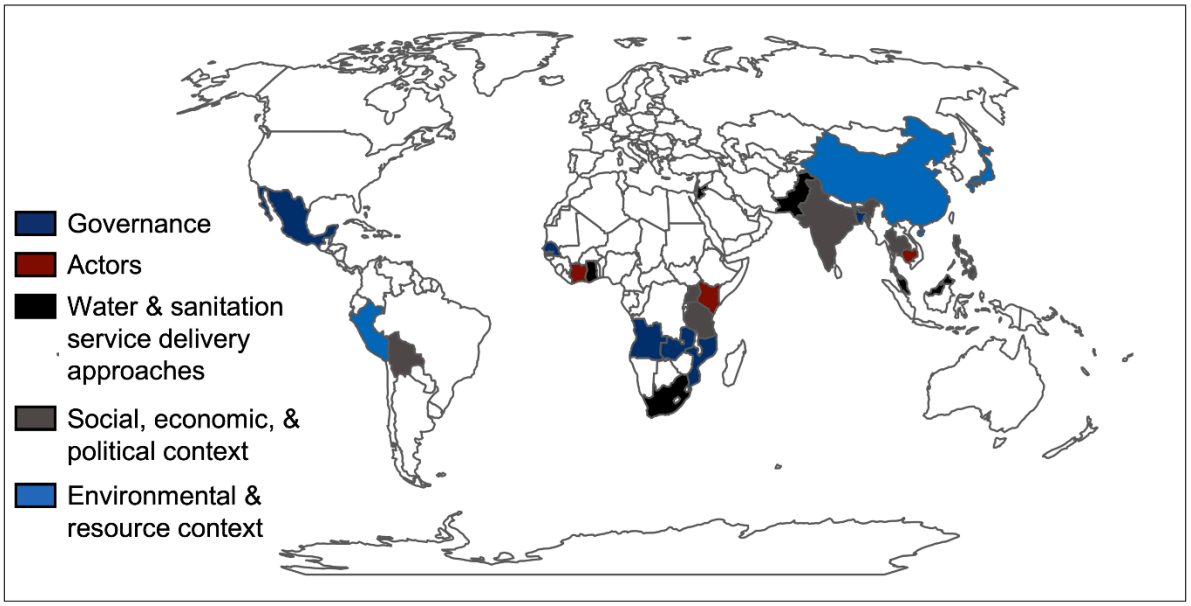
An important limitation to note is that the distinct focus of each set of cases (water services among historical cases and sanitation among pioneering cases) likely influenced the degree of alignment between historical and pioneering cases. The primary reason for this distinction was that historical candidates and selected cases typically saw progress in water first, whereas sanitation gains often came after substantial increases in economic status. Among pioneering cases, innovative sanitation approaches were especially prominent.

3.0 LESSONS FROM THE LITERATURE

What constitutes an effective enabling environment for improving urban water and sanitation services?

The team identified numerous factors that contribute to the enabling environment, either generally or within certain types of contexts. This section discusses these factors in detail, categorized according to the adapted version of the S-SES framework (Section 2). Within each category, the text highlights: (i) widely accepted components and (ii) unresolved debates (see Table 4 for a summary at the end of this section). Where possible, the team included examples from various countries to highlight these factors in practice (see Figure 3). This section concludes by focusing on remaining knowledge gaps on effective enabling environments for water and sanitation, which the comparative case study analyses help to address (Section 4).

Figure 3. Locations of cited examples related to each category in the simplified S-SES framework[3]



3.1 GOVERNANCE

3.1.1 WIDELY ACCEPTED COMPONENTS

Policies, regulations, and accountability mechanisms should be clear on roles while leaving room for flexibility and improvement over time. One of the most universally recognized aspects of the enabling environment for urban water and sanitation is the presence of governance mechanisms that define clear roles, responsibilities, and resources for the actors involved in service provision, regulation, and decision-making (Blackett & Hawkins, 2017; Gambrill et al., 2020; Mallory et al., 2022; McConville et al., 2022; McIntosh, 2003; McIntosh, 2013; Northover et al., 2016; Sinharoy et al., 2019). Service providers, users, and regulators should be clear on the functions, roles, and relationships of actors within the broader system, and these actors require sufficient resources to avoid cases of

[3] Note that some categories overlap across certain countries.

"isomorphic mimicry", in which bureaucratic structures are set up to look like successful institutions but do not perform as such (Andrews, Pritchett, and Woolcock 2013; Pritchett, Woolcock, and Andrews 2013).

For example, roles related to non-sewered sanitation service chain can be particularly ambiguous (Drabble et al. 2021; J. R. McConville et al. 2022; Norman and Cheruiyot 2021). In Kampala, Uganda, households and small enterprises have reportedly faced unclear delineations between specific responsibilities related to onsite containment, emptying, and conveyance (J. R. McConville et al. 2022). Developing clear standard operating procedures that define these responsibilities and are agreed upon by the actors involved can overcome such barriers (Drabble et al. 2021).

Mechanisms for holding providers accountable are also key to ensuring effective and equitable service delivery. Ideally, the responsibility of monitoring performance falls to an independent regulatory agency (ESAWAS 2022), and such actors can increase transparency by issuing public reports, rankings, or awards to well-performing utilities. In addition to their core role of monitoring and benchmarking, regulators are often well positioned to act as central coordinators, bringing sector actors together to clarify roles and strengthen information sharing (Drabble et al. 2019; 2021).

For example, Kenya's Water Services Regulatory Board (WASREB) produces annual reports that detail and rank the performance of utilities nationwide with respect to clear key performance indicators (KPIs). Similarly, South Africa's Blue Drop assessment program provides a comparative assessment of municipalities' water quality (Norman and Cheruiyot 2021).

Beyond direct regulation, providing complementary avenues for public engagement and downward accountability (e.g., customer feedback channels, citizen report cards, electoral accountability) is also important for ensuring that service providers are addressing needs on the ground and that current non-customers have a voice in advocating for their right to services (Barraqué 2004; Brinkerhoff and Wetterberg 2013; Drabble et al. 2021; Norman and Cheruiyot 2021; Obrist et al. 2006).

While policies should provide clear mandates and guidance on roles and responsibilities, they should generally avoid prescribing specific technological approaches for water and sanitation provision (Komives et al. 2005; J. R. McConville et al. 2022; Sinharoy, Pittluck, and Clasen 2019). Particularly for onsite sanitation in LIAs, technology-prescriptive building codes, regulations, or policies may limit innovative options by requiring that urban areas use piped water supply and sewerage. Shifting from technology-focused to performance-based requirements, as has been recommended in Kampala, Uganda, may provide space for approaches more suitable given existing constraints (J. R. McConville et al. 2022). On the other end of the spectrum, some policies and guidelines explicitly focused on innovative approaches (such as those related to circular economies and reuse) have been cited as being too vague or premature to create meaningful change (J. R. McConville et al. 2022). Such policies and regulations require outcome-based targets connected to service levels and product quality (Jones and Kimani 2021).

All of these policy, regulatory, and accountability mechanisms should provide sufficient flexibility, allowing for an adaptive approach as new information comes to light (Barraqué, 2004; Lerebours et al. 2021; Lerebours et al., 2021; Northover et al., 2016; WaterAid, 2016c). Some flexibility in regulatory enforcement (for example, by issuing a warning rather than a fine for a first offense of illegal fecal sludge dumping) can help to generate buy-in among small, private service providers (Lerebours, 2021; Rahman et al., 2011). Being willing to adapt and improve new regulations around complex topics such as FSM can increase the likelihood that these regulations are implemented in practice (Lerebours, et al., 2021).

Generally, instituting a learning culture that promotes trial and error, dynamic adaptation, and incremental improvement may often be more effective than creating ambitious, static plans designed to

overhaul the entirety of a multifaceted service provision system (Blackett and Hawkins 2017; Drabble et al. 2019; WaterAid 2016c). A process that balances innovation and performance regulation, aiming to identify those innovations that lead to improved system functionality, is critical in ensuring progress without jeopardizing existing services (Pritchett, Woolcock, and Andrews 2013). Furthermore, progress made in one area of the system can help to overcome institutional inertia and spur evolution in other areas (Blackett and Hawkins 2017; Drabble et al. 2019; Post and Ray 2020).

Finally, a continuous process of reform, aimed at identifying those innovations that lead to improved functionality and performance, can help to identify and address conflicting interests across different actors such as public sector utilities, private small-scale providers, and community groups, while also encouraging professional actors to be responsive to public feedback (Barraqué 2004).

Data from local monitoring efforts should inform decision-making processes. Governments, regulatory agencies, and service providers require accurate performance data from local monitoring efforts to improve services and adapt governance mechanisms to changing conditions over time. Numerous references cite the lack of data or its limited use in decision-making as a key barrier to improved services, especially in LIAs (Satterthwaite et al. 2019; Sinharoy, Pittluck, and Clasen 2019; WaterAid 2016a; WSUP 2018b). Particular challenges include limited information on the types of water and sanitation services provided, a lack of appropriate tools for monitoring citywide sanitation services, the need for reliable verification mechanisms to reduce misrepresentation of self-reported monitoring data, and limited capacity for local data sharing and analysis (Peletz et al. 2020; Safi et al. 2022; Satterthwaite et al. 2019; WaterAid 2016a; 2016c). Low-income areas are especially vulnerable to these challenges because existing datasets are often sparse, uncertain, or outdated, given rapidly changing populations and geographic boundaries (Mallory et al. 2022; WSUP 2018b).

Generally, the appropriate use of data to drive planning and decision-making can contribute to increased transparency and more effective monitoring that links outcome targets with the necessary financial inputs to efficiently achieve them (Jones and Kimani 2021). Such efforts require integrated information systems able to compile and analyze real-time data from multiple institutions to better understand financial requirements and redirect funding as needed.

Service providers and regulators should explicitly focus on equity and support for the poor. In Kenya, WASREB has instituted a new KPI focused specifically on tracking utilities' service delivery in LIAs (KPI 10) (WSUP 2018b), while one of the key elements of the World Bank's Utilities of the Future program focuses on inclusive services (Lombana Cordoba, Caltiel, and Perez Penalosa 2022). These types of indicators also provide opportunities to link utilities with existing small-scale providers, who often offer lower-quality water at higher prices where the utility does not operate, potentially improving their combined reach and service quality (Post and Ray 2020). Without such regulations, providers are more likely to focus on higher-income areas where service delivery and cost recovery are easier (Norman and Cheruiyot 2021; WSUP 2018b).

Even with clear responsibilities and expectations, encouraging service providers to ensure equitable and affordable water and sanitation access in LIAs may often require additional support and incentives that complement regulatory enforcement (Blackett and Hawkins 2017; Drabble et al. 2021; Sinharoy, Pittluck, and Clasen 2019). For example, ensuring that LIAs fall within utilities' service areas may necessitate adjustments to existing ordinances, while offering affordable user fees (or tariffs) for low-income residents may require subsidies (WSUP 2018b).

These types of incentives and support mechanisms are reported to be relatively uncommon, especially for FSM. Existing pro-poor measures are often not implemented in practice, even though they can help

both providers and their customers (Lerebours, Scott, and Sansom 2021; Sinharoy, Pittluck, and Clasen 2019). A study in Kisumu, Kenya, demonstrated that offering financial incentives for the completion of FSM emptying jobs benefitted service providers and potential customers, as the providers could expand their markets into LIAs while offering lower prices to customers (Peletz et al. 2020). However, these payments could not continue without ongoing external funding.

Additionally, one of the key challenges to providing such support is in ensuring that collected funds are used for their specified purpose. In Ghanaian municipalities, local governments instituted a sanitation surcharge collected as a portion of property tax payments. While most taxpayers were willing to contribute, the revenue was not tracked or ring-fenced, and it was either used for other purposes or was not released to fund sanitation improvements (WSUP 2019b; 2019a).

3.1.2 UNRESOLVED DEBATES

Legally enshrining a universal right to water and sanitation can create a broad mandate for equitable service provision, although realizing these rights may require additional resources and clarity around service responsibilities. Unclear legal status can hinder service provision in LIAs, as utilities may not be authorized or incentivized to operate in these locations (Drabble et al. 2021; Mallory et al. 2022). Incorporating specific language in national constitutions or other key legal documents can explicitly recognize the human right to water and sanitation, while other key documents and decisions concerning city boundaries can ensure inclusion of informal settlements (Drabble et al. 2021). Kenya provides an example where the 2010 constitution includes this right, under a broader right to shelter (i.e., accessible and adequate housing). The specific clause regarding sanitation has only been successfully used once in court, in a case focused on adequate sanitation services along major roadways.

The right to housing, and its links to water and sanitation, has been used more often. For example, in a case from Garissa, Kenya, 2,000 residents forcibly evicted from informal settlements were able to use this right as part of a case that declared the evictions, and the associated loss of water and sanitation services, were unconstitutional (Mallory et al. 2022). In South Africa, where courts have helped to establish rights to reasonable water and sanitation, the High Court required service providers to put temporary measures in place to rapidly restore access during water supply disruptions (Obani 2015).

Discussions around these outcomes note that realizing these rights can be challenging. If there is a lack of clarity around who is responsible for service delivery, entities may shift blame, resulting in divergence between laws and practice (Mallory et al. 2022; Mdee and Mushi 2021). Accordingly, the realization of explicitly defined rights for water and sanitation is connected to the need to clearly outline which actors are responsible for ensuring that this right is met (Drabble et al. 2021; Mallory et al. 2022).

In some cases, efforts to privatize or corporatize water and sanitation service providers in lower-income countries have aimed to increase efficiency and performance, but these processes have had mixed outcomes for low-income residents (Norman and Cheruiyot 2021). In many places, the state acts as a coordinator, while privatized or corporatized utilities actually provide services (Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; Norman and Cheruiyot 2021; Post and Ray 2020). Supporters of privatization advocated that private utilities would reduce government interference and increase cost recovery by charging user fees (or tariffs) to cover operational costs, especially when the private utility has effective internal financial and operational management (Mitlin et al. 2019; Post and Ray 2020). However, critics argued that treating water as a market good was in conflict with water as a human right and basic need, and that private utilities do not have an incentive to serve the poor, who may have difficulty paying regular bills. Politicians can also interfere and use private

utilities as political targets during elections, especially given that private entities can be portrayed as monopolies making a profit by providing a basic need (Post and Ray 2020).

The difficulties of privatization sometimes gave way to corporatization, in which the utility remains state owned but operates independently, often with goals related to efficiency and financial sustainability, mirroring those of private sector entities (Mitlin et al. 2019; Post and Ray 2020). Critics argue that many corporatization efforts have not led to high-quality services for the poor, due in part to an emphasis on cost recovery (Mitlin et al. 2019; Post and Ray 2020). Goals related to cost recovery and financial sustainability paired with a strong revenue base may provide opportunities to improve access and subsidize poorer areas, but privatization and corporatization efforts have not always resulted in this outcome (Lawson and Chappell 2018; Mitlin et al. 2019; Post and Ray 2020).

Instead, enabling the public sector (e.g., local governments and regulators) to coordinate with utilities and promote water and sanitation as necessary public services can help to balance financial sustainability concerns with progress toward universal coverage (Drabble et al. 2021; Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022). Giving these public sector actors the resources and ultimate responsibility for ensuring services, although they are not providing them directly, may help to promote more equitable outcomes (Drabble et al. 2021).

Integrating responsibilities for sanitation under a single actor is often considered to be the most straightforward approach, while splitting responsibilities may impart advantages through specialization at the cost of greater ambiguity. Zambia and Malaysia provide examples of city- and national-level utilities with mandates to ensure both sewered and non-sewered sanitation across the entire service chain, excluding household infrastructure for containment (Drabble et al. 2021). This type of arrangement enables the mandated entity to coordinate with other public or private actors to facilitate regulation and cross-subsidies. Examples of coordination include licensing private emptiers, creating dedicated FSM units to monitor performance, and subsidizing emptying services, often achieved through donor assistance and investments. There is a general shift in this direction across sub-Saharan Africa, with both the African Ministers' Council on Water (AMCOW) and the Eastern and Southern Africa Water and Sanitation (ESAWAS) Regulators Association recommending that all responsibilities for sanitation be integrated within a single institution (AMCOW 2021; Drabble et al. 2021).

In contrast, separate mandates for different types of services or parts of the service chain can create flexibility for actors to specialize and optimize their operations (Drabble et al., 2021; Ferguson et al., 2022). In Kampala, for example, the national utility is mandated to provide sewerage services and fecal sludge treatment, while the local government coordinates fecal sludge emptying and conveyance through private actors (Drabble et al. 2021). Similarly in Dhaka, the city utility is responsible for sewerage services, while local government units in the northern and southern parts of the city are mandated to manage the non-sewered service chain. In practice, however, non-sewered responsibilities are often neglected due to Dhaka's large size and complexity, as well as the local government's competing responsibilities. Sector experts have expressed concern that split responsibilities can lead to ambiguity around roles, non-alignment between policy and practice, and limited opportunities for cross-subsidization of non-sewered sanitation through water and sewerage revenues (Drabble et al. 2021; Jones and Kimani 2021). Contexts with split responsibilities likely require especially high levels of coordination to ensure clarity and reduce conflicts or gaps in service provision.

Regulating service provision through independent actors is generally seen as the gold standard, though regulation through contracts with government ministries may also be effective, particularly when existing arrangements do not easily lend themselves to the

creation of independent regulators. Establishing independent regulatory bodies is typically considered the best way to monitor implementation, ensure alignment with government policies, and protect the rights of consumers (ESAWAS, 2022; McIntosh, 2003). In many cases, they take the form of government agencies with safeguards from political interference (Norman and Cheruiyot 2021). In addition to monitoring key indicators, independent regulators should also have statutory power to enforce sanctions for poor performance. The National Water Supply and Sanitation Council (NWASCO) in Zambia and WASREB in Kenya represent examples of regulators that have this authority, which, along with the open publication of performance metrics, incentivizes utilities to work toward meeting targets.

Apart from independent regulation, regulation-by-contract can also be effective. This approach typically involves a performance agreement with the line ministry and the appointment of a review committee (Norman and Cheruiyot 2021). Ideally, regulation-by-contract models would include open publication of performance reports and clearly defined consequences for poor outcomes. In Senegal, the national sanitation utility has a three-year performance contract with two ministries, with contract renewal dependent on the utility's performance with respect to service targets. A Board of Directors, made up of diverse stakeholders, reviews performance on an annual basis, although performance reports and contracts are not shared publicly (Athena Infonomics 2021; Norman and Cheruiyot 2021).

Finally, self-regulation is another approach used in some contexts, for example, by professional associations of private operators to oversee members' activities (Lerebours, Scott, & Sansom, 2021). Johannesburg Water maintains an Internal Audit Department that publicly shares annual performance reports, providing a measure of accountability (Norman and Cheruiyot 2021). Generally, the conditions needed for effective self-regulation include internal units that are encouraged to criticize freely, as well as open publication of reports free from editing by utility management. However, these circumstances are often difficult to achieve, and self-regulation can transform into a mechanism for utilities to evade accountability.

3.2 ACTORS

3.2.1 WIDELY ACCEPTED COMPONENTS

In LIAs, high levels of community mobilization and collective action among residents have pushed political actors to improve services. Urban population growth and unplanned expansion in LIAs have often outpaced increases in piped water and sewer coverage, while also contributing to strains on existing services and a lack of up-to-date information (Barraqué 2004; Mitlin et al. 2019; Obrist et al. 2006; Safi et al. 2022; Satterthwaite et al. 2019; Stokstad 2008; WSUP 2018b). These conditions may lead individuals to pursue their own self-interest at the expense of the community, for example, by connecting to the system illegally and adding strain on the piped network (Obrist et al. 2006). Accordingly, community organizations can help mobilize residents to promote improved community-wide outcomes, either through their own collective action or by advocating for their rights to services (McGranahan and Mitlin 2016; Obrist et al. 2006).

Among Abidjan's LIAs, informal urban settlements with uncertain legal status were able to engage in efforts to improve services because residents organized through community leaders to connect with local government officials (Obrist et al. 2006). Once these links are established, community groups, government officials, and service providers can engage in coproduction to determine appropriate responsibilities for different groups. For example, the community organization may manage latrine blocks, while the utility is responsible for fecal sludge treatment (McGranahan and Mitlin 2016), although

community management may not be effective for large-scale infrastructure requiring considerable capital investment.

Relationships between landlords and tenants, particularly in LIAs, should be well regulated to promote equity in access and rights. Without effective regulation, renters often have limited control over accessible water and sanitation infrastructure (ADB 2021; Mallory et al. 2022; Satterthwaite et al. 2019). Landlords typically decide if private water and sewer connections will be installed in rental properties. They may block access to waterborne sanitation facilities, for example, when the piped water supply is intermittent (Satterthwaite et al. 2019). As documented through interviews in Kenya, landlords may resist the installation of any sanitation facility, as it would occupy space they could otherwise use for additional rental units (Mallory et al. 2022). Furthermore, newly installed sanitation facilities can enhance rental property values, enabling landlords to increase rents and potentially force out existing tenants if they are unable to pay (ADB 2021). To manage these numerous concerns, incentives and regulations need to be well designed to avoid exacerbating existing power differentials between distinct groups within LIAs (ADB 2021)—a point that also has relevance for relationships across class, race, or ethnicity, especially in post-colonial cities with legacies of discrimination (Post and Ray 2020).

Regulations around tenant-landlord relationships exist in lower-income countries. For example, rent regulations in Kenya include price controls for tenancies below a certain value to protect the large population of low-income tenants, as well as security of tenure provisions restricting a landlord's ability to arbitrarily evict tenants (UN Habitat 2020). In Antananarivo, Madagascar, the mayor adopted a communal decree requiring landlords to provide sanitation facilities for their tenants. The local authority and WASH committees were responsible for enforcing and monitoring latrine construction, and landlords could be fined for non-compliance (WSUP 2013). However, enforcement of these regulations in informal areas is often unclear. Making landlord-tenant relationships more predictable might require further codifying common law obligations and adding missing modern rights (UN Habitat 2020).

Coordination across institutional and political actors should be promoted through well-aligned incentives. As stated previously, defining clear roles and responsibilities for service providers, regulators, and policymakers is important for promoting a strong enabling environment for urban water and sanitation. Such an aim requires coordination to align priorities across actors and enable effective communication (Blackett & Hawkins, 2017; Gambrill et al., 2020; Mallory et al., 2022; McConville et al., 2022; McIntosh, 2003; McIntosh, 2013; Northover et al., 2016; Sinharoy et al., 2019). An absence of coordination and communication can lead to fragmented governance and service provision (Mallory et al., 2022; McIntosh, 2013; Sinharoy et al., 2019). Moreover, the importance of coordination extends beyond the water and sanitation sector itself, as advancements in water and sanitation services in LIAs have often come through integrated upgrading programs, for example, by installing piped networks when improving road infrastructure (Gambrill et al., 2020; McIntosh, 2013; Mitlin et al., 2019; Northover et al., 2016; Satterthwaite et al., 2019).

To enable and facilitate coordination, actors such as utility staff and government officials commonly require well-aligned personal, professional, and political incentives that promote a culture of learning and honest reporting (WaterAid 2016c). Incentives may include competitive salaries or performance-based bonuses to reduce the possibility of corruption, encourage customer communication, and motivate collaboration (McIntosh, 2003; Sinharoy et al., 2019). Non-monetary incentives focused on skills training or comfortable working conditions such as air conditioned offices can also encourage employees to avoid corruption so that they do not lose their job (Davis 2004).

Additionally, gender equitable staff policies and incentives (including pay parity, parental leave, child care facilities, gender-specific sanitation facilities, and guidelines to address issues of harassment) help to attract and retain women employees (World Bank 2019a). Generally, these types of concrete incentives linked to personal advancement, salaries, and other similar advantages tend to be most effective in creating tangible improvements in service delivery (WaterAid 2016c). However, public messaging aimed at fostering broader, shared worldviews related to collective and aspirational ideals, such as the goal of promoting a clean, forward-looking, and cohesive society, can also play a role in encouraging actors to actively participate in the communication and coordination that progress requires (WaterAid 2016a; 2016c).

3.2.2 UNRESOLVED DEBATES

Where individual champions drive water and sanitation improvements, there is a question of how best to sustain and institutionalize that progress beyond the tenure of the individual. A champion—a passionate individual who prioritizes and pushes for water and sanitation sector improvements—can move the needle on reforms, service enhancements, and other positive outcomes (McIntosh, 2013; Post & Ray, 2020; Stokstad, 2008; WaterAid, 2016a). Leadership from political officials or utility directors tends to be particularly effective, especially when coupled with well-aligned incentives or spurred on by shocks that highlight gaps (McIntosh, 2013; Post & Ray, 2020; WaterAid, 2016c).

However, champion-led improvements may not persist beyond the short term if new practices are not institutionalized by the time key individuals retire or are reassigned, or if government priorities change (Mallory et al., 2022; McIntosh, 2013). In Kenya, the reassignment of the head of the Ministry of Water and Sanitation led to a new prioritization of irrigation over sanitation (Mallory et al. 2022). The critical issue is how to institutionalize progress resulting from individual power and priorities, so that reforms and improvements continue after the person who pushed them forward is gone. In the Kenyan example, stakeholders hoped that sanitation could become a dedicated department within the ministry, so that personnel within that department would always be dedicated to sanitation progress specifically. Additional measures toward institutionalization critical to sustainability could include the development of transparent policies, regulations, accountability systems, and relationships between actors (McIntosh, 2013).

3.3 SERVICE DELIVERY APPROACHES

3.3.1 WIDELY ACCEPTED COMPONENTS

Generally, water and sanitation planning should be integrated to reflect the many ways in which these systems interconnect. Problems associated with one can lead to challenges for the other. For example, intermittent piped water supplies may prevent sewers from working effectively, increasing the likelihood that wastewater will pollute water bodies (Satterthwaite et al. 2019). Likewise, pollution caused by untreated wastewater or poor drainage can contaminate drinking water supplies (McIntosh, 2003; McIntosh, 2013; Mitlin et al., 2019).

While these connections may seem straightforward, it is possible for them to be overlooked in practice when water and sanitation planning are siloed (Gambrill, Gilsdorf, and Kotwal 2020). The concept of integrated planning can also extend beyond the water and sanitation sector to incorporate related considerations such as solid waste management, housing, and public health (Gambrill, Gilsdorf, and Kotwal 2020; Northover, Ryu, and Brewer 2016). Particularly in low-income urban areas, holistic upgrading efforts, whether led by local governments, such as in Singapore (Northover, Ryu, and Brewer 2016), or communities themselves, such as in the Philippines and South Africa (Mitlin et al. 2019), have

improved water and sanitation access and quality. In part, these systems require other appropriate infrastructure to function effectively (Mitlin et al. 2019).

Relatedly, providing low-income residents with flexible options around appropriate service levels, pricing, and payments is critical (McIntosh, 2013). Giving customers the opportunity to choose what works best for them (for example, options for private piped water connections, shared standpipes, or commercially operated kiosks) may increase the likelihood that the services they obtain will be affordable (Castro 2009; Komives et al. 2005; McGranahan and Mitlin 2016). This could place additional burdens on already stressed utilities, though. Such an approach requires a policy environment that incorporates the previously mentioned principles around adaptability, public engagement, and a performance-based rather than a technology-prescriptive perspective (Jennifer R. McConville et al. 2019; McGranahan and Mitlin 2016).

Reducing intermittency and increasing reliability of water service delivery require addressing complex issues including non-revenue water (NRW) (Galaitsi et al., 2016). NRW is the portion of water produced by a supplier for which treatment and distribution costs are never recovered. This typically stems from issues such as physical leaks, breakages, faulty metering, and illegal connections (McIntosh, 2003). As NRW limits the system's income, it can lead to a self-reinforcing cycle in which funds are not available for regular monitoring and maintenance (Orgill-Meyer et al. 2018). It also raises the per household cost of service provision. Along with factors such as water scarcity, network over-extension, and unreliable energy, NRW can also be a key contributor to water resource rationing, leading to intermittent piped supplies (International Finance Corporation 2011; Mitlin et al. 2019).

Intermittent supplies are the norm in lower-income countries. For example, piped water in Karachi, Pakistan, and Bengaluru, India, is reported to be available less than 10 hours per week (Mitlin et al. 2019). Beyond inconvenience, an intermittent water supply can also lead to water quality concerns, as sewage or other contaminants may enter pipes during periods of low pressure (Mitlin et al. 2019). Reliable metering and computerized tracking of flow pressure can be one means of identifying leaks or illegal connections, although it is unlikely to be a panacea for addressing intermittency (McIntosh, 2003; Mitlin et al., 2019).

For example, a scenario analysis in Lusaka, Zambia determined that holistic efforts incorporating both NRW reduction and consumption demand management would be most sustainable in transitioning from intermittent to continuous supply, in part because the needed NRW reductions alone (without demand management) were unattainable (Simukonda, Farmani, and Butler 2022). Prepaid water meters in particular can help to encourage conscientious water use while also ensuring that the utility receives revenue (Cook et al. 2020; International Finance Corporation 2011; Stokstad 2008). However, installing prepaid meters has sometimes been socially controversial and technically challenging. Their introduction in Nairobi, designed to improve cost recovery by reducing unpaid water bills, was met with public outcry and vandalism because of malfunctions that limited household water access (Cook et al. 2020).

Efforts to improve sanitation require greater focus on those not connected to sewer networks, concentrating especially on strong regulation and improvements in FSM. Most efforts to regulate fecal sludge emptying in low-income countries are relatively new. Many cities began the process after 2010, and regulations that are in place may only be partially implemented in practice (Lerebours et al. 2021). As the FSM service provision landscape typically contains numerous small-scale private actors making independent decisions, ensuring public health, inclusivity, and affordability requires some public sector coordination, regulation, and enforcement (Drabble et al. 2021; Satterthwaite et al. 2019). These efforts often include the licensing and professionalization of private emptiers (Blackett and

Hawkins 2017). In cases where independent regulation may be limited, self-regulation by professional organizations coordinating and overseeing their members' activities may be an effective alternative (Lerebours, 2021).

Along with monitoring of fecal sludge emptying services, regulations related to household-level toilet facilities may need to be established, because of the linkages between the two. Improving the fecal sludge service chain depends upon appropriate containment that is conducive to local emptying practices and technologies (Norman and Cheruiyot 2021). Accordingly, developing legislation, standards, and subsidies for FSM in collaboration with households and service providers helps to promote governance frameworks that are practically feasible, acceptable, affordable, and fair (Blackett & Hawkins, 2017; Lerebours, et al., 2021). Once again, governance frameworks that are flexible and allow for incremental improvements increase the likelihood that these mechanisms will be implemented and sustained (Lerebours, Scott, and Sansom 2021).

3.3.2 UNRESOLVED DEBATES

In the sanitation space, while some literature and policies continue to indicate preferences for an ideal of universal sewer coverage, efforts to strengthen FSM reflect broad movement toward increased diversity in service provision through frameworks such as CWIS. These developments highlight explicitly the view that universal sewer coverage may not always be an appropriate ideal. Heterogeneous alternative approaches including onsite and decentralized options may be better suited to certain contexts—particularly LIAs—depending on a variety of conditions such as available water supply, local soil type, and the presence of water bodies vulnerable to nutrient contamination (Gambrill, Gilsdorf, and Kotwal 2020; Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022). The greater complexity inherent in a more heterogeneous mindset requires the presence of policies, regulations, funding, and incentives that support and give credibility to innovative alternatives (Gambrill, Gilsdorf, and Kotwal 2020; Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; J. R. McConville et al. 2022; Norman and Cheruiyot 2021).

Worldviews associated with striving toward a "modern ideal" of universal piped water and sewer coverage reportedly played a role in the past progress of several Asian cities (Northover, Ryu, and Brewer 2016; WaterAid 2016a; 2016c). Such worldviews related to "modern infrastructure" still endure in the written policies of some cities currently working to improve sanitation through CWIS frameworks, and piped sewer networks are often still considered the gold standard wherever they can be realized (Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; Satterthwaite et al. 2019). Accordingly, in some places such as Kampala, Uganda, onsite service regimes are described as "battling" for policy and regulatory recognition (J. R. McConville et al. 2022).

Advocates of sewered networks note that the household-facing costs and responsibilities of onsite sanitation are typically greater than those associated with sewer connections (despite the higher overall costs of sewage regimes), making affordability of these alternatives a considerable challenge often requiring subsidized support (Satterthwaite et al. 2019). Notably, however, some results from cities such as Kisumu and Nakuru, Kenya, have shown household-facing costs of sewered and non-sewered sanitation to be similar (Delaire et al. 2021).

Those supporting universal piped sanitation tend to see onsite options as interim or transitional approaches prior to sewer extensions (Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; Satterthwaite et al. 2019). However, some who support diverse service provision approaches encourage a more "modest" outlook, suggesting that universal sewer networks may be an unrealistic goal—even in some high-income settings—due to unsustainable resource consumption and illusions of complete

control over nature and urban development (Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022). They expect the long-term persistence of onsite sanitation as seen, for example, in Japanese municipalities of 100,000–300,000 residents, where approximately 10 percent of the population used onsite systems in 2018 (Hashimoto 2021).

Simplified or condominial sewers can act as something of a middle ground on the continuum of centralized and decentralized approaches, potentially discharging into a conventional, centralized sewer or into a separate, dedicated treatment facility (Mara 2018). Condominial sewers have been particularly successful in Brazil, where they were developed by the local public sector. Similarly, a study in South Africa found gravity flow simplified sewerage to be less expensive than urine-diverting dry toilets and ventilated improved pit latrines when population densities exceeded 158–172 people per hectare in Soweto, Johannesburg (Manga, Bartram, and Evans 2020).

For decentralized sanitation facilities, scheduled desludging can lead to efficiency improvements for service providers, who can optimize truck routes (Mehta, Mehta, and Yadav 2019). Scheduled desludging can also improve cost recovery for FSM through mechanisms that ensure consistent payments, such as incorporating payments into household water bills or instituting a property tax surcharge. However, scheduled desludging may not always be appropriate, especially in contexts where the predominant onsite technologies are unlined pit latrines that fill at variable rates due to soil conditions or rising water tables during rains (Drabble et al. 2021). In these cases, call centers that allow households to request services when needed may be more appropriate (Peletz et al. 2020; Blackett and Hawkins 2017).

Container-based sanitation (CBS) is an alternative that can offer safe and effective services encompassing the entire sanitation chain particularly suited to LIAs (World Bank 2019b). CBS is associated with relatively low capital costs but higher operational costs, while cost recovery is difficult due to low willingness to pay for CBS services (Delaire et al. 2021). At present, while revenues collected by CBS providers typically represent only a fraction of costs, the prices being charged are similar to other options (World Bank 2019b). In addition, locally specific processes for managing waste can sometimes drive perceptions of CBS as a non-scalable and non-viable solution across diverse contexts. Generally, CBS has faced the challenge of attempting to achieve two difficult goals: providing safe sanitation to the poor and operating a sustainable business model. To some extent, these may be unfair expectations to place on CBS, as other sanitation technologies and utilities are not profitable.

Greater consensus exists around the goal of on-premises piped connections for water services, but the role of private providers in managing services alongside utilities remains unclear. Like sewer networks, piped water supplies are typically seen as the gold standard, providing the highest quality water at the greatest level of convenience (Kumpel et al. 2016; Mitlin et al. 2019). Advocates have called for extending piped networks as much as possible, often in connection with general upgrades to LIAs, while noting that affordable water kiosks can act as interim measures prior to realizing household connections (Mitlin et al. 2019).

While private small-scale suppliers such as water vendors and tanker trucks (who may resell utility water) currently fill service gaps, the water they provide is commonly more expensive than piped utility water, often violating recommendations that households should spend no more than 5 percent of their income on water and sanitation (McPhail 1993; Mitlin et al. 2019; Post and Ray 2020; Rusca and Schwartz 2018). As an extreme example, tanker trucks in Karachi, Pakistan—able to operate due to the influence of political elites—provided water estimated to cost nearly 25 percent of typical household income, if used as the sole water source (Mitlin et al. 2019). Water provided by small-scale suppliers is also associated with safety concerns, as regular monitoring and treatment are often less common among these entities (Kumpel et al. 2016; Post and Ray 2020). Small-scale suppliers or individual households

who rely on groundwater wells can also contribute collectively to over-extraction, leading to land subsidence and saltwater intrusion, as in the case of Jakarta (Abidin et al. 2011; Colbran 2009).

Cities aiming for a "modern" ideal may see water vendors and tanker trucks as conflicting with that image (Post and Ray 2020). However, others expect small-scale providers to persist, perhaps providing services better-suited to high-density unplanned settlements in the absence of upgrading projects or utility expansion, which can be difficult and costly (Post and Ray 2020).

Given the drawbacks of direct provision by both utilities and small-scale providers in LIAs, some utilities have adopted delegated management models, in which community organizations or individuals receive bulk water and manage a small piped network to serve local households (Castro 2009; Post and Ray 2020). Utilities typically regulate the prices charged in these systems, while local operators perform billing, revenue collection, and maintenance. These arrangements help to reduce risks for the utility associated with expanding to such LIAs, while still providing affordable piped water (Castro 2009; Post and Ray 2020). Key considerations for these models include clear and transparent contractual arrangements with local operators and well-designed financial incentives (Castro 2009).

3.4 SOCIAL, ECONOMIC, AND POLITICAL CONTEXT

3.4.1 WIDELY ACCEPTED COMPONENTS

Cities should regularize LIAs with uncertain standing and clarify land tenure. Ambiguity around legal status and land tenure can make service providers hesitant to deliver water and sanitation, for fear of legal repercussions or lost investments if residents are displaced (McIntosh, 2003; Satterthwaite et al., 2019; Sinharoy et al., 2019). Land tenure refers to the legal arrangements, informal agreements, and relationships that determine how land is held or used. Land ownership disputes may also disincentivize individual households from installing onsite infrastructure because they may be forced to leave in the future (McGranahan and Mitlin 2016). Moreover, central utilities may not be legally authorized to directly provide services in informal areas, or their responsibilities may be unclear (Drabble et al. 2021; Mallory et al. 2022; McGranahan and Mitlin 2016). For example, before WASREB instituted new KPIs for informal settlements in Kenya, ambiguous legal status obscured residents from utilities' mandates to ensure access for all people in their service areas (Mallory et al. 2022). An active approach promoting regularization and clear land tenure may be most effective in ensuring service provision (McIntosh, 2013; Sinharoy et al., 2019).

Linking such efforts with settlement upgrading initiatives could go further in establishing high-quality service provision, by supporting necessary infrastructure improvements (Mitlin et al. 2019; Satterthwaite et al. 2019). Regularization may be complex when land ownership is disputed or unclear—often the case in LIAs. One proposed solution has been to treat residence as ownership, or to use proof of residence as a requirement when applying for services, rather than formal proof of ownership (McIntosh, 2013). These approaches may be difficult to apply in areas where landlord-tenant relationships are common, requiring additional regulations that build informal governance structures within the community (Mallory et al. 2022).

Achieving service improvements in LIAs often entails a supportive political environment and updated sanitation curricula that include on-site sanitation. Both at the city and national levels, focused campaigns linked with specific indicators, sometimes incorporating political narratives and worldviews related to public health, societal cohesion, and state-of-the-art infrastructure, have been effective in promoting sustained and inclusive progress (McIntosh, 2013; Northover et al., 2016; WaterAid, 2016a). Such dedicated leadership can influence local and national budgets (Jones and Kimani 2021), while coordinating with donors and development partners to avoid conflicting goals and

fragmented assistance programs (McIntosh, 2013; WaterAid, 2016a). Where champions are not already leading such efforts, collective action through community groups can help garner support from local authorities (McGranahan and Mitlin 2016; Obrist et al. 2006). For example, the Orangi Pilot Project in Karachi and the Indian Alliance in Mumbai organized community members to engage in collective action, which led to political support from local authorities and sanitation improvements (McGranahan and Mitlin 2016). When this supportive and well-coordinated environment does not exist, the political incentive structure may lead politicians to interfere with service providers or regulators to increase or decrease service quality or affordability in specific locations, in efforts to raise their own standing or to undermine an opponent before an election (Mallory et al., 2022; McIntosh, 2013; Post & Ray, 2020).

Relatedly, the education system produces local leaders and sector experts. Traditionally, sanitation curricula tend to focus on centralized sewage systems. In contexts such as Kampala, the contradiction between university curricula and the common reality of onsite sanitation and FSM leads to graduates lacking expertise in alternative service delivery approaches (J. R. McConville et al. 2022). Greater alignment of curricula with local practices can develop leaders and professionals open to inclusive strategies that reach all parts of the city with suitable technologies.

3.4.2 UNRESOLVED DEBATES

Achieving full cost recovery has been an increasing focus for water and sanitation utilities, although conditions in low-income contexts make this goal difficult to realize and suggest a need to broaden strategies for maintaining affordability. Support for full life cycle cost recovery comes from the idea that utilities who recover their operating and capital expenses have greater capacity to maintain their systems effectively and offer pro-poor support mechanisms (Jones and Kimani 2021). How best to achieve this, however, remains an open debate. In many cases, funding provided by central governments (e.g. through tax revenues) or transfers from external donors contribute to a utility's capital expenses, while the utility endeavors to recover operating costs through user fees (or tariffs).

Critics suggest that this approach may disincentivize utilities from investing in greater efficiency or system maintenance, preferring instead to simply increase user fees to account for existing inefficiencies or allow infrastructure to depreciate with the expectation that the central government will provide for future replacement (Jones and Kimani 2021). However, raising user fees to fully reflect life cycle costs is unlikely to be economically or politically feasible in many cases. In higher-income contexts such as the United States, sources such as progressive taxes and bonds supplement utilities' user fee revenue, suggesting that financial support beyond user fees is typically necessary and appropriate for water provision in lower-income countries (Libey, Adank, and Thomas 2020).

In practice, utilities often struggle to recover even operating costs. Wastewater costs are a particular challenge, because wastewater user fees are often levied as a percentage of the water user fee, even though wastewater expenses may exceed those for water (Jones and Kimani 2021). Underpricing of user fees below what is needed for cost recovery—especially when including capital costs—is common worldwide due to factors such as socioeconomic conditions that constrain tariff affordability, substantial non-attributable costs, and the high fixed costs and long asset lifetimes of water and sewage infrastructure (Cook et al. 2020; Komives et al. 2005). Attempts to raise user fees have spanned diverse contexts and produced a variety of results. Experiences from Cochabamba, Bolivia; Phnom Penh, Cambodia; and Jordan suggest that incremental reforms and tariff increases have achieved more success than sharp user fee increases and shut-off enforcement (Jones and Kimani 2021; Mitlin et al. 2019; Orgill-Meyer et al. 2018; Post and Ray 2020; Rusca and Schwartz 2018; Wutich, Beresford, and Carvajal 2016).

Beyond standard consumption tariffs, governments and utilities may employ additional strategies to balance financial sustainability with affordability and pro-poor inclusion (Rusca and Schwartz 2018). These strategies may include (Jones and Kimani 2021; Mehta, Mehta, and Yadav 2019; Mitlin et al. 2019; Rusca and Schwartz 2018; Satterthwaite et al. 2019):

- Transfers from central governments or external funders for capital expenses,
- Support for alternative service approaches in LIAs,
- Loan programs or adjusted tariff structures to support payment of connection fees,
- Regulations and performance indicators to address disincentives for serving the poor, and
- Taxes and surcharges to fund subsidy programs.

Scheduled desludging operations in India, Thailand, and the Philippines have instituted sanitation tax payments linked to property taxes or water bill surcharges to help cross-subsidize fecal sludge operations for lower-income residents (Mehta, Mehta, and Yadav 2019). This type of program may work well when there is a sustainable tax base with effective collection systems and ring-fencing (WSUP 2019b; 2019a). Additionally, effective FSM may require especially strong government regulation to ensure quality and affordability, and it may be particularly difficult to sustain following startup funding provided by donors (Jones and Kimani 2021; Satterthwaite et al. 2019).

Urban areas classified as "informal" consist of complex social, political, and economic arrangements that require flexible approaches reflecting local power dynamics. The literature has highlighted that informality does not simply represent an absence of rules and regulations in the urban environment, is not necessarily limited to low-income contexts, and can take multiple forms (Banks, Lombard, and Mitlin 2020; Harris 2017). Rather, informality encompasses a different set of processes institutionalized in local relationships, negotiations, and manipulations, potentially including elite, higher-income, or political actors (Banks, Lombard, and Mitlin 2020; Harris 2017).

Furthermore, power differentials exist based on length of tenure, stability of income, or ownership of land in LIAs. Those with greater power may employ informality as a strategy to avoid legal oversight or taxes, to monopolize services within LIAs, or to garner political influence (Banks, Lombard, and Mitlin 2020; Ranganathan 2014). In Bengaluru, India, water "mafias" gained control over water provision not by filling a previous gap in service delivery but by colluding with state institutions to create scarcity in LIAs—an arrangement that may exist in similar forms in other locations as well (Banks, Lombard, and Mitlin 2020; Ranganathan 2014). After gaining control, they distanced themselves from state actors but also engaged in some practices that mirrored the formal procedures of those actors, including political lobbying and the provision of welfare for disadvantaged residents (Ranganathan 2014).

In other settings, changing attitudes toward informality have led to recognition of informal areas as part of the service provision mandate for the public sector (Banks, Lombard, and Mitlin 2020; Mitlin and Walnycki 2020). Utilities are experimenting with a variety of approaches and learning lessons from informal service providers (Banks, Lombard, and Mitlin 2020; Castro 2009; Mitlin and Walnycki 2020; Obrist et al. 2006). The water utility in Dar es Salaam, Tanzania, has engaged in identifying, sanctioning, and overseeing private boreholes outside of the piped network, while several cities in sub-Saharan Africa have instituted water kiosks or developed relationships with vendors who resell piped water (Mitlin et al. 2019; Mitlin and Walnycki 2020; Obrist et al. 2006).

At least in some cases, however, these methods continue to struggle with balancing affordability, expanded access, and cost recovery (Banks, Lombard, and Mitlin 2020; Mitlin and Walnycki 2020). Additionally, blurring the lines between formal and informal service provision can conflict with worldviews related to modernity (i.e., universal piped services). Critics of these views note that the

complex processes, relationships, and realities of informality require new modes of operation (Banks, Lombard, and Mitlin 2020; Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; Northover, Ryu, and Brewer 2016; WaterAid 2016c). Improving conditions for the most disadvantaged residents of LIAs may require going beyond conventional ideas of formalization and regulation to develop something of a hybrid framework. This would incorporate common characteristics of informality such as flexibility, incremental change, and a deep awareness of existing dynamics and interactions (Banks, Lombard, and Mitlin 2020). Beyond LMICs, nations such as the United States have also engaged in flexible water affordability programs using approaches such as recurring bill assistance and crisis relief (Pierce et al. 2021).

3.5 ENVIRONMENTAL AND RESOURCE CONTEXT

3.5.1 WIDELY ACCEPTED COMPONENTS

As LIAs expand informally, policies are needed to address local environmental issues that may exacerbate service provision challenges in these areas. Urban population growth—especially unplanned expansion of LIAs—often outpaces improvements in coverage of piped water and sewer networks (Mitlin et al. 2019; Satterthwaite et al. 2019; Stokstad 2008; WSUP 2018b). In many cases, low-income populations excluded from private property and rental markets move to peripheral locations less conducive to profitable infrastructure and therefore available for informal development (Sinharoy, Pittluck, and Clasen 2019). Often these areas abut water bodies, including rivers, lakes, canals, or the ocean. Unstable or flood-prone soils, shallow water tables, limited roadway infrastructure, unfavorable topography, and high-density housing can deter installation of pipe networks (Satterthwaite et al. 2019; Sinharoy, Pittluck, and Clasen 2019). Within heterogenous LIAs, households geographically close to pipes may be able to connect, but access, satisfaction, and reliability decline with distance from the water main (Victor et al. 2022). Poor soil, high water tables, and congestion can also hinder onsite sanitation approaches reliant on underground containment; this may lead to outcomes such as flooded latrine pits (Satterthwaite et al. 2019; Sinharoy, Pittluck, and Clasen 2019).

As built-up areas grow, increases in impervious surface area can reduce groundwater recharge, contributing to depleted supplies, land subsidence, and flooding (Mitlin et al. 2019). In Nairobi, impervious surfaces now cover many swamps that had been important sites for natural groundwater recharge, causing severe flooding and damage in low-income neighborhoods. Such locations can be particularly prone to pollution from untreated wastewater, upstream industrial or agricultural activity, or groundwater salinization resulting from over-extraction, leading to concerns related to health and livelihoods such as fishing (McIntosh, 2003; Obrist et al., 2006; Stokstad, 2008).

Given these numerous environmental complexities, it can be difficult to adapt formal planning processes to fit locations of unplanned urban expansion. Flexible policies may provide an effective foundation. These allow for appropriate technologies, offer balanced incentives and sanctions to reduce pollution, support upgrading of existing LIAs, and delineate suitable areas for expansion of affordable housing. For example, Thailand's long history of slum upgrading incorporated community demands and programs to support greater access to services, including water, for the urban poor (Lee 1998).

A sustainable enabling environment for water and sanitation should explicitly account for resilience to the effects of climate change and other shocks. Climate change is likely to increase water scarcity in locations where supplies are already stressed (Mitlin et al. 2019). Similarly, the recent effects of the COVID-19 pandemic have highlighted and exacerbated institutional gaps in service provision, while showing the limitations of planning that does not account for the potential impacts of shocks and disasters (Jones and Kimani 2021; Mukhtarov, Papyrakis, and Rieger 2022). Historically,

reforms have often come in response to catalyzing shocks, such as droughts, floods, or other disasters that highlight vulnerabilities (Post and Ray 2020). Such instances emphasize the importance of promoting resilience through robust planning, risk assessments, and policy modeling (Jones and Kimani 2021)—when possible, prior to the shocks that would bring key weaknesses to light.

3.5.2 UNRESOLVED DEBATES

Markets for reusing resources recovered from wastewater or fecal sludge treatment are underdeveloped or ambiguous, limiting knowledge on their practical ability to contribute to circular economies and financial sustainability. Agricultural reuse of fecal sludge extends back hundreds of years. More recently, though, these practices have diminished due to safety concerns associated with untreated fecal sludge and transitions to waterborne sanitation systems (D. T. Ferguson 2014; Kawa et al. 2019). Today, recovered nutrient resources—particularly concentrated in urban areas—could substantially augment agricultural inputs (fertilizers) used in low-income countries (Trimmer, Cusick, and Guest 2017; Trimmer and Guest 2018). However, practical aspects related to transport, contextual suitability, safety, and regulation continue to limit their actual use and impact (Blackett and Hawkins 2017; C. Ferguson et al. 2022; Trimmer et al. 2019; Trimmer and Guest 2018; VanRiper et al. 2022). For example, cities may be prohibitively far from large agricultural areas to transport bulkier types of recovered resources, such as sludge. In other cases, the composition of certain resources may not be suitable for local soils (Blackett and Hawkins 2017; Trimmer et al. 2019; Trimmer and Guest 2018).

The regulatory environment is often cited as a key barrier to markets, business models, and supply chains for reuse (Ferguson et al., 2022; Gambrill et al., 2020; McConville et al., 2022; VanRiper et al., 2022). In some cases, regulatory ambiguity and a lack of policy guidance explicitly allowing reuse products may create a perceived risk associated with entering the market (J. R. McConville et al. 2022; VanRiper et al. 2022). In other cases, regulations may prohibit the use of agricultural inputs derived from human waste, or at least make their application more difficult on certain categories of crops, such as those designated for export (Ferguson et al., 2022; VanRiper et al., 2022). In general, those working to develop reuse markets have recommended clarifying regulations and standards designed to ensure safety and quality (Ferguson et al., 2022; McConville et al., 2022; VanRiper et al., 2022).

These regulatory challenges can limit revenues that might come from reuse. For example, export crops tend to be more profitable than crops for domestic consumption, limiting possible income from selling compost when regulations for export crops constrain the use of reuse products (Ferguson et al., 2022; VanRiper et al., 2022). Other policies beyond regulations, such as government subsidies for competing products, may also limit profitability (Ferguson et al., 2022). Even apart from these regulatory challenges, however, present approaches to reuse are unlikely to generate revenue sufficient to make the full sanitation service chain profitable (J. R. McConville et al. 2022). Developing strong reuse markets likely requires some initial support or subsidy, perhaps through linkages with environmental protection, combined with a favorable regulatory environment. With this support, it may be possible for revenues to offset a portion of onsite containment and collection costs by linking actors across the service chain, improving household-level affordability (Ferguson et al., 2022; McConville et al., 2022).

3.6 REMAINING KNOWLEDGE GAPS

The 13 widely accepted components (Table 4) identified through this literature review provide a useful foundation for effective enabling environments promoting urban water and sanitation services. Among the 10 unresolved debates, the team illuminated and summarized any existing general guidance (Table 5).

These conversations are ongoing because key knowledge gaps remain, which the case studies may help to address.

Table 4. Widely accepted components and unresolved debates related to an effective enabling environment for improving urban water and sanitation services

Category	Widely accepted components	Unresolved debates
Governance	• Clear policies, regulations, and accountability mechanisms with room for flexibility • Integration of data into decision-making • Explicit focus on equity, services, and support for the poor	• Realization of legal rights to water and sanitation • Trade-offs between corporatization, privatization, and public sector service provision • Trade-offs between single and multi-party service provision in sanitation • Effectiveness of different regulatory models
Actors	• High levels of community participation and mobilization in LIAs • Fair landlord/tenant relationships in LIAs • Clear coordination and incentives for institutional and political actors	• Sustainability of improvements achieved through champions
Service delivery approaches	• Integrated water and sanitation planning • Water: focus on addressing NRW and intermittent supplies • Sanitation: focus on regulations for FSM	• Universal sewerage coverage or diversity of approaches to provide sanitation services • Effective engagement of private water providers
Social, economic, and political context	• Regularization of LIAs and land tenure status • Supportive political and educational environments	• Methods to achieve affordability and cost recovery • Complex arrangements associated with service provision in informal urban areas
Environmental and resource context	• Policies to manage unplanned LIA expansion, especially when complicated by challenging topography, water tables, or pollution pressures • Effective formulation and implementation of plans for climate change mitigation and adaptation to build resilience	• Markets and opportunities for reuse

Table 5. Summary of existing guidance and knowledge gaps for each of the 10 unresolved debates identified in the literature review

Unresolved debates	Existing guidance from literature	Examples of remaining questions
Governance		
Realization of legal rights to water and sanitation	Clarify roles and responsibilities of actors to avoid ambiguity, blame-shifting, and unclear service areas.	Is incorporating an explicit, legal right to water a necessary condition to drive service improvements in LIAs?
Corporatization, privatization, and public sector provision	A promising model is one where the public sector acts as a coordinator/regulator with a focus on equity, while private or corporate entities are responsible for service provision.	Which service provision models effectively balance financial sustainability with equity? Does public coordination or regulation support an effective balance? What institutional reforms or changes to existing policies are required for this model and how can governments make these reforms politically acceptable?
Split or integrated service provision responsibility	Integrated responsibilities can reduce ambiguity around roles and promote cohesive planning, while split responsibilities require high levels of coordination.	What institutional arrangements can effectively encourage the high levels of coordination required when responsibilities for water and sanitation service provision are split?
Type of regulation	Independent regulators provide the greatest capacity to monitor service providers, though regulation-by-contract can also succeed with transparent public reporting.	What factors most effectively encourage accurate public reporting in situations where regulation is less independent?
Actors		
Sustainability of improvements achieved through champions	Support champions to institutionalize the advances they are driving, thereby promoting sustainability and creating new norms for service provision.	What methods are effective for institutionalizing changes brought about by champions (e.g., specific policies, institutional culture, etc.)?
Service delivery approaches		
Full piped coverage or diversity of approaches	Utilities may fill existing service gaps by coordinating with small-scale providers through delegated management models or formalization efforts, while also expanding piped coverage as part of general upgrading of LIAs.	What approaches are successful in processes to formalize small-scale suppliers and resellers operating in LIAs?
Use of emerging approaches: scheduled desludging, call centers, shared sanitation, CBS	Allow for flexibility and diversity of sanitation approaches by avoiding technology-prescriptive standards or regulations.	How can emerging approaches be best integrated into citywide plans? How can financial sustainability be ensured after external startup funding?
Social, economic, and political context		
Methods to achieve affordability and cost recovery	User fee (or tariff) increases should occur gradually, but they are not the only way to achieve cost recovery. Taxes, cross-subsidies, and government investment can complement user fees (or tariffs).	What financing solutions beyond user fees (or tariffs) can be put in place to contribute to cost recovery and equitable services, and what are the institutional frameworks required to make them viable?
Complex arrangements and realities associated with urban informality	Utilities can experiment and coordinate with small-scale providers to develop appropriate models that are flexible and responsive to local dynamics.	What are the roles and relationships among diverse actors involved in informal service delivery processes? How do these processes advantage or disadvantage certain groups?
Environmental and resource context		
Markets and opportunities for reuse	Clarify policies, regulations, and standards to specifically address safety and suitability of recovered resources and	What levels and types of financing and demand (e.g., local vs. regional) are needed to develop a sustainable market for reuse?

Unresolved debates	Existing guidance from literature	Examples of remaining questions
	provide support for initial market development when there is potential for local demand.	Can additional opportunities related to funding for environmental protection improve profitability?

4.0 COMPARATIVE CASE STUDY ANALYSES

This section details findings from comparative analyses of historical and pioneering case studies, structured according to the categories of the simplified S-SES framework.

4.1 TYPES AND CHARACTERISTICS OF PROGRESS ON WATER SERVICE PROVISION FROM HISTORICAL CASES

This discussion of the six historical cases begins with statistics on key indicators, including water coverage over time, water supply reliability, and cost recovery (Tables 6–7). All historical cases with available citywide data on piped water and sewer coverage were less advanced with respect to sanitation policies and coverage than with water. The team, therefore, focused the analysis on the enabling environment for water service provision and water quality management. Below, this section provides brief summaries of the cases, highlighting three different *types of progress* involving specific actors and institutional models that initiated and propelled advancements in service provision, as well as general enabling factors that cut across various contexts (see Supplementary Document 1 for full narratives, institutional maps, and timelines of key events for each historical case).

Table 6. Key indicators on population and household piped water coverage, if available, across historical cases* (ND: No data)

City	Total population	Share of population in informal settlements (%)	Citywide coverage of household piped connections (%)			Coverage of household piped connections in LIAs (%)	
			Before 2000	~2000–2010	2010–present	1990–2010	2010–present
Abidjan	4,920,776	61.1%	29% (1989)	63% (1998)	90.8% (2016)	12% (2005)	57% (2018)
Ahmedabad	7,680,935	34.8%	65-87% (mid-1990s)	85% (2010)	85% (2014)	1-37% (mid-1990s)	60% (2014)
Bangkok	10,156,316	24.5%	82% (1995)	ND	>90% (2019)	10.5-42.5% (1994)	ND
Cairo	20,076,002	3.1%	64% (1979)	97% (1996)	90-100% (2018)	ND	ND
Phnom Penh	1,952,329	45.6%	25% (1993)	90% (2006)	90.5% (2014)	ND	ND
Porto Alegre	4,094,398	15.2%	94.7% (1989)	99.5% (2001)	99.5 (present)	ND	ND

* (Abers et al., 2018; ADB, 2017; Angoua et al., 2018; Bhatkal et al., 2015; Bhatt, 2003; Bhuvan & Ashram, 2002; CEPT University, 2011, 2014; Cross & Morel, 2005; da Costa et al., 2006; Daniere & Takahashi, 1999; EWRA, 2010, 2018; Gautam, 2010; GDF, 2019; Hall et al., 2002; Hoehn & Krieger, 2000; Maltz, 2005; Marin et al., 2009; McIntosh, 2003; McIntosh, 2014; McIntosh & Yñiguez, 1997; Menard & Clarke, 2000; MWA, 2019; Obrist et al., 2006; UN Habitat, 2019; UNDP & WSP, 1999; Urban Management Centre, 2011; van den Berg & Danilenko, 2017; World Bank, 2009b)

Table 7. Key indicators on additional water performance metrics and sewer coverage across historical cases*

City	Service provider cost recovery (%)	Water supply reliability	Non-revenue water
Abidjan	100% (2017)	20 hours/day (2018)	20% (1980)
Ahmedabad	99% (2010)	2 hours/day (2010)	31% (2010)
Bangkok	67% (2010)	24 hours/day (2011)	25% (2011)
Cairo	>100% (2018)	24 hours/day (2018)	29–32.5% (2018)
Phnom Penh	99.9% (2006)	24 hours/day (2006)	8.18% (2018)
Porto Alegre	100% (2005)	24 hours/day (2005)	34% (2001)

* (Abers et al., 2018; ADB, 2017; Angoua et al., 2018; Bhatkal et al., 2015; Bhatt, 2003; Bhuvan & Ashram, 2002; CEPT University, 2011, 2014; Cross & Morel, 2005; da Costa et al., 2006; Daniere & Takahashi, 1999; EWRA, 2010, 2018; Gautam, 2010; GDF, 2019; Hall et al., 2002; Hoehn & Krieger, 2000; Maltz, 2005; Marin et al., 2009; McIntosh, 2003; McIntosh, 2014; McIntosh & Yñiguez, 1997; Menard & Clarke, 2000; MWA, 2019; Obrist et al., 2006; UN Habitat, 2019; UNDP & WSP, 1999; Urban Management Centre, 2011; van den Berg & Danilenko, 2017; World Bank, 2009b)

The cases illustrated that different types of progress can underlie citywide water service improvements. While each of the six historical cases represented a unique set of contextual conditions and factors driving successful service provision, the team identified three types of progress (utility-driven, regulator-supported, and municipality-driven). These were mainly characterized by the institutions or individuals who commonly initiated, drove, and supported water service improvements. The analysis did not suggest that any of these types was more effective than others, and improvements often involved key contributions from additional drivers and actors. Rather, the types described here represent alternative ways in which cities with differing characteristics and contexts have improved coverage levels, equity, water supply reliability, financial sustainability, and other key indicators (Table 8), and the key actors in each can represent potential points of entry for programming in other similar contexts. Within each type, the team also identified specific drivers and characteristics of progress (Figure 4).

Bangkok and Phnom Penh both illustrated **utility-driven** progress, in which local autonomous public utilities with strong leadership have been proactive in making improvements. Following Thailand's financial crisis in 1997, the water utility in Bangkok (Metropolitan Waterworks Authority [MWA]) successfully resisted pressure to privatize by instituting reforms that improved efficiency and customer relations, and by banding together with other state enterprises under similar pressure (Dhamasiri, 1988; McIntosh & Yñiguez, 1997). The policy and regulatory environments were not strong drivers of progress in the Bangkok case, and no examples illustrated the MWA Board of Directors engaging in enforcement actions, because the utility regularly exceeds the expected standards.

Phnom Penh offers a similar story, with the Phnom Penh Water Supply Authority (PPWSA) making proactive improvements to increase efficiency, coverage, financial sustainability, and staff motivation under the leadership of Director Ek Sonn Chan (MWA 2019). Although PPWSA is overseen by a Board of Directors with representatives from a variety of national ministries, utility staff, the municipality, and private shareholders, Director Chan, and not the Board, has been credited with driving progress (Biswas & Tortajada, 2009; McIntosh, 2013). Porto Alegre also appears to represent a similar model, with a high-performing local water and sanitation utility (Municipal Water and Sewage Department [DMAE]) operating autonomously, with all operational decisions approved by a Deliberative Council appointed by

the municipality to represent various political and civil society interests (da Costa et al. 2006; Hall et al. 2002; Viero 2003). The common feature of these cases was that utility autonomy, and the absence of political interference gave the utilities relative freedom to pioneer reforms.

Abidjan and Cairo illustrated **regulator-supported** types of progress. This type of scenario is similar to current trends across many contexts in sub-Saharan Africa, where a great deal of focus has gone into developing strong and effective regulatory environments, aided by international associations such as ESAWAS (ESAWAS 2022). However, the stories are a bit more nuanced in that substantial expansions in coverage occurred prior to the creation of the regulatory agencies, while the regulators contributed to greater quality control, performance monitoring, and additional investments. Prior to the regulators' emergence, improvements in coverage were driven by governmental actors and, particularly in Cairo's case, external funding.

In both cities, once regulators were part of the governance framework, utilities provided the regulatory agencies with annual reports for review, covering water quality, reliability, financial performance, and other key indicators to monitor performance (van den Berg and Danilenko 2017). In Côte d'Ivoire, the regulatory agency (National Drinking Water Office) also now coordinates infrastructure investments, which reportedly made the process more efficient and contributed to fast gains in water coverage. In Egypt, the national regulator (Egyptian Water Regulatory Agency [EWRA]) has substantial authority to determine standard service levels, establish performance indicators, and update water quality and treatment standards (Allen, Dávila, and Hofmann 2006; EWRA 2010). In addition to the reports provided by subsidiary companies, EWRA produces its own nationwide reports and maintains a database to track indicators, and it conducts its own sampling, field visits, and laboratory assessments to monitor water quality (EWRA 2010).

Finally, Ahmedabad illustrated **municipality-driven progress**. The Ahmedabad Municipal Council (AMC) is one of the few municipalities in India reported to be working toward fulfilling all 18 responsibilities outlined for local authorities under the 74th Constitutional Amendment Act of 1992 (Bhatkal, Avis, and Nicolai 2015). Given this breadth of service provision, AMC has been able to directly integrate water and sanitation advances into comprehensive pilots and initiatives supporting the urban poor, such as the Slum Networking Project (Bhatkal, Avis, and Nicolai 2015; Bhatt 2003). This approach is bolstered at the local level by the urban governance principles AMC has established, one of which focuses on addressing the needs of the urban poor (Gautam 2010), while national and state policies have provided a clear policy mandate for AMC to engage in pro-poor support (Bhatt 2003; Urban Management Centre 2011).

Additionally, the Government of India's National Urban Sanitation Policy in 2008 led to a National Sanitation Ranking of 423 cities in 2009, providing a mechanism for accountability through a comparison of city performance. Ahmedabad ranked nineteenth nationally and third among peer megacities of similar size (Urban Management Centre 2012). The fact that the service provider is the local municipality allowed it to fund service provision through property taxes, as opposed to consumption-based user fees (or tariffs) (Bhatkal, Avis, and Nicolai 2015; Urban Management Centre 2012). Strong financial management systems enabled AMC to obtain and use municipal bonds to fund infrastructure improvements. Finally, as some of the members of the AMC are elected, the municipal council may have been particularly receptive to the electoral benefits of improving service provision amongst the urban poor (Bhatt 2003).

From the comparative analysis across these six historical cases, the team identified general characteristics that played a role in their success. (In Section 5, Figure 5 presents all characteristics identified from both the historical and pioneering analyses.) In many instances, the characteristics aligned

with existing knowledge gleaned from the literature review, but the team also highlighted insights that were new or different. The following paragraphs categorize these findings according to the S-SES framework and summarize the evidence for the characteristics identified from the historical case studies, with linkages to the literature review where appropriate.

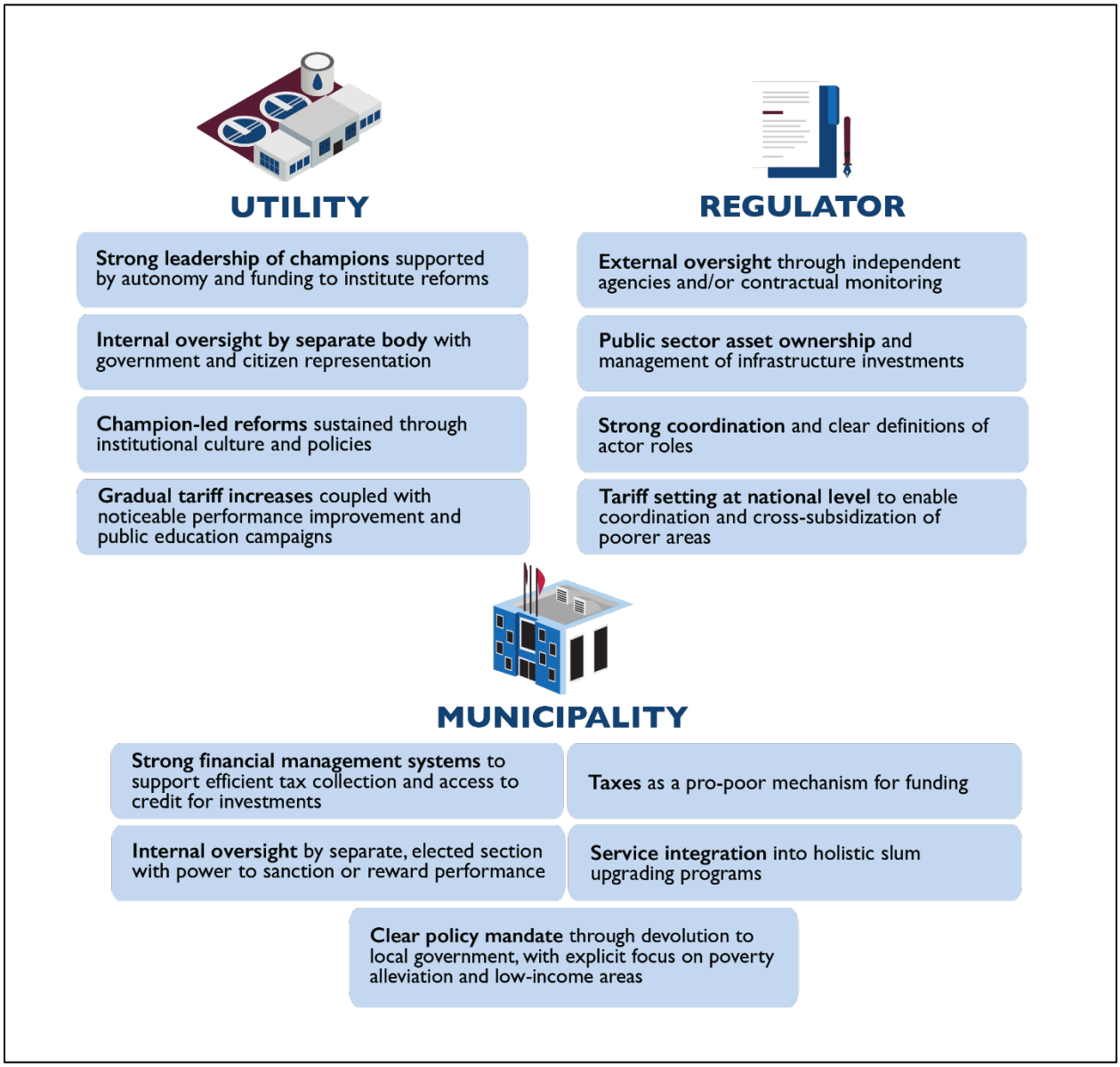
Table 8. Key drivers of progress and characteristics of historical cases categorized according to the S-SES framework[4]

	Abidjan	Ahmedabad	Bangkok	Cairo	Phnom Penh	Porto Alegre
Primary type of progress	*Regulator supported*	*Municipality driven*	*Utility driven*	*Regulator supported*	*Utility driven*	*Utility driven*
Governance	Regulation through performance contracts with public agencies	Devolution to local authorities with clear mandates for serving the poor	Service provider autonomy, with internal Board of Directors oversight	National regulatory agency monitoring performance	Service provider autonomy, with internal Board of Directors oversight	Internal Deliberative Council oversight
Actors	Private company provides services with public asset ownership	Municipal government provides services directly and self-regulates	Champion-led institutional reforms at autonomous local public utility	Through reforms, local utilities made subsidiaries of national holding company	Champion-led institutional reforms at autonomous local public utility	City-water department transformed to autonomous local public utility
Water and sanitation approaches	National company operates urban piped systems under a countrywide increasing block tariff (IBT), with connection subsidies for low-income residents; informal resale of water is common	Municipality provides piped water services funded through property tax surcharges, with connection subsidies for low-income residents; integrated upgrading programs in low-income areas	Local utility provides piped water services under an IBT; utility-led reforms reduced NRW and improved reliability, while national government upgraded and improved services in low-income areas	Local utility operating under the national holding company provides piped water services; national and local government promoted upgrading of low-income areas, where many depend on private wells	Local utility provides piped water services under an IBT, with a connection subsidy program for low-income residents; utility-led reforms reduced NRW and improved reliability	Local utility provides piped water services under an IBT, with services for low-income residents improving through participatory budgeting
Social, economic, and political context	Complex arrangement of urban and peri-urban low-income areas; displaced persons from civil wars increased size of low-income areas	Municipality guaranteed periods of tenure security and removed tenure requirements for connections; decline of local textile sector impacted low-income industrial workers	Due to financial crisis, push for privatization (which was resisted)	Large foreign investment; external push for privatization was resisted; removed tenure requirements for connections	External funding supported reforms	Participatory budgeting increased equity

[4] Empty cells indicate a lack of available data related to the corresponding SES category.

	Abidjan	Ahmedabad	Bangkok	Cairo	Phnom Penh	Porto Alegre
Environ-mental and resource context	Peri-urban communities along local lagoon face issues of pollution	Groundwater over-extraction; climate will likely increase existing susceptibility to flooding, droughts, and water scarcity	Flooding and pollution have been persistent issues; frequent flooding has created a perception of water as an inexhaustible resource; groundwater use reduced after over-extraction led to land subsidence	Arid climate with high levels of water stress and heavy, nearly exclusive reliance on the Nile; these conditions have factored centrally in national development plans	-	Historically, faced extreme flooding; more recently, a push toward an integrated water cycle vision aims to control pollution

Figure 4. Characteristics promoting an effective enabling environment specific to certain types of progress identified in the cases



4.1.1 GOVERNANCE: PERFORMANCE INDICATORS, INTERNAL ACCOUNTABILITY, AND PRO-POOR MEASURES

Use of clear performance indicators by bodies somewhat separate from service providers drove success across all types of progress. Consistent with the literature review (Blackett & Hawkins, 2017; Gambrill et al., 2020; Mallory et al., 2022; McConville et al., 2022; McIntosh, 2003; McIntosh, 2013; Northover et al., 2016; Sinharoy et al., 2019), the use of performance indicators factored into all six of the historical cases. Further, four out of six cases illustrated that performance indicators can function effectively even in cases where oversight bodies are linked with the service provider, as long as there is some degree of separation. That separation implies credible threats to dishonest reporting and reduces the likelihood that the oversight body will misrepresent indicator values.

In Bangkok, Phnom Penh, and Porto Alegre, the utilities' oversight bodies review annual reports containing performance indicators on water quality, piped coverage, NRW, reliability, and cost recovery (McIntosh, 2003; McIntosh, 2014; World Bank, 2009b). Analogously, in Ahmedabad, the municipal council's administrative wing provides services, while committees in the elected wing monitor performance indicators, impose sanctions, and confer awards based on outcomes relative to those indicators (AMC n.d.). Finally, in Abidjan and Cairo, regulatory agencies review utility-produced annual reports on KPIs (van den Berg and Danilenko 2017). In Egypt, EWRA also produces its own nationwide reports that include additional information (e.g., water quality sampling and analysis) collected by the regulator itself (EWRA 2010).

Clear accountability mechanisms for utility employees can improve service delivery and support pro-poor initiatives. While the literature review noted the importance of regulatory, public, or electoral accountability for service providers (Barraqué 2004; Norman and Cheruiyot 2021; Obrist et al. 2006), the cases highlighted the value of internal policies and mechanisms that specifically incentivized staff to act honestly, transparently, and efficiently. In Bangkok, Phnom Penh, and Abidjan, water utilities introduced internal accountability mechanisms and incentives, such as the development of clear codes of actions (MWA 2019), strict penalties for corruption (including removal of staff), and incentives to encourage reporting of illegal connections (McIntosh, 2003; Menard & Clarke, 2000; MWA, 2019).

Connection subsidies can successfully remove barriers to access among the poor and can be sustainably funded through tariffs and taxes. Existing literature highlighted that connection subsidies, or opportunities to purchase connections on credit, are often a key component to improving piped water access and general welfare among the poor (Devoto et al. 2012; Mitlin et al. 2019). If connecting to the piped network is unaffordable, the poor cannot benefit from consumption subsidies (Jones and Kimani 2021; Mitlin et al. 2019). Ongoing consumption subsidies are commonly made possible through increasing block tariffs, which charge relatively higher fees for higher-volume water users. The use of increasing block tariffs was a common element across historical cases, sometimes including additional mechanisms where payments or surcharges from higher-volume customers cross-subsidized social tariffs or connections for low-income residents (e.g., in Abidjan) (Collignon, Taisne, and Kouadio 2000; Maltz 2005; Menard and Clarke 2000; WSP 2007).

Connection subsidies have enabled substantial expansions of piped coverage in Abidjan, with 87 percent of new connections from 1986 to 1998 being subsidized (Collignon, Taisne, and Kouadio 2000; Lauria, Hopkins, and Debomy 2005). Phnom Penh and Ahmedabad have also implemented connection subsidy programs, sometimes additionally providing residents with the opportunity to pay connection fees in installments over time (Lee 1998; Mok 2022). The use of property taxes to fund water and sanitation

services (as in Ahmedabad) has been seen as intrinsically progressive, since lower-income households tend to pay less property tax (Bhatt 2003).

Separating land tenure requirements from service provision can further enable cities to increase piped access among low-income residents. Existing literature flagged that the ambiguity of land tenure, common in many low-income urban areas, can hinder or dissuade utilities from extending services (Drabble et al., 2021; Mallory et al., 2022; McGranahan & Mitlin, 2016; McIntosh, 2013; Sinharoy et al., 2019). Addressing these issues may be one of the most effective methods for increasing water access.

In Cairo and Ahmedabad, service providers only require proof of residency (for example, through an electricity bill or voter identification card that displays an address) to connect those without formal land tenure. This practice began in Cairo in 2014, following the governor's 2008 endorsement of the extension of piped networks into LIAs regardless of legal status (Khalil 2019). In Ahmedabad, it began in 2002 with AMC's No Objection Certificate scheme, enabling all slum residents to apply for piped water and sewerage connections if their house was below a certain size and they could provide proof of residence (Urban Management Centre 2011). The use of electricity bills to show proof of residency in both Ahmedabad and Cairo suggests that the electricity sector had freed itself from land tenure requirements ahead of the water sector. In other case study cities, proof of land tenure has remained a requirement—and a critical barrier for low-income households—to apply for and obtain piped household connections (Collignon, Taisne, and Kouadio 2000; Lauria, Hopkins, and Debomy 2005).

Constitutional rights to water and sanitation may be unnecessary, especially if other rights conflict with this and clear institutional mandates, policies, and regulations exist. Existing literature has shown that explicit rights to water and sanitation enshrined in national constitutions or other key policy documents can sometimes help to improve access, especially when those rights are employed in court (Drabble et al. 2021; Mallory et al. 2022). In most of the historical cases, however, constitutional rights to water and sanitation did not exist. Exceptions included Porto Alegre and Ahmedabad, but in these cases, the right to water has often conflicted with rights to private property (Brahmbhatt 2022; NHRC 2021). In Brazil, this has allowed utilities to continue requiring proof of land tenure before providing a piped connection (Narzetti and Marques 2021). Accordingly, constitutional rights to water do not seem to have been a driving force in the case of Porto Alegre.

Consistent with the literature review, enshrining a legal right to water and sanitation in a country's constitution may generally be useful in providing a legal basis for demanding water services or contesting rejection of service provision in low-income communities. However, it can also be obscured by other conflicting rights or a lack of clarity around when and how it applies, with limited guidance on quality, reliability, and affordability.

4.1.2 ACTORS: CHAMPIONS, INCENTIVES, COMMUNITY MOBILIZATION, AND CUSTOMER FEEDBACK

Champions can play a key role in driving sustainable reforms and improving utility performance. The role of champions was especially apparent in utility-driven cases such as Bangkok and Phnom Penh. In both cases, a strong leader took over the utility at a difficult time, due to economic, environmental, or political challenges, and (aided by external support) instituted reforms to improve the utility's efficiency, water quality, service coverage, customer relations, and financial sustainability (McIntosh, 2014). Reforms of note included incremental user fee (or tariff) increases coupled with public education campaigns in Phnom Penh (Fallavier, 2003; McIntosh, 2013) and the Drinkable Tap Water project in Bangkok, where utility staff visited schools, offices, and households to inspect water quality

and resolve issues (McIntosh, 2013). Autonomy granted by the local government was critical in giving champions the ability to implement these changes (McIntosh, 2013; Stokstad, 2008). Progress driven by champions may not always be sustainable (Mallory et al., 2022; McIntosh, 2013); however, these two cases highlighted that champion-led improvements can help to create a sustained institutional culture of accountability and efficiency (GDF 2019).

Incentives and benefits for staff can encourage high levels of performance. Competitive salaries, training, the potential for advancement, and a culture of teamwork play a role in motivating staff, reducing corruption, and improving customer relations (McIntosh, 2003; Sinharoy et al., 2019). Water utilities used similar measures in a number of historical cases, including where champions had instituted key reforms. The utilities in Bangkok and Phnom Penh increased salaries and introduced incentives for honest and efficient reporting (McIntosh, 2013; MWA, 2019). Similarly, in Abidjan, the Water Distribution Company of Côte d'Ivoire (SODECI) offered a number of employee benefits including high salaries, training, merit-based promotions, and social funds to finance social activities and help with housing needs (Menard and Clarke 2000). In Ahmedabad, Slum Networking Project staff members reported that consistent interaction with community members led to a sense of pride in working together to improve people's lives and a stronger commitment to deliver services (Davis 2004). These examples contribute evidence of the importance of staff incentives and motivation within institutions, in combination with structural reforms, to promote efficiency and accountability.

Community mobilization played an important role in improving access to services, particularly in LIAs, through political advocacy, participatory budgeting, or delegated management models. Community groups had a clear role in advocating for services. They often combined collective action with political connections to push for recognition and progress. The team saw a similar pattern in the Abidjan, Ahmedabad, and Bangkok cases (McGranahan and Mitlin 2016; Obrist et al. 2006).

Notably, in Ahmedabad, democratically elected neighborhood associations mobilized community finances for slum upgrading projects and were instrumental in expanding water and sanitation infrastructure (Bhuvan and Ashram 2002; Diacon 1997; UNDP and WSP 1999). In Bangkok, self-organized community groups set up what were essentially delegated management models in partnership with the utility: locally elected committees managed the network in LIAs, paid bulk tariffs to the utility, collected connection fees and tariffs from consumers, and used the surplus to fund other community projects (Lee 1998). In Porto Alegre, communities played a part in participatory budgeting, which was instrumental in prioritizing equitable water service provision for low-income residents largely left out of previous water system expansions (Abers et al. 2018). However, since the Workers' Party lost power in 2004, the participatory budget process it supported has been deprioritized, and the results of participatory budgeting have been mixed when applied in other locations (Abers et al. 2018; de Renzio, Spada, and Wampler 2019).

Linked with community mobilization, opportunities and venues to provide customer feedback improved service provision across most cases. Providing avenues for public engagement and downward accountability (i.e., feedback from customers and residents) ensured that service providers addressed needs on the ground (Drabble et al. 2021; Norman and Cheruiyot 2021). One mechanism for instituting effective feedback mechanisms may involve the mediation of civil society organizations (CSOs) between communities and service providers. This was seen in Ahmedabad, where national policies have established specific rights for CSOs to participate in city planning and decision-making processes (Bhatt 2003; UNDP and WSP 1999). Utilities and regulators may also directly elicit community feedback. In Abidjan, the national regulator set up a consumer relations center where utility customers can call in to file complaints (Berta 2022). The Phnom Penh water utility directly requested

feedback from low-income communities on social pro-poor policies. This feedback led to more easily accessible payment centers in LIAs and educational workshops focused on the importance of water treatment (Spencer and Meng 2019). In Bangkok, the utility set up a computerized system where customers could provide feedback or complaints (Kordach et al., 2018; McIntosh, 2013; MWA, 2021).

4.1.3 SERVICE DELIVERY APPROACHES: METERING, DATA, AND FORMALIZATION

Metering can contribute to substantial improvements in NRW and service reliability. NRW and supply intermittency are two key challenges for piped water systems; recommended solutions involve reliable metering and computerized monitoring of network flows and pressures (McIntosh, 2003; Mitlin et al., 2019). Phnom Penh and Bangkok confirmed that these types of measures can be successful, especially when paired with institutional reforms at the utility to increase efficiency, ensure transparent reporting, and reduce illegal connections (McIntosh, 2003; McIntosh, 2014; World Bank, 2009b).

As one example, from 1993 (when Ek Sonn Chan's leadership began in Phnom Penh) to 2006, PPWSA reduced NRW from 72 percent to 6 percent and increased supply durations from 10 to 24 hours per day, while the total number of connections increased by more than a factor of five (World Bank 2009b). These improvements were linked with reforms that increased metering, offered staff incentives for efficient operations and reporting of illegal connections, and improved financial sustainability (McIntosh, 2013, 2014). In contrast, Ahmedabad has performed relatively poorly in terms of intermittent supply, while NRW has been difficult to estimate due to a lack of metering (Bhatkal, Avis, and Nicolai 2013; Mehta, Mehta, and Vavaliya 2021; Urban Management Centre 2011). This stems from the use of taxes to fund operations, as opposed to tariffs that would require meters to measure water consumption (Gautam 2010; Mehta, Mehta, and Vavaliya 2021). Limited metering likely also contributes to the intermittency problems, due to the difficulty of identifying and addressing leaks or illegal connections.

Data can be successfully incorporated into decision-making to improve water safety management, performance, and customer relations. While real-time data supports decision-making, data availability tends to be limited in LIAs (Jones and Kimani 2021; Mallory et al. 2022; WSUP 2018b). Abidjan and Bangkok both highlight particularly noteworthy efforts related to the use of remote sensing. In Abidjan, SODECI has installed sensors to monitor pH and conductivity within the network, sending automated alerts to the utility when water quality drops below standards (LACROIX n.d.). In Bangkok, recent advances by MWA have included digitizing of the utility's entire piped network, enabling real-time hydraulic and water quality modeling, helping to maintain high levels of water quality, and allowing customers to check the age of the water at their meter. If the water is more than three days old, the system automatically triggers a response from MWA.

In Ahmedabad, the Centre for Environmental Planning and Technology University helped to set up a performance assessment system, conducted socioeconomic and sanitation surveys of slum communities in 2008, and mapped existing water and sanitation infrastructure in geographic information systems (Mehta, Mehta, and Vavaliya 2021). The performance assessment data is linked to a publicly available website, where residents can easily see relevant statistics, offering a degree of transparency and public supervision. However, the system does not include indicators on water quality or sewage collection.

Where desired, formalizing small-scale water providers requires strong business incentives such as reduced user fees (or tariffs), connection subsidies, or the ability to organize. In numerous contexts, small-scale informal providers serve areas not covered by utilities' piped networks (Mitlin et al. 2019; Post and Ray 2020; Rusca and Schwartz 2018). A key case in this respect is Abidjan, where the utility (SODECI) began attempting to license informal resellers of its piped water in the early 1980s (Collignon, Taisne, and Kouadio 2000; Water Utility Partnership 2003; WSP 2002). These efforts

were not particularly effective, at least in part because licensing came with limited benefits with regard to small-scale operators' costs and profitability. However, resellers who have been licensed were able to form an umbrella body (Association of Water Resellers in Precarious Areas of Côte d'Ivoire). This body lobbied for greater incentives associated with licensing and the formalization process, such as reduced bulk water tariffs, connection subsidies, and better working conditions (Water Utility Partnership 2003). The current sector view in Abidjan is that resellers should be phased out by filling the service gaps they were addressing, for example through household connection subsidies (Berta 2022).

4.1.4 SOCIAL, ECONOMIC, AND POLITICAL CONTEXT: DONOR ALIGNMENT, PARTICIPATORY PRACTICES, TARIFF-RAISING, AND LEGITIMACY OF LOW-INCOME AREAS

Developing relationships between governments and external funders, supported by economic and political alignment as well as political stability, can attract funds for water and sanitation. External funding has often been used to support capital investments in infrastructure, while political leaders can be important in coordinating with donors and securing funding (Jones & Kimani, 2021; McIntosh, 2013; WaterAid, 2016a). The historical cases highlighted how alignment with donors' economic or political priorities can lead to strong relationships. For example, from Côte d'Ivoire's independence up to the civil wars that began in 2002, the country's political stability (through single-party rule) and capitalist priorities led to strong donor relationships with nations such as France (Menard and Clarke 2000). In Egypt, President Al-Sadat's Open Door Policy in 1974 and increased alignment with the United States and Europe resulted in high availability of foreign capital from these nations (Daef 1986; World Bank 2009a). President Mubarak's rule, from 1980 to 2011, provided stability that enabled continued economic progress and donor relationships, but at the cost of political repression (Bahgat 2015).

Democratic practices, especially those with strong participatory elements supported by elected bodies, can improve equity in service provision. Political leadership had value in establishing narratives promoting water and sanitation (McIntosh, 2013; Northover et al., 2016; WaterAid, 2016a). The historical cases that followed a utility-driven type of progress (e.g., Bangkok) highlighted the additional worth of politicians providing space and support for reforms instituted by the utility (McIntosh, 2013). Porto Alegre also showed the value of citizen participation in the city's participatory budgeting process, backed by the political commitment of the Workers Party that was in power locally from 1988 to 2004. This process granted citizens opportunities to choose priorities where the municipality would invest, and citizens consistently prioritized water and sanitation (Abers et al. 2018; Viero 2003).

Various studies have illustrated the process to increase equitable access to infrastructure and services in historically underserved neighborhoods, although results have been mixed elsewhere (Abers et al. 2018; de Renzio, Spada, and Wampler 2019). In Thailand, democratic perspectives that developed in the 1970s led to a public view of Bangkok's slum dwellers as having a right to basic services, eventually translating into pro-poor policies and funding for participatory projects (Lee 1998; ODI 2015). Similarly, India (particularly Ahmedabad) has a long tradition of collectivist and movement-based struggles dating back to independence, which is linked to its leadership and vision in pursuing participatory projects to improve basic services like water and sanitation in low-income settlements (Bhatkal, Avis, and Nicolai 2013; Brahmbhatt 2022).

Increased legitimacy of unplanned LIAs often preceded water service improvements. Recognition of the complex realities associated with the formation and persistence of informal areas is growing to include the informal relationships that often govern service provision in these locations

(Banks, Lombard, and Mitlin 2020; Ranganathan 2014). Cases such as Cairo and Bangkok exhibited movement away from classifying these areas as "illegal" and the creation of dedicated programs focused on improving services (Kipper and Fischer 2009; Zayed 2012). Ahmedabad was also a pioneer in this area, with holistic slum upgrading programs coupled with expansions of city boundaries to ensure service provision for surrounding LIAs. In Phnom Penh, the municipal government (supported by UN-Habitat) developed a Urban Poverty Reduction Strategy in 1999 that ended the practice of treating squatters as illegitimate residents and decentralized some decision-making power to communities (Fallavier 2003). Generally, programs securing land tenure have aided progress toward improving water service delivery.

Raising user fees (or tariffs) can contribute to achieving operational cost recovery when integrated into a broader strategy of public engagement, and high-level support, and efficiency and service delivery improvements. The literature showed the importance of financial sustainability, at least for operational expenses, as well as the difficulty of increasing user fees and achieving robust cost recovery in low-income contexts (Jones and Kimani 2021; Mitlin et al. 2019; Post and Ray 2020; Rusca and Schwartz 2018; Wutich, Beresford, and Carvajal 2016). The Phnom Penh case provided a successful example of a multi-pronged strategy, including user fees increases, to transform service delivery and achieve financial sustainability—an example that may be particularly instructive (Box 1).

Tariff-setting practices have contributed to cost recovery in different ways across the remaining cases, with strategies reflecting the distinct institutional arrangements at play. In Thailand, the national government historically controlled tariffs, which were criticized for subsidizing wealthier, high-volume customers (Dhamasiri, 1988; McIntosh & Yñiguez, 1997; Sethaputra et al., 1990). The Bangkok utility (MWA) was unable to generate a profit and fully cover operating costs until after 1984, when the government began allowing MWA to gradually raise tariffs (Dhamasiri 1988). In Abidjan and Cairo, where utilities operate under a centralized model with strong regulatory oversight, water tariffs are set at the national ministry level to be uniform across the country (EWRA 2018; SODECI 2022). In Côte d'Ivoire, national-level tariff setting is also important because tariff revenues are distributed across different national actors to fund operation as well as some degree of infrastructure investment and debt servicing (Menard and Clarke 2000).

The notable exception to this pattern of consumption-based tariffs is Ahmedabad, where AMC operates primarily through the collection of water and sanitation taxes, both set as 30 percent surcharges on property taxes (Gautam 2010). Key informants described this approach as progressive and pro-poor, in that low-income households pay less in tax due to lower property values—although it may still represent a substantial burden for low-income renters, as landlords will likely increase rental charges to accommodate the surcharges. Additionally, this strategy may contribute to service intermittency as discussed previously. AMC's role as both a municipality and water service provider likely makes this model more feasible to coordinate and implement.

Box 1. Water Utility Transformation in Phnom Penh: A Path toward Financial Sustainability

The Government of Cambodia only allowed PPWSA to start charging for water in 1986, and even after that, employees of PPWSA reportedly continued to receive a free supply of water (Biswas and Tortajada, 2010; Stokstad, 2008). When Ek Sonn Chan began leading PPWSA in 1993, his multi-pronged strategy to transform the utility included tariff increases. PPWSA carried out a socio-economic survey to collect information on how much consumers were paying to private vendors. The survey demonstrated the willingness and capability of consumers to pay higher tariffs (Biswas and Tortajada, 2010). Supported by calculations of financial needs, PPWSA proposed a three-step increase to the tariff over the next seven years (McIntosh, 2003).

PPWSA also recognized that customers needed to witness service quality improvements as a precursor to improving its own credibility. By 1995, 24-hour uninterrupted service was available to customers in Phnom Penh, and customers saw significant enhancements in water quality (Biswas and Tortajada, 2010). In tandem, PPWSA began concerted efforts to improve metering, billing, and collection practices, including by building a customer database and implementing an automated billing system (Biswas and Tortajada, 2010; McIntosh, 2003). By 1996, 85% of connections were metered (McIntosh, 2003). The following year, PPWSA introduced block tariffs along with a tariff increase, and the prime minister publicly proclaimed that everyone should pay their water bills promptly so PPWSA could continue ensuring high levels of service delivery (Biswas and Tortajada, 2010).

PPWSA still faced massive resistance from army installations, government offices, and senior officials of the government and the army, who had never paid before and wanted free services to continue indefinitely (Biswas and Tortajada, 2010). Accordingly, Chan embarked on a public education campaign targeting these high-ranking officials and agencies, going door-to-door to explain how the fees would improve the system. In one instance, a military officer pulled a gun on Chan while refusing to pay for water, and Chan returned to the property escorted by the military police to disconnect the officer's illegal tap (Stokstad, 2008). In 2001, all connections were metered, and PPWSA introduced a second tariff increase. At this point, PPWSA's revenues began to meet cost recovery levels, and the utility did not need to push for a third increase (McIntosh, 2003). Chan himself acknowledged that increasing the water tariff was not an easy task nor sustainable in the long run. In light of this, the utility's top priority was to increase the collection ratio, which they brought close to 99% by 1999 (McIntosh, 2014).

PPWSA's financial turnaround was supported by the Cambodian government and international donors, who stepped in after the trade embargo was lifted in 1992. France provided grants to improve the city's water distribution network and water supply facilities, while the United Nations Development Programme provided a technical assistance grant to rehabilitate the Phnom Penh and Sihanoukville water utilities. In 1993, the Japanese International Development Cooperation assisted in developing a master plan and feasibility study for the city, and in 1995, the World Bank and ADB each provided concessionary loans of roughly $20 million to PPWSA (Biswas and Tortajada, 2010; McIntosh, 2013). All of these grants and loans created an opportunity for Chan and his team to follow through on their vision for financially sustainable services.

Overall, PPWSA's journey followed the trajectory laid out by the World Bank for utility turnarounds. An initial reliance on transfers, coupled with performance and efficiency improvements, led to increased credibility and a more supportive environment for tariff increases and commercial financing (Soppe et al., 2018).

4.1.5 ENVIRONMENTAL AND RESOURCE CONTEXT: POLLUTION AND SHOCK-INDUCED RESILIENCE

Water pollution concerns, common across cases and often resulting from inadequate wastewater treatment, may drive advancements in supply and treatment. The literature review noted the linkages between water and sanitation systems, in particular the potential for inadequate sanitation to pollute water sources (McIntosh, 2003; McIntosh, 2013; Mitlin et al., 2019; Satterthwaite et al., 2019). Many of the cases highlighted issues around pollution and the ways in which it

occasionally spurred improvements to water and sanitation systems. Examples include Ahmedabad, where pollution of the Sabarmati River led to additional sewage treatment plants (Urban Management Centre 2011), and Bangkok, where surface water pollution associated with severe flooding caused reconsideration of water supply and treatment approaches (Daniere and Takahashi 1999). In Porto Alegre, the presence of blue algae in Guaiba Lake, where wastewater discharged, led to a new sewerage plan (da Costa et al. 2006). It developed an "integrated water cycle vision" covering the sanitation chain from household sanitation infrastructure to discharge of effluent wastewater.

While environmental and economic shocks such as natural disasters or financial crises are unequivocal tragedies, they sometimes play a role in encouraging investment in resilience. Natural disasters may highlight weaknesses in existing water and sanitation systems, potentially leading to improved resilience if the information is put to use (Post and Ray 2020). In Bangkok, MWA's previous use of groundwater resources led to widespread land subsidence that contributed to increased flooding and damage. In response, a 1983 cabinet resolution drove reductions in the utility's use of groundwater, which accounted for less than 0.4 percent of its water supply by 2001 (Babel et al., 2006; McIntosh, 2003). In Egypt, the construction of the Grand Ethiopian Renaissance Dam is expected to decrease Egypt's incoming Nile River flow by 25 percent. Given that 90 percent of Cairo's water supply comes directly from the river (Edo, Sadayeva, and Hassan 2020), Egypt's National Water Resources Plan 2037 and National Vision 2030 focus on developing new water supplies, such as through rainwater harvesting and water reuse, as well as managing demand and advancing water purification technology, to improve water security (Edo, Sadayeva, and Hassan 2020; EWRA 2018).

Overall, these examples highlight the importance of capitalizing on crises and long-term challenges to focus political attention and drive reforms, strategies, and improvements in resilience (Box 2). (For additional details on examples of shocks and measures to increase resilience from the historical and pioneering cases, refer to Appendix B). Still, pollution or other environmental shocks, no matter how severe, may not always be sufficient to propel authorities to make necessary investments or take mitigating actions. The problems may seem overwhelmingly large or complex, with incremental changes appearing to have little impact.

Box 2. Resilience: Responses to and Preparations for Shocks and Long-Term Pressures

Example snapshots associated with shocks, long-term pressures, and resilience come from historical and pioneering cases (details in Appendix B). Three central findings appear:

1. Analyzing information from past experiences, spatial and temporal modeling, or risk analyses is important for developing *knowledge regarding how environmental threats (e.g., pollution crises, climate change) may impact local or national economies and populations.*
2. Past crises or compelling findings from analyses can galvanize *political attention and action leading to strategies, visions, and frameworks*. These either directly address the issue or create conditions in which non-political actors, such as service providers and regulatory agencies, can implement internal or sector-wide reforms.
3. Approaches should involve *long-term strategic thinking* that:
    a. Considers the full effects of threats,
    b. Integrates realistic expectations regarding future service delivery patterns (e.g., continued use of onsite sanitation and need for FSM), and
    c. Recognizes existing conditions that may impact feasibility (e.g., local attitudes regarding wastewater treatment and reuse as a mechanism for augmenting available water supplies).

Snapshots from historical and pioneering cases

Financial crisis in Bangkok. A national financial crisis in 1997 led Bangkok's water utility (MWA) to institute several reforms that improved efficiency, performance, and customer relations, helping to garner public support for successfully resisting the national government's call for privatization (McIntosh, 2014). Subsequently, utility leaders and others saw the financial crisis as inducing improvements that have made MWA a celebrated service provider in the region (MWA, 2019).

Reduction of Nile River flow in Cairo. The construction of the Grand Ethiopian Renaissance Dam is expected to decrease Egypt's incoming Nile River flow by 25%. Accordingly, Egypt's National Water Resources Plan 2037 and its National Vision 2030 focus on developing new water supplies, managing demand, advancing water purification technology, and increasing reuse to improve water security (Edo et al., 2020; EWRA, 2018).

Cholera outbreak in Lusaka. A 2017–2018 cholera outbreak in Lusaka associated with groundwater contamination from "drain and bury" pit-emptying practices acted as a major factor in galvanizing political attention on these issues (Nyambe et al., 2020; USAID, 2010). Moving forward, this shock and additional drivers, such as population growth and previously weak coordination, contributed to the development of a new Urban Onsite and Fecal Sludge Management Framework for Provision and Regulation (Drabble et al., 2019; WHO, 2019; WIN, 2021). It clearly mandated Lusaka Water and Sanitation Company (LWSC) as having responsibility for onsite sanitation and FSM.

Flooding resilience in San Fernando. Flooding is a common concern in the Philippines, with climate change expected to increase flooding intensity in the futu

4.2 CHARACTERISTICS FROM PIONEERING CASES FOCUSED ON SANITATION SERVICE PROVISION

Statistics on key indicators helped to initially characterize each of five sanitation case study cities (Table 9). Most of the innovative approaches focused on sanitation provision, and on non-sewered sanitation in particular. The analysis therefore focused primarily on the enabling environment for sanitation. In several cases, the pioneering innovations and improvements began quite recently, and their impacts on actual sanitation outcomes have yet to be seen.

Table 9. Key indicators on population and household sanitation coverage, if available, across pioneering cases[a] (ND: No data)

City	Total Population	Share of population in informal settlements (%)	Citywide household sanitation access and facilities (%)				Fecal sludge emptying and treatment (%)		
			Safely managed	Sewer connections	Septic tanks	Pit latrines	Septic tanks emptied	Pit latrines emptied	Fecal sludge treated
Faridpur	121,632	47.6%	10%	No sewer system	32%	68%	ND	ND	10%
Lusaka	2,523,844	63.3%	17%	14–20% (2018)	ND	95%	ND	59% (informal)	10%
Maputo	1,101,771	76.9%	<10%	9% (2018)	49%	41%	37%	43% (informal)	3%
Nairobi	4,385,853	46.1%	60%	48%	0%	52%	ND	ND	6%
San Fernando	125,640	44.3%	5.7–99.6%[b]	No sewer system	84%	3%	3%	ND	ND

[a] (Baltazar et al. 2021; Blackett and Hawkins 2017; Brosse, Renouf, and Nath 2017; CDIA 2021; County 2014; Dalberg Global Development Advisors 2017; Drabble and Parente 2018; Kennedy-Walker, Amezaga, and Paterson 2015a; Lerebours et al. 2022; NWASCO 2021; Satterthwaite et al. 2019; Susana n.d.; WASREB 2022; WaterAid 2016a; Weststrate et al. 2019; WIN 2021; World Bank Group 2020)

[b] A shift flow diagram (SFD) created for San Fernando, based on data from 2015, reported that 99.59 percent of septage was managed safely, but nearly 94 percent was stored in septic tanks that were not yet desludged. Many of these tanks may have been leaching due to a "bottomless" design (Baltazar et al. 2021; WaterAid 2016b). Between 2016 and 2021, the city instituted a program to begin sealing these septic tanks (CDIA 2021).

As with the historical cases, pioneering cases illustrated that leadership or support from different types of institutions can lead to improvements in the enabling environment for sanitation (Table 10). See Supplementary Document 2 for full narratives, institutional maps, and timelines of key events for each pioneering case.

Lusaka and Maputo illustrated examples of ***regulator-supported*** progress, while Nairobi likewise had a strong independent regulator (WASREB)—as expected, given the regional focus on developing strong regulatory frameworks and leadership (ESAWAS 2022). Independent national regulatory agencies play central roles in coordinating the sector and engaging in strong external oversight of institutional service providers (the Lusaka Water and Sanitation Company [LWSC] and the Maputo Municipal Council) producing annual nationwide reports on KPIs that provide benchmarking and comparisons across each country (Drabble et al. 2021; WASREB 2022; World Bank Group 2020). I

The utility in Lusaka (LWSC) has developed delegated management models in peri-urban areas with Water Trusts, local community-based entities operating under license with LWSC (Kennedy-Walker, Amezaga, and Paterson 2015b). A few Water Trusts have begun providing FSM services (Kennedy-Walker, Amezaga, and Paterson 2015b; Renouf et al. 2019). The regulator in Mozambique (the Water Regulatory Authority Public Institute [AURA IP]) has been instrumental in developing sanitation

surcharges, while Zambia's regulator (NWASCO) led the development of the country's new FSM regulatory framework after a major cholera outbreak that began in 2017 (Blackett and Hawkins 2017; Drabble et al. 2019; Drabble and Parente 2018; WASREB 2022; WIN 2021). The institutional arrangement in Maputo provides an example of public sector infrastructure ownership, similar to the historical case of Abidjan. In Maputo, a public asset holder managed urban sanitation infrastructure, while the municipal council was responsible for service provision (Blackett and Hawkins 2017; Drabble et al. 2019; Jones and Kimani 2021; Weststrate et al. 2019; Wilson and Dias 2016).

The two cases from Asia (Faridpur, San Fernando) illustrated ***municipality-driven*** types of progress, in which municipalities have clear mandates for ensuring service provision, with some level of internal oversight via local steering committees or councils (ADB 2013; Brosse, Renouf, and Nath 2017; Dalberg Global Development Advisors 2017; GSGS 2018; Mills, Tilmans, and Islam 2017; Zaqout et al. 2021). Nongovernmental organizations (NGOs) tend to play a larger role in directly serving low-income residents in Faridpur, in partnership with the municipality, while LIAs are limited in San Fernando (Brosse, Renouf, and Nath 2017; Mansour, Islam, and Akhtaruzzaman 2017; Practical Action 2016; WaterAid 2016b). In San Fernando, a city wastewater management council oversees the septage management program. Citizens voluntarily pay an annual fee as part of their property taxes to become eligible for septic tank desludging services once every five years (GSGS 2018; Ockelford and Cohen 2013). Similar to Ahmedabad, this arrangement represents an example of local property taxes funding service provision, enabled by the fact that the municipality oversees both (Baltazar et al. 2021; Centre for Advanced Philippines Studies 2011; Cruz 2019; GSGS 2018; Ockelford and Cohen 2013; Robbins, Strande, and Doczi 2021; WaterAid 2016b).

In Faridpur, a multi-stakeholder steering committee chaired by the municipality's conservancy department is primarily responsible for monitoring service-level agreements associated with public-private partnerships (PPPs) for fecal sludge management and treatment (Brosse, Renouf, and Nath 2017; Mills, Tilmans, and Islam 2017; Stevens, Islam, and Morcrette 2015). Like PPPs in Abidjan, in these FSM PPPs, the municipality owns assets (e.g., mechanized equipment, protective gear, and the treatment plant) leased and used by operators (including pit emptying cooperatives), (Brosse, Renouf, and Nath 2017; Practical Action 2016).

Finally, Nairobi reflects a primarily ***utility-driven*** type of progress, although the national regulatory agency also played a prominent role as noted above. In Nairobi, under the 2016 Water Act, the county government owns infrastructure, a local water works agency is responsible for infrastructure development, and the local utility (Nairobi City Water and Sewerage Company [NCWSC]) provides water and sanitation services (Athi Water Works 2020). One of NCWSC's main contributions has involved the creation, expansion, and effective functioning of an informal settlements department, established in 2009. The department expanded considerably in the following years and was eventually converted to a "region" within the utility, with increased responsibilities for service provision in LIAs. As of 2018, NCWSC's Informal Settlements Region had over 200 employees and was operating effectively across the utility's head office and four zonal offices located within low-income areas (WSUP 2018a).

Findings from the pioneering city examples were compared with the characteristics identified through the historical analysis. Interestingly, while the details of the pioneering cases are quite different from those in the historical cases (including differing time periods and foci on water vs. sanitation), their general characteristics were largely consistent. The next sections focus primarily on new insights from the pioneering analysis, while briefly noting findings that confirm or align with historical findings.

Table 10. Key drivers and characteristics associated with each pioneering case and each category of the S-SES framework

	Faridpur	Lusaka	Maputo	Nairobi	San Fernando
Primary type of progress	Municipality driven	Regulator supported	Regulator supported	Utility driven	Municipality driven
Governance	Service-level agreements and performance contracts between municipality and private providers, overseen by steering committee within municipality.	Dedicated Ministry for Water and Sanitation created in 2016; national regulator acts as central coordinator and monitors performance under new FSM regulatory framework.	National regulator acts as central coordinator, leading development of a sanitation tariff, and monitors performance under new FSM regulatory framework.	National regulator monitors performance; KPI 10 explicitly monitors water and sanitation service provision in LIAs; since 2018, national government has been developing a policy giving Ministry of Water overall authority for sanitation	Strong local policy framework, including a sanitation code and city ordinance that created an oversight council, which is the main regulatory mechanism.
Actors	The municipality formed PPPs with FSM cooperatives and a private company operating the treatment plant; strong NGO and community engagement.	Local utility is responsible for water and sanitation services, including sewered and non-sewered sanitation, and works with Water Trusts to delegate service provision in some LIAs.	Under Delegated Management Framework, municipality manages service delivery for water and sanitation, and public asset holders manage infrastructure investment; Deputy Minister of Public Works championed urban sanitation.	City utility provides services, with infrastructure owned by the county government and infrastructure development managed by a local water works agency; strong presence of influential NGOs and social sanitation enterprises.	City provides services, with mayors often acting as champions for sanitation.
Water and sanitation approaches	Residents rely on pit latrines and septic tanks; improved emptying through mechanization and organization of private providers.	Most residents rely on pit latrines, especially in LIAs, and safely managed coverage remains low.	Most residents rely on septic tanks or pit latrines, especially in LIAs, and safely managed coverage remains low.	LIAs rely on onsite sanitation, with approaches including community ablution blocks and CBS, while sewers serve other areas.	Experimentation and piloting of ecological sanitation and septage management; most residents rely on septic tanks.
Social, economic, and political context	Heavy reliance on external funding through the national government.	Declining economic growth and rapid urbanization placed stress on sanitation.	Heavy reliance on donor funding, highlighted by debt crisis in 2016; strong focus on social protection policies and programs.	Donor funding has been critical, including for a social connection policy where low-income residents could pay in installments.	Popular ecotourism location; national legislation has supported but not driven progress.
Environmental and resource context	High vulnerability to flooding led to adjustments in fecal sludge treatment; fecal sludge seen as valuable for compost production.	Major cholera outbreak caused by groundwater contamination focused political attention on onsite sanitation and FSM.	FSM and onsite sanitation have contaminated Maputo's shallow water table.	Nairobi River Basin Programme aimed to reduce pollution of local rivers that were the city's main drinking water source.	Green and Integrated Wastewater Management program focused on climate resilience for drainage and flood control.

4.2.1 GOVERNANCE: CLEAR PERFORMANCE INDICATORS, REGULATORY FRAMEWORKS FOR FSM, AND PRO-POOR MEASURES

Clear performance indicators used by national regulators to rank service providers promoted effective FSM service provision. In particular, annual benchmarking reports produced by NWASCO (Zambia) and WASREB (Kenya) helped to identify and award high-performing utilities. They also encouraged others to improve, with KPIs showing where progress was most needed. While these KPIs tended to focus most on water service provision, they did include at least one indicator on sanitation coverage. Of particular note was WASREB's development and implementation of KPI 10, which combines dimensions on governance, impact (including both water and sanitation access), planning, and finance associated with service provision in LIAs (WASREB 2022; WSUP 2018b). In its 2021 sector performance report, WASREB was able to assess this indicator for 58 utilities across the country; NCWSC ranked second (WASREB 2022).

Clear regulatory frameworks with a specific focus on onsite sanitation and FSM help to navigate complexities of the non-sewered sanitation service chain. The focus on FSM is increasing, especially in the context of CWIS initiatives, lending importance to dedicated policies and regulations (Gambrill, Gilsdorf, and Kotwal 2020; Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; J. R. McConville et al. 2022; Norman and Cheruiyot 2021). FSM services, which often require multiple actors performing functions along complex service chains, dominated the pioneering cases, where sewer networks tended to be limited or nonexistent.

Faridpur, Lusaka, Maputo, and Nairobi illustrated the importance of, and various pathways toward, the development of national regulatory frameworks for FSM. For example, Zambia's 1991 constitution gave local authorities the mandate for coordinating water supply and wastewater services (World Bank 2020), leaving a responsibility gap regarding the provision of non-sewered services. Once onsite sanitation was identified as an important issue, Zambia had to develop a dedicated framework for onsite sanitation and FSM, which clarified mandates, standards, and options for urban non-sewered sanitation (Drabble et al. 2019; WIN 2021). As a result, the utility in Lusaka (LWSC) created an operational unit for onsite sanitation and FSM (NWASCO 2021). In Mozambique, regulatory changes in 2019 renamed the national regulator (AURA IP) and granted it explicit powers to monitor all urban sanitation provision, including non-sewered approaches (Drabble et al. 2019; 2021). In cases such as Zambia and Mozambique, the operationalization and practical success of newer regulations (such as through recorded increases in safely managed sanitation) remains to be seen (Satterthwaite et al. 2019; Susana n.d.).

Finally, in San Fernando, the city put in place a sanitation code and an ordinance that established the septage management program, appropriate design standards, and an oversight council for monitoring purposes (Baltazar et al. 2021; GSGS 2018; Ockelford and Cohen 2013).

Although formalizing FSM is an inherently pro-poor action, progress toward inclusive sanitation similarly requires household subsidies. FSM is intrinsically a pro-poor activity, since low-income residents are more likely to use onsite sanitation, as shown especially in Lusaka and Maputo (Blackett and Hawkins 2017; Drabble and Parente 2018; Satterthwaite et al. 2019; WIN 2021). Compared to sewered sanitation, FSM is less likely to be hindered by land tenure issues, as it does not necessitate laying out piped infrastructure. FSM approaches in Lusaka, Maputo, and Faridpur have been gaining regulatory and operational traction, but FSM costs remained high for the poor. Prices for regulated emptying services were typically set by the contracting or licensing institutions, such as the Lusaka utility (LWSC) or the municipal authorities in Maputo and Faridpur, in an effort to balance financial sustainability and affordability (Brosse, Renouf, and Nath 2017; Dalberg Global Development

Advisors 2017; Mills, Tilmans, and Islam 2017; Renouf et al. 2019; Zaqout et al. 2021). At these prices, households still required subsidies, and informal emptying services were more likely to be used instead (Blackett and Hawkins 2017; Drabble et al. 2019; Drabble and Parente 2018; Lerebours et al. 2022). Nairobi had the highest levels of piped sewer connections (40–50 percent) among the studied cases, where a social connection policy enabled low-income households to pay sewer connection fees in installments through no-interest loans over a period of up to 60 months (Mwangi, Otiego, and Ndakorerwa 2015; WSUP 2018a).

Constitutional rights to sanitation were not necessary to improve services. With the exception of Kenya, which established the constitutional right to sanitation in 2010, no other pioneering cities enshrined this right. Only one legal case in Kenya directly involved the right being successfully raised in court. More commonly, as noted in the literature review, the separate constitutional right to housing has been used to demand for sanitation and other basic services (Mallory et al. 2022).

4.2.2 ACTORS: CHAMPIONS, COMMUNITY PARTICIPATION, AND NGOS PILOTING NEW APPROACHES

Champions, community involvement in service provision and planning, and customer feedback all contributed to progress in pioneering cases, aligning with the findings from the literature review and historical analysis. Champions played important roles in expanding NCWSC's Informal Settlements Region in Nairobi, recognizing urban sanitation as a critical issue in Maputo, and experimenting with sanitation innovations in San Fernando (Blackett and Hawkins 2017; Ockelford and Cohen 2013; Porciuncula 2022; WaterAid 2016b; WSUP 2018a). In Nairobi and Maputo, champion-led advances were sustained, thanks to institutional reforms and a national budget line item for sanitation.

With respect to community participation, Lusaka provided a strong example of a delegated management model, in which the utility (LWSC) coordinated with community-based Water Trusts to provide water and, in a few instances, sanitation services in the city's peri-urban areas (Drabble et al. 2019). The Faridpur municipality worked across three levels of community engagement and planning: (i) community-based organizations, (ii) ward-level coordination committees, and (iii) a town-level coordination committee. All three levels included provisions for representation of women and poor households and provided mechanisms for participatory planning and accountability of elected officials (ADB 2012). In Nairobi, NCWSC employed a similar three-level structure to increase transparency and accountability for its interventions in LIAs (NCWSC and AWSB 2009). With respect to customer feedback, service providers and regulatory agencies in Faridpur and Lusaka set up mechanisms to monitor and respond to complaints (ADB 2012; Brosse, Renouf, and Nath 2017; Mills, Tilmans, and Islam 2017; Stevens, Islam, and Morcrette 2015; WIN 2021).

NGOs piloting innovative approaches can support champions and help initiate regulatory reforms in sanitation service provision. Piloting of new technologies or approaches drove improvement in San Fernando, Maputo, and Kenya. San Fernando's pilots were supported by Rotary International (Ockelford and Cohen 2013). Water and Sanitation for the Urban Poor (WSUP) supported the Maputo Municipal Council's pilots for shared sanitation facilities and formal FSM services, which highlighted the importance of onsite sanitation and the need for expanded FSM transport and treatment infrastructure (Drabble et al. 2019; Drabble and Parente 2018). WSUP has played an important role in supporting institutional changes in Kenya for over 10 years; they worked with NCWSC's Informal Settlements Region to develop policy and strategy documents and with WASREB to develop the sanitation surcharge plus KPI 10 to monitor pro-poor performance (WSUP 2018b; 2018a). Social enterprises focused on CBS, such as Sanergy and Sanivation, have been working in Kenya to

develop sustainable and scalable service provision models in LIAs (Mallory et al. 2022). Their efforts focused on becoming government contractors to increase the potential for public subsidies. The NGO Practical Action helped to set up Faridpur's PPPs for FSM emptying and treatment. At the national level, Practical Action helped to develop Bangladesh's institutional and regulatory framework for FSM (Brosse, Renouf, and Nath 2017).

4.2.3 SERVICE DELIVERY APPROACHES: FORMALIZATION OF SMALL-SCALE PROVIDERS AND EXPERIMENTATION

Formalizing, organizing, and incentivizing small-scale FSM providers can help to improve service delivery and working conditions. Formal associations of FSM emptiers have played important roles in Lusaka and Faridpur. The Zambia Emptiers Association reportedly included 55 members as of 2021 (WIN 2021). The association monitored members' activities and lobbied the local utility (LWSC) for favorable fees and working conditions, as formal emptiers needed to set up contracts with LWSC and operate using fees set by the utility (Lerebours et al. 2022). In Faridpur, two previously informal manual emptying groups organized into cooperatives—recognized as legal entities under Bangladesh law—enabling them to sign service-level agreements with the Faridpur municipality. Under these PPPs, the municipality leased mechanized emptying equipment and protective gear to the cooperatives, improving emptying efficiency and safety.

The formalization of these groups has increased their trustworthiness in the municipality and reduced the stigma they face as members of lower societal castes (Box 3) (Brosse, Renouf, and Nath 2017; Saha 2022; WSSCC and FANSA 2016; Zaqout et al. 2021). Faridpur has an interesting system in which the fecal sludge treatment plant operator paid FSM providers for their sludge (reversing the typical arrangement), offering them a strong incentive to discharge sludge at the plant (Brosse, Renouf, and Nath 2017; Chong et al. 2017). FSM cooperatives and the treatment plant both received support in the form of equipment leases (e.g., mechanized emptying equipment, the treatment plant itself) from the Faridpur municipality, helping to sustain operations.

On the demand side, Faridpur has a website where residents can request emptying services from the emptying cooperatives. This website collects data on demand over time, tracks when emptying jobs are complete, and records where the emptier discharged the sludge (Mills, Tilmans, and Islam 2017). Separately in Maputo, the municipal council piloted the integration of formal FSM services into existing businesses providing solid waste management services. These integrated services could better address common issues such as solid waste disposal in latrines, although emptying fees remain higher than those offered by informal emptiers (Blackett and Hawkins 2017; Drabble et al. 2019; Drabble and Parente 2018).

Experimentation with innovative technologies and service models can provide insight into the most suitable approaches for the context. This principle is especially critical for FSM, given its complexity and the involvement of numerous actors and technologies in the service chain. The literature review identified a number of innovative sanitation approaches, such as scheduled desludging, call centers, and CBS, with questions remaining concerning their widespread applicability or scalability (Drabble et al. 2021; C. Ferguson et al. 2022; Mallory et al. 2022; Peletz et al. 2020).

The pioneering cases provided examples of some of these approaches, such as in Nairobi, where CBS enterprises have been aiming to become government contractors (Mallory et al. 2022). Lusaka offered an example of an innovative delegated management model for FSM—typically seen in the literature for water provision—via the utility's Water Trusts (Kennedy-Walker, Amezaga, and Paterson 2015b; Renouf et al. 2019). Faridpur went beyond a call center to offer a website where residents could request

emptying services, while the city's service level agreement with the fecal sludge treatment plant operator began as a pilot in 2016 (Brosse, Renouf, and Nath 2017; Mills, Tilmans, and Islam 2017; Practical Action 2016). San Fernando is especially noteworthy for extensive experimentation prior to instituting its septage management program across the city.

Alternative approaches such as Ecosan facilities continue to be used in certain areas with shallow water tables and water scarcity challenges (Baltazar et al. 2021; Centre for Advanced Philippines Studies 2011; Cruz 2019; GSGS 2018; Ockelford and Cohen 2013; Robbins, Strande, and Doczi 2021; WaterAid 2016b). Maputo's pilots of shared sanitation facilities and formal FSM services helped the municipal council to see these as effective approaches, while also highlighting challenges related to financial sustainability and limited fecal sludge transport and treatment capacity (Blackett and Hawkins 2017; Drabble et al. 2019; Drabble and Parente 2018). FSM arrangements in the five pioneering study cities all differed, reflecting distinctive contextual elements and highlighting that one-size-fits-all FSM approaches likely do not exist.

4.2.4 SOCIAL, ECONOMIC, AND POLITICAL CONTEXT: EXTERNAL FUNDING, DEMOCRATIC PRACTICES, AND CENTRAL CONTROL

Evidence from pioneering cities supported the importance of good governance, alignment of priorities, and stable donor funding. With regard to external funding, Maputo and Nairobi were of particular note, as local or national public asset holders have been instrumental in securing and utilizing funds to make infrastructure investments (Athi Water Works 2020; Blackett and Hawkins 2017; Drabble et al. 2019; Jones and Kimani 2021; WASREB 2018; Weststrate et al. 2019; Wilson and Dias 2016). In Mozambique's 2016 debt crisis, certain government officials secretly created state-owned enterprises that took on over two billion USD in foreign debt (Buur and Salimo 2018; Gebregziabher and Sala 2022). This offered a window into the negative effects of poor governance, including large inflation and the suspension of donor funding. Generally, Mozambique has relied heavily on external funding for operations. Development partners have noted that such unsustainable arrangements can cause backsliding and diminish trust in local service providers (Drabble et al. 2019).

Pioneering cases confirmed the positive impacts of democratic practices that prioritize sanitation. San Fernando provided an important example of strong local political support from a succession of democratically elected mayors who prioritized sanitation initiatives and secured loans to develop effective service models (Ockelford and Cohen 2013; Porciuncula 2022; WaterAid 2016b). Notably, the city has been pursuing national support through the Philippines' National Sewer and Septage Management Program (CDIA 2021). In Faridpur, local political commitment to achieving citywide FSM services was critical in overcoming setbacks to the city's PPP model caused by national clashes between the ruling and opposition political parties in 2015 (Brosse, Renouf, and Nath 2017; International Crisis Group 2015).

Some form of central control over financial aspects (e.g., price setting for emptying services, sanitation surcharges for cross-subsidies, use of taxes to fund sanitation) is necessary to address both affordability and the imperative of operational costs recovery. Prices for emptying services were often set by the contracting or licensing institutions, such as the Lusaka utility (LWSC) or the local municipalities in Maputo and Faridpur, in an effort to balance financial sustainability and affordability (Brosse, Renouf, and Nath 2017; Dalberg Global Development Advisors 2017; Mills, Tilmans, and Islam 2017; Renouf et al. 2019; Zaqout et al. 2021). The cases of Lusaka and Maputo offered insight into the usefulness of a sanitation tariff or surcharge added to utility customers' water bills. These used funds collected from residents who already had piped connections to fund

sanitation improvements for lower-income households (Drabble et al. 2019; Drabble and Parente 2018; NWASCO 2021).

Both contexts, however, showed the complexity of bringing a revenue stream online and ensuring it can be used for non-sewered sanitation (Drabble et al. 2019; 2021; Norman, Daryanani, and Peal 2012). San Fernando partially funded its septage management program through voluntary annual fees linked with property taxes. Any household paying the fee is eligible to receive desludging services every five years; others who do not pay can access the service through a one-time surcharge when they request desludging (Baltazar et al. 2021; GSGS 2018; Ockelford and Cohen 2013; WaterAid 2016b). A cautionary tale emerged in Ghana, where deficiencies in property tax collection, ring-fencing, and tracking hindered efforts to incorporate sanitation surcharges into property taxes (WSUP 2019b; 2019a). Generally, the financing mechanisms discussed here continue to require some refinement, but they provide a starting point for options that may help to sustainably fund sanitation operations.

4.2.5 ENVIRONMENTAL AND RESOURCE CONTEXT: POLLUTION, SHOCKS, AND REUSE

Water and soil pollution, public health concerns, and environmental shocks helped drive efforts to improve sanitation services and treatment. Nairobi, Lusaka, Maputo, and San Fernando all faced pollution issues (Table 10), often related to groundwater contamination, that led to improved pollution control, regulatory reforms, and a drive to improve sanitation provision (Blackett and Hawkins 2017; Nyambe, Agestika, and Yamauchi 2020; UNEP 2009; Weststrate et al. 2019).

In Lusaka, these concerns factored strongly into progress toward an improved FSM regulatory framework. Due to groundwater contamination issues related to onsite sanitation, Lusaka frequently experienced cholera outbreaks. A severe outbreak beginning in late 2017 focused political attention on sanitation and helped drive the development of NWASCO's new regulatory framework focused on onsite sanitation and FSM (Box 2) (Drabble et al. 2019; USAID 2010).

Authorities in San Fernando have been particularly receptive to environmental protection and conservation due to the city's heavy reliance on eco-tourism. Preserving surrounding forests, mangroves, and coastal areas (Pajimola and Pajimola 2015; Porciuncula 2022) was a key motivation for improving sanitation services (Baltazar et al. 2021; WaterAid 2016b). Additionally, as climate change is expected to increase the frequency and severity of flooding (CDIA 2021), the San Fernando Municipality worked with the Cities Development Initiative for Asia to create the green and integrated wastewater management report. It included a long-term roadmap to address sanitation, drainage, and flood control in the city (Box 2).

Although the cases provided a few examples of efforts to promote resource recovery and reuse, sustainable fecal sludge markets have yet to develop at scale. In Faridpur, the treatment plant operator sold treated sludge as compost, and Bangladesh's Agriculture Extension Service was reportedly interested in this approach. However, local demand for compost remained low due to limited acceptance and difficulties with certifying a product from human waste as safe fertilizer (Brosse, Renouf, and Nath 2017; Mills, Tilmans, and Islam 2017; Practical Action 2016). In Lusaka, the Water Trusts that have been providing FSM services set up biodigesters to treat collected sludge, aiming to sell the product to local farmers. Similar to Faridpur, local demand and sales have remained limited (Blackett and Hawkins 2017).

The literature review similarly revealed that viable markets for reuse of water and other recovered resources from sanitation remain elusive (Blackett and Hawkins 2017; C. Ferguson et al. 2022; Trimmer et al. 2019; Trimmer and Guest 2018; VanRiper et al. 2022). These difficulties suggest that resource recovery requires policy reforms and public financing, at least initially. Public involvement would

encourage local markets and/or export opportunities, for example by certifying reuse products as safe soil amendments. More broadly, questions of whether and where profitable reuse markets can be established remain open.

Finally, along with the characteristics discussed in this chapter, the findings from the case study analyses provided insights related to the widely accepted components and unresolved debates identified from the literature review. Appendix D provides a summary of these insights and comparisons between the literature review and case studies. In many cases, this comparison highlights possible recommendations for future research (summarized in the following chapter).

Box 3. GESI: Pro-Poor Focus, Gender Representation, and Worker Dignity

From the GESI considerations highlighted across the historical and pioneering cases (details in Appendix C), two central findings appear. Future research may help to confirm or refine them:

- Development of **explicit GESI policies and strategies that promote increased representation in decision-making processes and among institutional staff** improve equity and ensure that services consider the needs and rights of vulnerable groups and underserved populations.
- Governments and utilities can create **safe spaces for organizations or individuals who champion GESI considerations** to keep these issues at the center of future policies and programs.

Snapshots from historical and pioneering cases

Pro-poor support. All of the cases included some set of policies and programs focused explicitly or implicitly on improving water and sanitation access in LIAs. From historical cases in particular, a key issue concerned land tenure (i.e., the possibility of addressing or bypassing requirements that households present proof of land ownership when applying for a piped connection). Generally, GESI literature has shown that different types of land tenure (e.g., individual vs. communal ownership) and the specific individuals who hold land titles (e.g., men or women) can have gender-specific impacts on water access and decision-making (Wambu et al., 2016).

Women's representation in Ahmedabad. Women's inclusion in the municipality's elected regulatory body, as well as neighborhood-level associations, was mandated. This contributed substantively to the process and outcomes of integrated slum upgrading projects (Bhuvan & Ashram, 2002; Diacon, 1997; UNDP & WSP, 1999).

Gender-focused policies and strategies in Lusaka. Zambia established the National Gender Policy and National Social Protection Policy in 2014. It included specific protections for people with disabilities and measures to ensure women could actively participate in water and sanitation decisions (WHO, 2019). The water and sanitation utility (LWSC) developed a Gender Policy and Gender Strategy and appointed a Gender Focal Point to coordinate gender-related activities and mainstreaming (African Development Bank, 2015). While previous reports have noted that sex-disaggregated employment data are scarce in the WASH sector (USAID, 2020), NWASCO's annual reports provide data on women's representation among utility staff (NWASCO, 2021).

Improved conditions for sanitation workers in Faridpur. In Faridpur, sanitation workers often belong to the lowest castes in society, face discrimination, and must contend with extreme safety and health hazards (WSSCC & FANSA, 2016; Zaqout, 2018). However, the formal organization of previously informal workers into cooperatives, along with increased use of mechanized emptying, have reduced risks and increased revenues for sanitation workers (Dalberg Global Development Advisors, 2017; WSSCC & FANSA, 2016). In particular, PPP models have improved trust between the members of emptier cooperatives and the municipality (U. Saha, personal communication, June 9, 2022). The NGO Practical Action played an important role in driving these developments (U. Saha, personal communication, June 9, 2022; Zaqout et al., 2021).

5.0 CONCLUSIONS AND RECOMMENDATIONS

Achieving and sustaining equitable access to safe drinking water and sanitation services remain key challenges in many urban areas of low- and middle-income countries. Employing a literature review and comparative case study analysis, this study sought to identify and understand the policies, regulations, institutional arrangements, and contextual factors that enable and contribute to inclusive urban water and sanitation service delivery.

This final section of the report summarizes the study's findings and shares recommendations for future research.

5.1 CONCLUSIONS

The 11 cases examined within this report illustrated three different types of progress, distinguished by the primary actors initiating, driving, and supporting improvements toward more inclusive water and sanitation:

- *Utility-driven progress (Bangkok, Phnom Penh, Porto Alegre, Nairobi):* Utilities with autonomy and strong leadership proactively drove progress through measures such as institutional reforms, efficiency improvements, increased metering, appropriate user fee (or tariff) increases, and public engagement.
- *Regulator-supported progress (Abidjan, Cairo, Lusaka, Maputo):* Independent regulatory institutions provided strong monitoring and coordination of the sector, contributing to greater quality control, performance monitoring, additional investments, and the development of regulatory frameworks tailored to local practices.
- *Municipality-driven progress (Ahmedabad, Faridpur, San Fernando):* The local government directly provided water and sanitation services and drove improvements using integrated measures such as holistic slum upgrading programs, taxes to fund operations, and PPPs.

The three progress pathways described above (utility-driven, municipality-driven, and regulator-driven) indicate multiple possible entry points to promote effective enabling environments. Priority interventions will differ depending on whether efforts are focused on the utility, municipality (i.e., local government), or regulator, as detailed in Table 11.

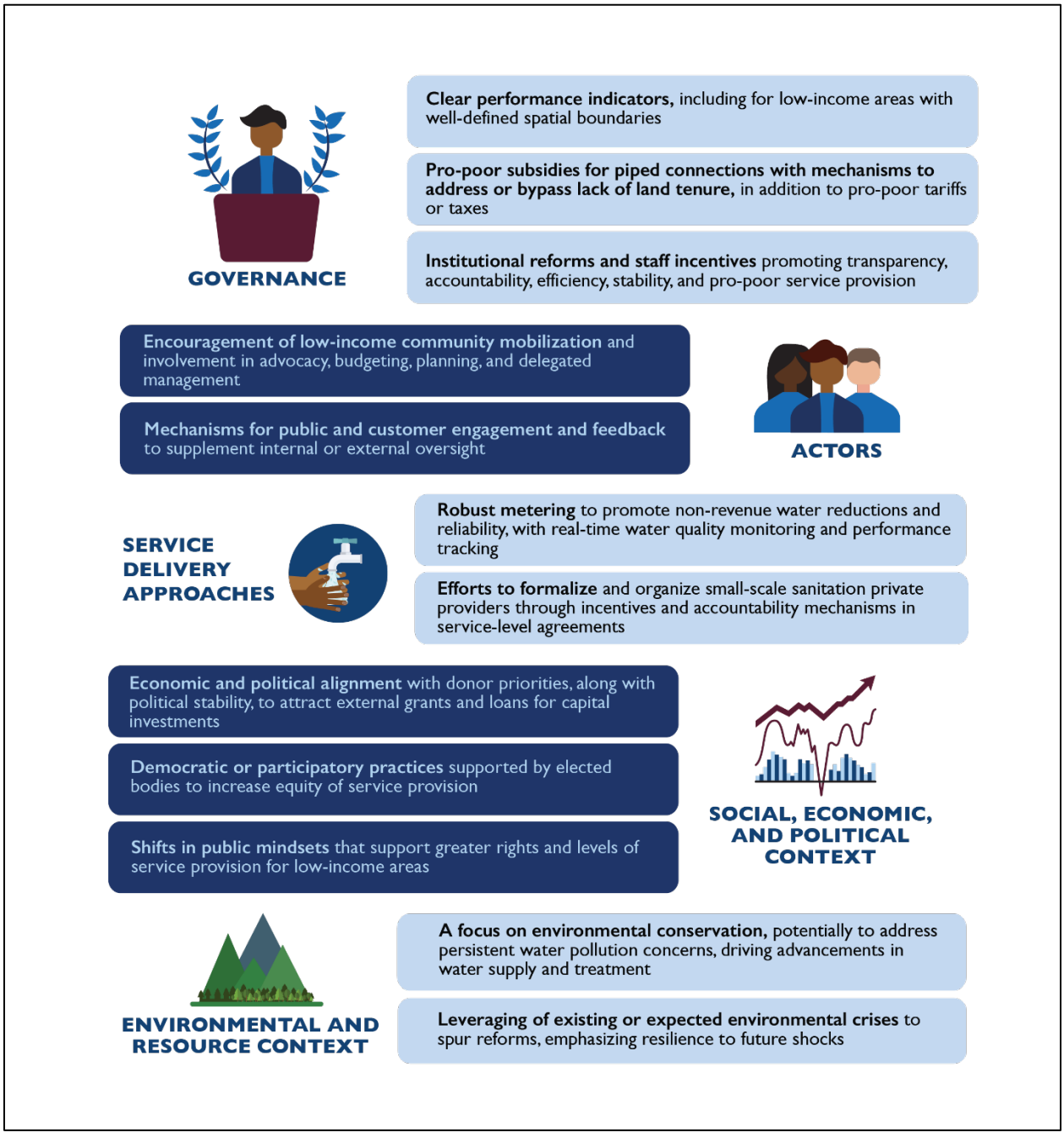
Table 11. Specific guidance for programming when working with utilities, municipalities (i.e., local governments), and regulators as entry points into promoting an effective enabling environment for inclusive water and sanitation

Entry point for programming focused on:	Utility	Municipality	Regulator
Service Provision	Encourage champions to institutionalize reforms, policies, and culture that promote sustainability of service delivery and improvements in efficiency	Create clear policy mandates for service provision in LIAs and integrate water and sanitation with other urban services (e.g., roads, drainage) where possible	Develop clear performance indicators with a specific focus on services in LIAs
Oversight	Promote a set of clear KPIs that can be monitored by a body internal to the utility but with some degree of separation from service provision sections	Ensure appropriate oversight by a body with some degree of separation from the service provider, with power to sanction or reward performance	Develop regulatory frameworks that define clear roles and responsibilities, coordinate across actors, and monitor performance
Finances	Prior to gradually raising user fees (or tariffs) to improve financial sustainability, build credibility through public engagement campaigns and noticeable improvements in performance	Encourage strong financial management systems to access credit for infrastructure investments and effective collection of taxes that can support affordable services	Explore cross-subsidization mechanisms (e.g., tariff surcharges for higher-income residents) to fund service provision improvements in LIAs

The analysis identified 12 cross-cutting factors characterizing the enabling environment for inclusive urban water and sanitation services (Figure 5). While not all these factors can be easily influenced by external interventions (particularly those relating to the social, economic, political, or environmental context), factors relating to governance, actors, and service delivery offer more practical entry points to promote favorable enabling environments. For example, the following approaches may be effective across a variety of contexts to improve equitable water and sanitation service provision:

- Pro-poor measures to promote access to piped connections, such as connection subsidies and removal of land tenure requirements.
- Regulatory frameworks that explicitly cover fecal sludge management and include performance indicators about service delivery in low-income areas.
- Incentives for the people at the heart of service delivery, such as benefits and performance rewards for utility staff or incentives for small-scale service providers (e.g., FSM operators) to formalize and improve their services.
- Participation of low-income residents in budgeting, planning, or management of services (e.g., through delegated management models) and mechanisms for customer feedback.
- Increased reliable metering to improve bill collection, reduce NRW, and improve overall performance.

Figure 5. General characteristics synthesized from the historical and pioneering cases



Overall, the findings from this report align with and contribute to the existing literature, highlighting in particular that **a variety of approaches effectively deliver, monitor, and improve inclusive water and sanitation services in different contexts. Policy or regulatory frameworks that allow for a diversity of service delivery approaches can improve services, particularly amongst the urban poor living in LIAs.** In addition, the general characteristics (Figure 5) show that **numerous factors beyond policies, regulations, and institutional frameworks influence outcomes.** Determining factors for success include community engagement, political perspectives, and environmental challenges. The relative importance of these factors varied from case to case, but they provided a general blueprint strategy, particularly from a historical perspective.

Characteristics from the historical analysis of water sector improvements did not fully capture best practices associated with the cases pioneering innovative sanitation frameworks. The distinct focus of each set of cases—water services among historical cases and sanitation among pioneering cases—likely contributed to this result, especially given the prevalence of non-sewered sanitation approaches in the pioneering cases. One would reasonably expect the details of specific strategies, frameworks, and arrangements to differ across water and sanitation cases. New elements that played important roles in sanitation cases reflected the complexity inherent to onsite sanitation and fecal sludge management. The diversity of actors involved and approaches available often necessitated dedicated institutional and regulatory frameworks. Additionally, experimentation to identify locally appropriate technologies and financing options is critical in this context as stakeholders work toward achieving goals of universal access to safe water and sanitation. Interestingly, many of the underlying philosophies at work in the water cases, such as clearly defined responsibilities and participatory practices, were consistent with those observed in the sanitation cases.

The following section provides details on possible future research activities, some of which directly relate to current ongoing research under the USAID Urban Resilience by Building and Applying New Evidence in WASH (URBAN WASH) project, that could help to further clarify the state of knowledge.

5.2 RECOMMENDATIONS FOR FUTURE RESEARCH

This study's literature review focused predominantly on references directly concerned with urban water and sanitation provision. It included rich perspectives and discussions on broader topics concerning public administration, public policy, political economy, and other issues that encompass aspects of the enabling environment for water and sanitation, which this study only touched on briefly (Andrews, Pritchett, and Woolcock 2013; Brinkerhoff and Wetterberg 2013; Pritchett, Woolcock, and Andrews 2013). Further study of these topics would likely offer additional lessons for the water and sanitation sector.

Additional possibilities for future research (below) were informed by specific features or gaps highlighted in the cases. The team identified one priority research question within each category of the modified SES framework. Several correspond to work areas being pursued under URBAN WASH, such as research into the impacts of subsidies for piped connection subsidies for low-income households, improving water safety among small-scale suppliers, and integrating subsidies and sanitation benchmarking into city-wide approaches to monitor and improve FSM services.

Governance: *What approaches to support piped connections, and to remove associated land tenure requirements, can effectively increase access across various governance contexts?* Abidjan provided an example of connection subsidies increasing access to piped water services. Studying connection subsidy programs in other contexts would help to better understand their impacts on equitable service provision and barriers to broader implementation. Meanwhile, in Ahmedabad and Cairo, low-income households with unclear land tenure status have been able to acquire water and electricity connections. The electricity sector led the water sector in this respect, as electricity bills were one method through which these households could provide proof of residence when applying for water connections (Khalil 2019; Urban Management Centre 2011). The team did not find specific information regarding what measures made these electricity connections possible; thus, studying approaches used by the electricity sector in these or other contexts may offer lessons for the water sector.

For example, electrification of the Kibera settlement within Nairobi, Kenya required the electrical utility to adapt to residents' practices and affordability levels, acknowledge city dwellers' rights to service, and collaborate with former members of electricity "cartels," despite remaining inequalities and broader

issues of tenure (de Bercegol and Monstadt 2018; Singh et al. 2015). More broadly, identifying effective strategies to eliminate land tenure requirements for water connections across various governance and service provision arrangements would critically improve access among low-income households.

Actors: *What institutional arrangements and incentives can effectively integrate small-scale suppliers into service provision frameworks (e.g., through organization and formalization) and ensure they provide safe services to low-income residents?* The case studies reinforced findings from the literature that small-scale suppliers often fill gaps left by piped water and sanitation networks, particularly in LIAs. However, apart from the FSM cooperatives in Faridpur, few examples successfully incorporated informal service providers into broader institutional frameworks. Challenges from Abidjan in particular suggest a need to better understand what types of institutional arrangements and incentives most effectively encourage small-scale providers to organize and deliver levels of service as prescribed by policies and regulations. Other URBAN WASH research identified strategies for cities to expand services by leveraging small-scale suppliers, but evidence gaps remain regarding how these partnerships can be achieved and their impacts on equitable service provision.

Service delivery approaches: *What are effective strategies for operationalizing newly developed FSM regulatory frameworks and monitoring progress toward increasing access to safely managed sanitation?* Most of the pioneering case studies demonstrated the importance of developing national or local regulatory frameworks for FSM to drive future progress in sanitation. Since the regulatory frameworks are still relatively new in many contexts, their operationalization and resulting impacts remain to be seen and deserve to be studied in the future. In particular, key areas of study include how these regulatory frameworks link to pro-poor support mechanisms, financially sustainable strategies for scale-up of FSM services, and effective systems for benchmarking and monitoring of progress.

Social, economic, and political context: *How can cities most effectively access and utilize domestic public resources to increase financing options for local infrastructure investments and service delivery?* Ahmedabad offered a unique example among the cases of a city cultivating a municipal bond market in order to access financing for diverse infrastructure investments. In both Ahmedabad and San Fernando, portions of property taxes were used to pay for water and sanitation services. While municipal bond markets and tax revenues commonly support infrastructure development and pro-poor access in higher-income countries, more can be done to elucidate feasible strategies for their implementation in lower-income settings. Identifying additional cases where a municipal bond market has been successfully developed, or where tax revenues (e.g., from property taxes) finance or subsidize services, could provide insights into multifaceted strategies for financially sustainable water and sanitation services. Less successful cases could offer insight into the reasons why municipal bonds have not been employed, or how ineffective tax collection and use processes may limit benefits or regress tax burdens.

Environmental and resource context: *What policy measures or institutional arrangements can encourage integrated planning to combat pollution and effectively serve low-income areas, while mitigating the adverse effects of unplanned urban expansion?* Many case studies highlighted challenges with water quality, often linked to poor sanitation practices or the prevalence of industrial and agricultural contaminants. Additionally, the impact and challenge of unplanned urban expansion on water and sanitation services are plainly clear across all contexts. Still, the focus on water and sanitation literature did not reveal much evidence on policies to mitigate unplanned urban expansion, perhaps because the WASH sector is siloed from the land use planning sector. Further research is required to understand policies or institutional arrangements that could strengthen linkages between the water, sanitation, and land use planning sectors. For example, source water protection and diversification policies and initiatives, potentially combined with improvements in fecal sludge management services, can protect the quality of

drinking water sources needed to help address the challenges and service demands associated with urban expansion.

Finally, while the case analysis offered a step forward in identifying elements that may contribute to progress in inclusive water and sanitation provision, it did not directly test whether the identified characteristics were necessary or sufficient for promoting success. The focus on learning from examples limited opportunities to identify direct counterfactuals characterized by low performance. Drawing from lessons and experiences in existing literature helped to contextualize and support the characteristics identified. Future work could focus on testing the specific impacts of each characteristic. One approach to evaluating the importance and relationships of these characteristics could involve the application of fsQCA (Tribbe et al. 2021), which would require a larger number of both successful and unsuccessful cases.

APPENDIX A. DETAILED METHODOLOGY ON LITERATURE REVIEW AND CASE STUDY SELECTION

LITERATURE REVIEW APPROACH

The primary goal of the literature review was to survey the existing body of knowledge regarding what constitutes an effective enabling environment for improving urban water and sanitation services. The team identified existing reviews, case studies, policy analyses, and other available publications through literature searches focused on urban water and sanitation in low- and middle-income countries. The team used search terms such as "citywide sanitation," "citywide inclusive sanitation," "urban sanitation," "fecal sludge management," "sanitation policy," "water policy," "urban water," "urban drinking water quality," and similar phrases, while also identifying additional relevant resources referenced in key papers. In addition, the team also included specific resources that were recommended by the experts interviewed as part of the case identification process (see Section 2.3.1). Notably, the literature review went beyond water quality policies alone to consider broader performance in the water sector, as inclusive access to good quality water is as much about improving service coverage, reducing intermittencies, and strengthening financial sustainability as it is about water safety management.

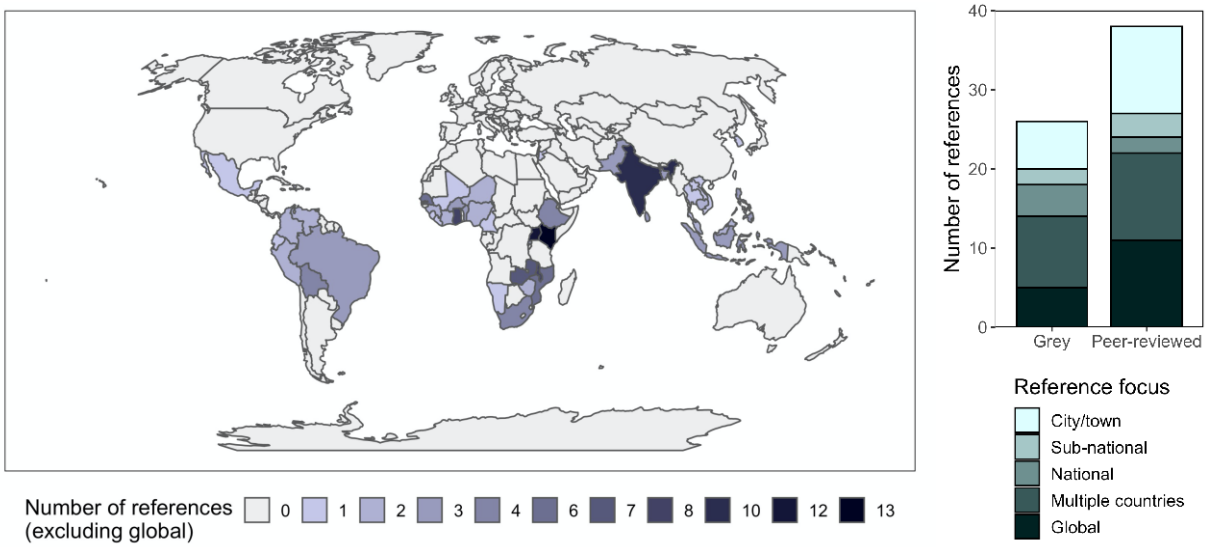
In total, the team reviewed 64 references on topics related to the enabling environment for urban water and sanitation services. Generally, the team focused on materials that have been published within the past 5–10 years, aiming to develop a picture of the current body of knowledge. Approximately 60 percent of the reviewed references were published after 2017, and over 80 percent were published after 2012. These resources included both peer-reviewed and grey literature, and they represented a variety of geographies and levels of focus (Figure 6). Beyond nine references with a general or global outlook, the reviewed resources concentrated on 43 countries in South and Southeastern Asia, Central and South America, and sub-Saharan Africa. In particular, Kenya appeared in the largest number of studies (13), followed by Uganda (12) and India (10). Five other countries were each discussed in at least five of the references (Ghana, Mozambique, Malawi, Senegal, Zambia). Numerous resources (20) included case studies or analyses across multiple countries, while several others (17) concentrated on a single city, such as Kampala, Uganda (Lawhon, Nsangi Nakyagaba, and Karpouzoglou 2022; Jennifer R. McConville et al. 2019; J. R. McConville et al. 2022), or Abidjan, Côte d'Ivoire (Obrist et al. 2006).

While reviewing literature, the team categorized factors within the simplified version of the sanitation social-ecological system framework (McGinnis and Ostrom 2014; Ostrom 2009; Trimmer, Miller, et al. 2020). The team differentiated factors into two broad classifications, representing their place within the current state of knowledge:

1. *Widely accepted components*: Factors that have been well defined in the literature, with broad agreement regarding how they contribute to the enabling environment;
2. *Unresolved debates*: Factors whose contributions to strengthening the enabling environment are uncertain or unresolved in the literature, at least with respect to certain contexts.

These lists of factors provided us with a starting place regarding what elements to focus on within the comparative case study analyses. However, as is described below, the team also allowed additional considerations to emerge organically from the cases.

Figure 6. Geographic representation, focus level, and type of the 64 references included in the literature review



METHODOLOGY FOR COMPARATIVE CASE STUDY ANALYSES

The team conducted two comparative case study analyses, one on historically successful cities and one on cities pioneering new approaches, to study the arrangements and mechanisms that can promote improvements in water and sanitation service delivery. Below are details on how each set of cases was selected. The text then describes the process for analyzing the selected cases.

CASE STUDY IDENTIFICATION, ELIGIBILITY, AND SELECTION

The overall process used to select cases involved three steps: (i) shortlisting, (ii) eligibility screening, and (iii) final selection. The procedures used for selecting historical and pioneering cases were similar but also included some important differences (Figures 7–8), described in detail below.

Eligibility screening of historical cases. Shortlisted cities were not eligible if: (i) they were relatively low performers with respect to access to piped water on premises and basic sanitation, or (ii) their water, sanitation, and hygiene (WASH) expansion took place at a time of relatively high national income (Supplementary Document 3).

To assess the first condition, the team reviewed the World Health Organization (WHO)/UNICEF Joint Monitoring Programme (JMP) (WHO/UNICEF 2022) data for the subnational regions in which candidate cities were located.[5] The team extracted data from the earliest and latest available JMP datasets for the following indicators:[6]

---

[5] Subnational regions are the smallest administrative units for which the JMP reports data. In eight cases, the subnational region aligned exactly with our city of interest, and in seven cases, it was larger than our city of interest. Subnational data was not available for the remaining three cities (Kuala Lumpur, Brasilia, Porto Alegre).

[6] Depending on the country, the earliest reported surveys fell between 2000 and 2006, while the latest surveys occurred between 2014 and 2019.

- Access to piped water on premises (a proxy for high-quality drinking water, as piped water tends to have a lower likelihood of microbial contamination than other types of sources) (Kumpel et al. 2016).
- Access to basic sanitation (i.e., access to flush toilets, pit latrines with slabs, or composting toilets that are not shared with other households), as data on safely managed sanitation was unavailable for a number of countries.

Figure 7. Summary of the three-stage process to identify and select historical case study cities

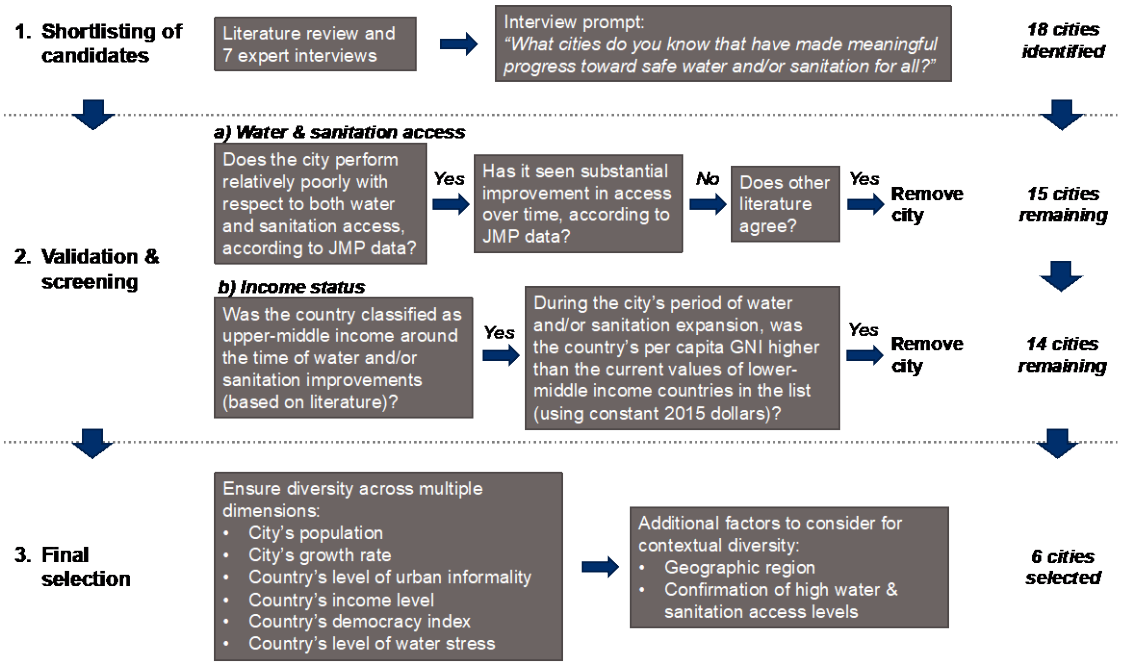
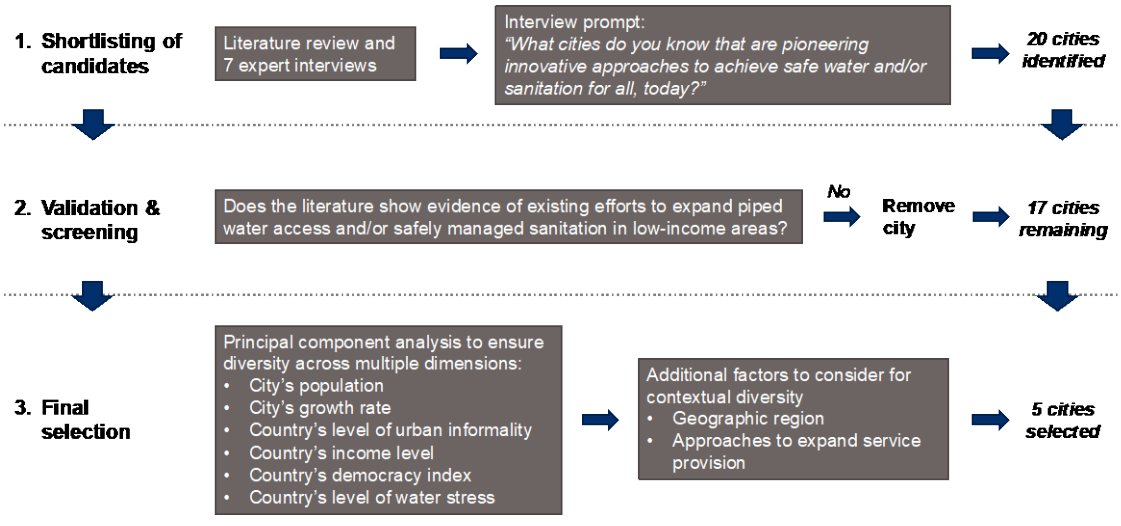


Figure 8. Summary of the three-stage process to identify and select pioneering case study cities[7]



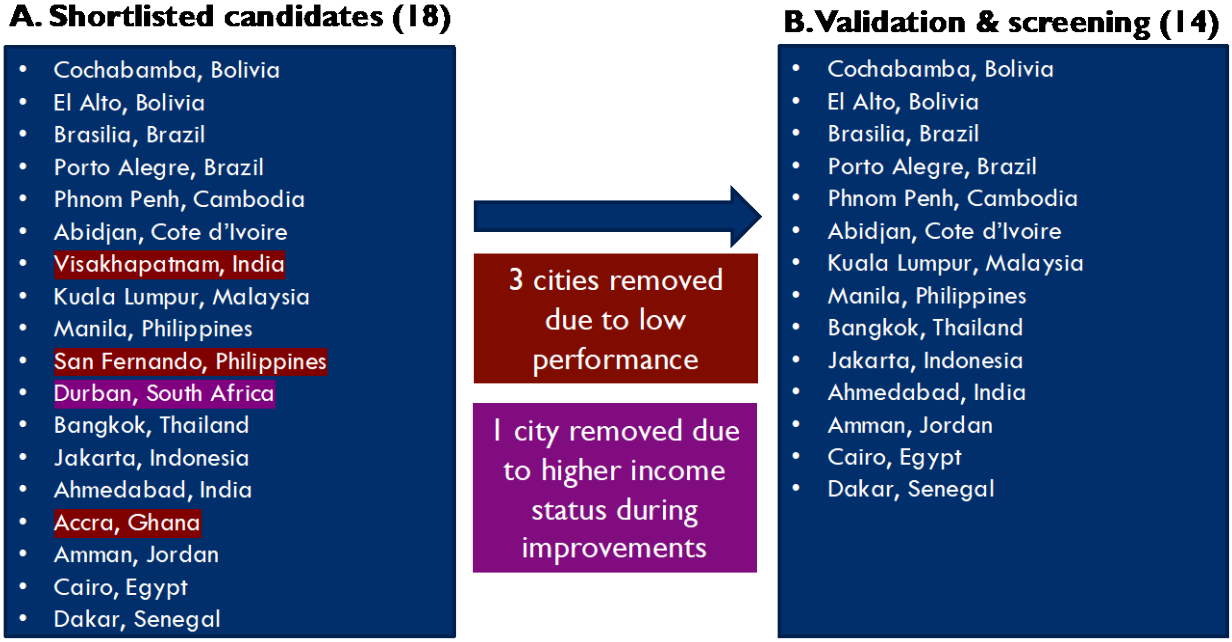
The team defined cities as relatively low performers if they met three criteria: (i) there was less than 65 percent access to piped water on premises and less than 60 percent access to basic sanitation in their

[7] The shortlist of 20 candidates also included three cities that had been removed from the historical group.

sub-national region[8]; (ii) these indicators progressed by less than one percentage point per year over the past 9–19 years (the exact time frame is dependent on each country's survey dates); and (iii) other (non-JMP) literature agreed with the trends observed in the JMP data (Supplementary Document 3). The team excluded three candidate cities according to this first condition (Visakhapatnam, San Fernando, and Accra; Figure 9). However, as each of these cities has been engaged in efforts to improve service provision in low-income areas, they were reassigned to the list of pioneering candidates.

To assess the second condition, the team reviewed countries' World Bank income classification and gross national income (GNI, reported in constant 2015 dollars) (World Bank 2022), both at present and during the period when candidate cities improved water and sanitation access. The team excluded cities whose country (i) was classified as upper-middle income both presently and around the time of WASH improvements and (ii) had, at the time of WASH improvements, a GNI higher than present low- and lower-middle income countries. This second condition led the team to exclude Durban (Figure 9).

Figure 9. List of candidate cities for the historical case study analysis, developed through expert interviews and literature review (left), and after eligibility screening (right)[9]



Eligibility screening of pioneering cases. Among pioneering candidates, the team only retained cities with evidence in the literature of efforts to scale up access to piped water or safe sanitation in low-income areas (Supplementary Document 3). This literature verification step helped ensure that the analysis only included cities whose efforts have likely been occurring for at least one to two years, with more opportunities for learnings about impacts or challenges. As a result of this process, three of the pioneering candidates were removed from the list (Khulna, Chennai, and Warangal; Figure 10).

---

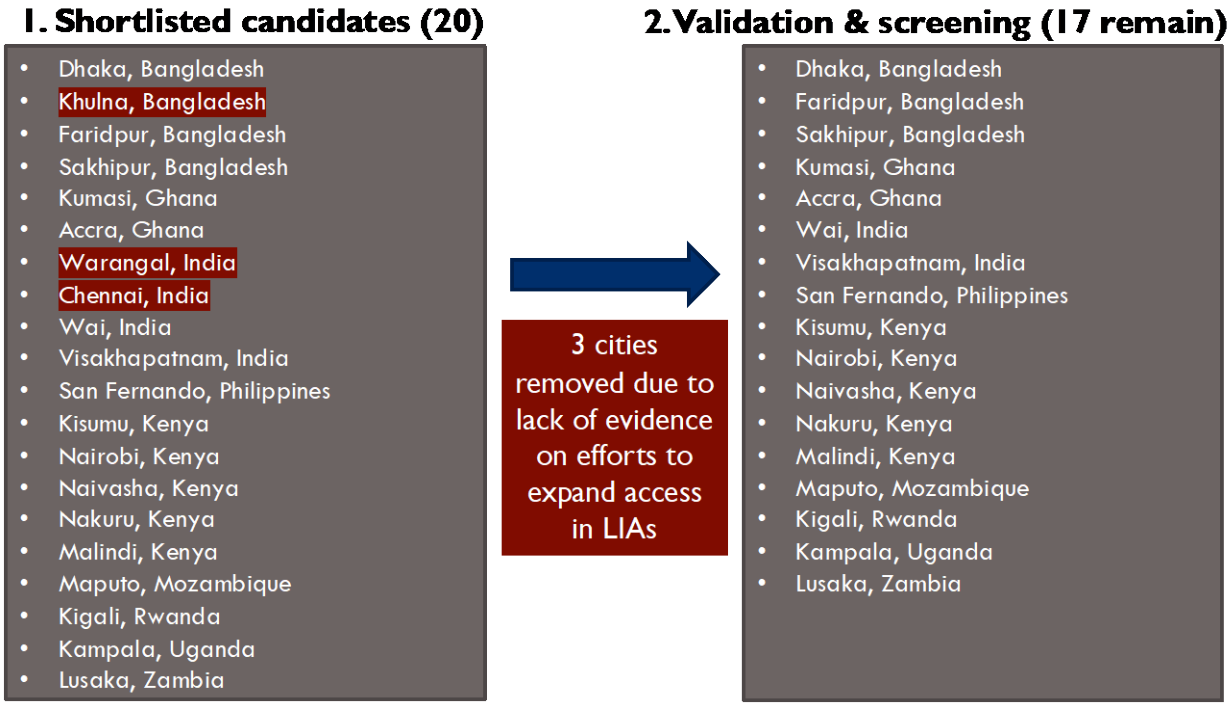
8 The team defined these thresholds based on averages across JMP surveys and data clustering.

9 During the validation and screening step, the team removed three cities because they performed relatively poorly with respect to water and sanitation access metrics. These three cities were reassigned to be candidates for the pioneering case study analysis, based on information gathered from a literature review. The team remove one additional city due to relatively high national income levels during its period of water and sewer expansion. See Supplementary Document 3 for further detail on screening of historical candidates.

Final selection. The team selected six cities in the historical category and five in the pioneering category with the goal of capturing a diverse range of geographic, economic, political, and environmental contexts. The team employed principal component analysis (PCA) to visualize similarities between cities with respect to their population (United Nations 2018), their average annual growth rate (United Nations 2018), their country's degree of urban informality (UN Habitat 2021), their country's democracy index (The Economist Intelligence Unit 2021), their country's income level (World Bank n.d.), and their country's water stress (UN FAO 2021). PCA identified the two linear combinations of these variables that captured most of the variability across cities, providing a two-dimensional visualization of the distribution (Figures 11–12). Using this visual representation, the team identified clusters of cities with similar characteristics (Figures 11–12). For each cluster, the team selected only one or two cities with attention to geographic regions, WASH access levels, and service provision models.

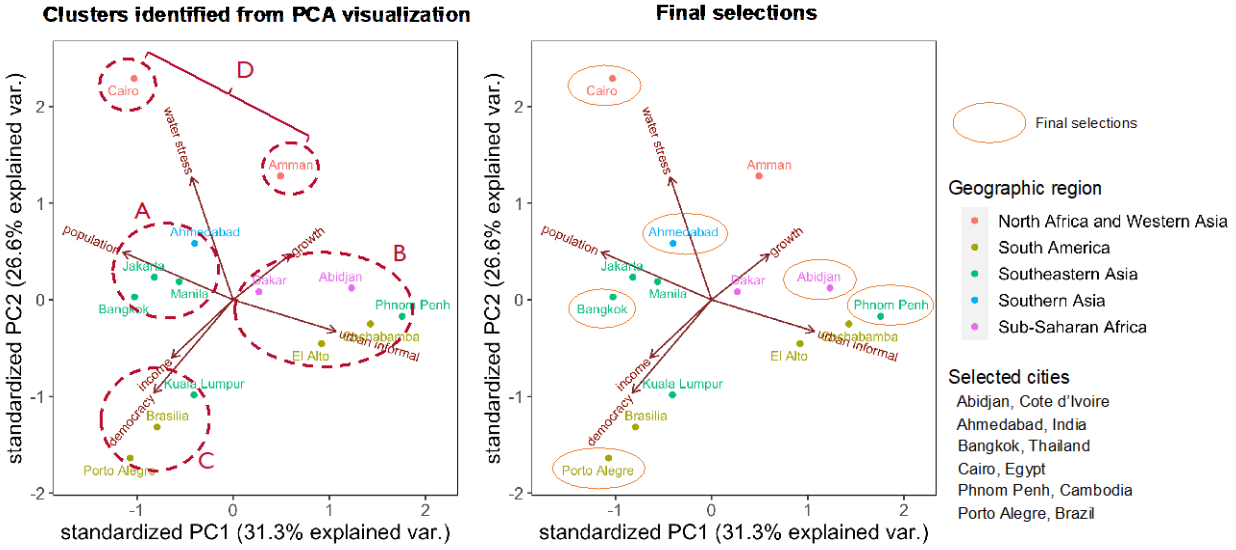
For *historical cases*, the PCA visualization identified four clusters (Figure 11) and selected six historical case studies with varying characteristics (Table 1). From Cluster A (cities with larger populations), the team selected Bangkok because it was the highest performing city in the cluster with respect to water and sanitation. Ahmedabad was also selected, as it was the only remaining historical candidate from South Asia. From Cluster B (cities with higher growth rates and levels of informality), the team selected Phnom Penh because of its higher level of basic sanitation access (87 percent). Abidjan and Dakar were also identified as performing well with regard to water access. As these two were both located in sub-Saharan Africa, Abidjan was selected over Dakar because water prices were reported to be more affordable there (van den Berg and Danilenko 2017). From Cluster C (higher income levels), the team selected Porto Alegre because of its higher levels of water and sanitation access, and because it provided representation from South America. Finally, from Cluster D (higher levels of water stress), the team selected Cairo because of its better performance regarding water access. Overall, these selections resulted in a final set of six historical cases (Figure 11, Table 1, Table 12).

Figure 10. List of candidate cities for the pioneering case study analysis, developed through expert interviews and literature review (left), and after eligibility screening (right)[10]



[10] During the validation and screening step, the team removed three cities due to a lack of literature evidence verifying that they were implementing approaches to improve water or sanitation in low-income areas. See Supplementary Document 3 for further detail on screening of pioneering candidates.

Figure 11. Biplot produced from the PCA on 14 historical case candidates[11]



For *pioneering cases*, the PCA visualization identified five clusters (Figure 12) and selected five pioneering cases (Table 2). Cluster A (high urban informality) only included Maputo, which was retained in the final selection. Lusaka was selected from Cluster B (lower water stress and intermediate informality), because of its efforts operating a delegated management model for water and supporting both sewered and non-sewered sanitation services. The team did not retain Kampala or Kigali because their efforts were similar to the fecal sludge management (FSM) regulations and innovative legal frameworks being implemented in Maputo. From Cluster C (higher population or higher growth), the team selected Nairobi because it had been pioneering container-based sanitation (CBS) services and loans for water and sewer connections, as well as subsidized water kiosks. The other candidates in this cluster were pioneering approaches already captured in previous selections (e.g., CBS in Kumasi and Naivasha, connection subsidies in Accra, public-private partnerships for FSM in Dhaka). Finally, from Cluster D (lower population), the team selected San Fernando and Faridpur. San Fernando was pioneering scheduled desludging and was the only candidate from Southeastern Asia. Faridpur was engaged in formalization of pit emptiers. Again, the remaining cities in this cluster were all engaged in activities similar to those of previous selections. Overall, these selections provided a final set of five pioneering cases (Figure 12, Table 2).

[11] The two axes represent the first two principal components, which captured the majority (58%) of the overall variation across dimensions of population, growth rate, income level, democracy index, water stress, and urban informality. A city's characteristics determine its location within the plot, with higher values of a given dimension pushing it in the direction shown by the corresponding arrow (e.g., cities with larger populations tend to be located toward the upper-left portion of the graph). The left plot identifies clusters of cities sharing similar characteristics, from which the team selected the final set of six cities highlighted in the right panel.

Figure 12. Biplot produced from the PCA on 17 pioneering case candidates[12]

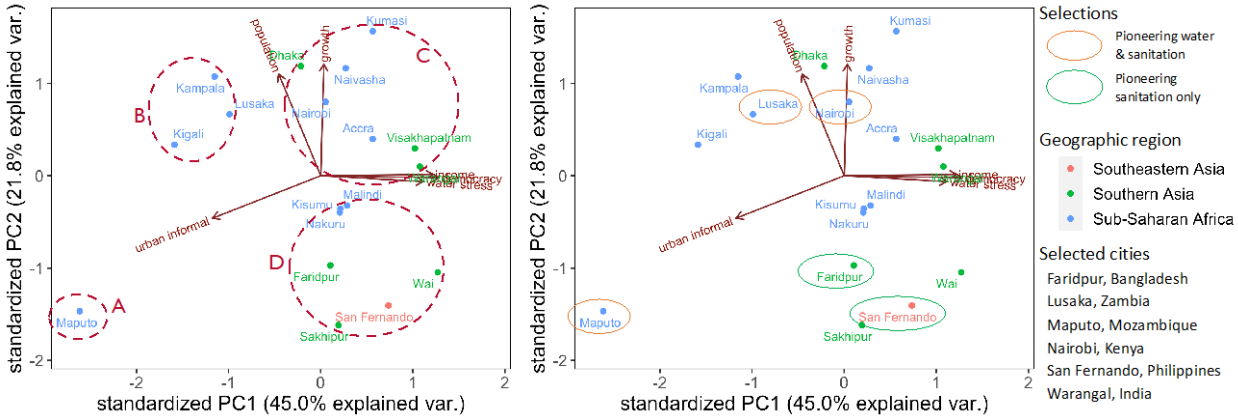


Table 12. Summary of the distribution of candidates throughout the case selection processes

Candidates	Total	Geographic region					National income level		
		Sub-Saharan Africa	Southern Asia	Southeastern Asia	North Africa and Western Asia	South America	Low	Lower-middle	Upper-middle
Historical									
Initial list	18	4	2	6	2	4	0	12	6
Screened list	15	3	1	5	2	4	0	9	6
Final selections	6	1	1	2	1	1	0	4	2
Pioneering									
Initial list	20	11	8	1	0	0	3	17	0
Screened list	17	11	5	1	0	0	3	14	0
Final selections	5	3	1	1	0	0	1	4	0

Table 13. Key informants interviewed when conducting the comparative case study analyses

Relevant Case(s)	Name	Affiliation	Date
Ahmedabad	Meera Mehta	Centre for Environmental Planning and Technology	6/7/22
Phnom Penh, Bangkok, San Fernando	Hubert Jenny	Consultant (Asian Development Bank, World Bank)	5/18/22
Lusaka	Abel Manangi	Assistant Director, Ministry of Water Development and Sanitation	5/31/22
Nairobi	Robert Gakubia	Former Water Services Regulatory Board Chief Executive Officer	6/8/22
San Fernando	Alma Porciuncula	Chief of Party for USAID Safe WASH Project in Philippines; former USAID WASH and Finance Activity Philippines Team Leader	6/8/22
Faridpur	Uttam Kumar Saha	Strategic Lead at Practical Action	6/9/22
Abidjan	Sylvain Usher	African Water Association	6/10/22
Cairo	Ahmad Alkasir	Tetra Tech	6/10/22

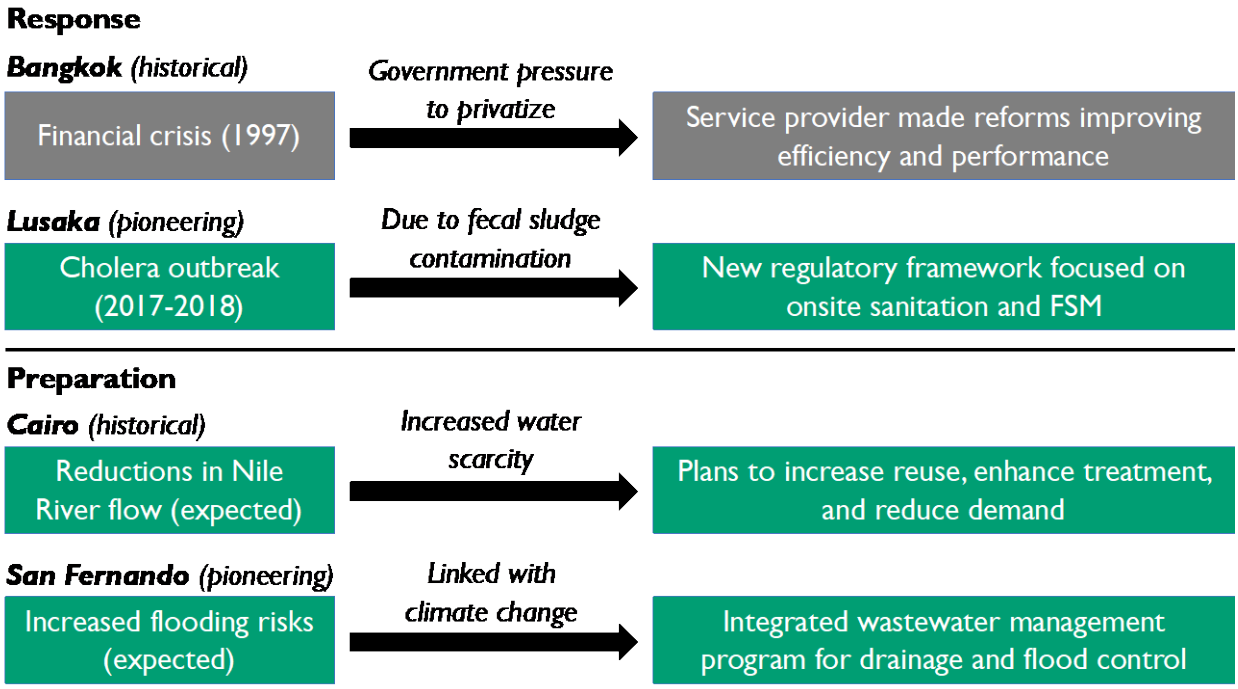
[12] The two axes represent the first two principal components, which captured the majority (66%) of the overall variation across dimensions of population, growth rate, income level, democracy index, water stress, and urban informality. A city's characteristics determine its location within the plot, with higher values of a given dimension pushing it in the direction shown by the corresponding arrow (e.g., higher levels of urban informality tend to appear toward the lower-left portion of the graph). The left plot identifies clusters of cities based on this visualization, from which the team selected the final set of five cities highlighted in the right panel.

Relevant Case(s)	Name	Affiliation	Date
Maputo	Pedro Pimentel	WASH Technical Manager, WaterAid Mozambique	6/13/22
Maputo	Suzana Saranga	President of Water Regulatory Authority Public Institute (the regulator)	6/15/22
Phnom Penh	Sokha Mok	WaterAid Program Manager, WASH Systems Strengthening	6/17/2022
Abidjan	Aw Sadat	Water Distribution Company of Côte d'Ivoire, Director of Water Quality	6/22/2022
Ahmedabad	Bijal Brahmbhatt	Director, Mahila Housing Trust	6/28/2022
Abidjan	Ibrahima Berte	Managing Director National Drinking Water Office	6/29/2022
Porto Alegre	José Viegas TSA	Engineer based in Porto Alegre	7/1/2022
Nairobi	Joanne Kiarie	Sanergy, Government Relations	7/15/2022

APPENDIX B. DETAILED EXAMPLES OF SHOCKS AND RESILIENCE FROM HISTORICAL AND PIONEERING CASES

As seen from some of the historical and pioneering cases, various types of shocks have pushed cities and service providers to take measures to increase resilience to similar events that may occur in the future. This appendix compiles, highlights, and distills some key examples where such responses have occurred, and where other cities have been working to build more resilient systems in preparation for expected events that are likely to occur, without the direct push of a clear shock (Figure 13). These examples can provide insight regarding the factors that drive changes and the types of changes that improve resilience.

Figure 13. Examples of efforts to improve resilience through responses to shocks (top) and preparation for expected future events (bottom)



Responses to Shocks

Financial crisis in Bangkok. In 1997, a national financial crisis in Thailand caused financial institutions to close down, budgets to be cut, bank deposits to be frozen, and investment projects to be halted (McIntosh, 2013). As a result, the national government announced and pushed for the privatization of utilities, in an effort to increase efficiency. Governor Dhamasiri, who was leading the Metropolitan Waterworks Authority (MWA) at the time, worked with other utilities to study privatization in other countries and present findings to the government, with a focus on its negative effects (McIntosh, 2014). Simultaneously, MWA also restructured, putting several institutional reforms in place to improve the utility's efficiency, performance, and customer relations, which helped to garner public support for resisting privatization. In particular, MWA streamlined procedures, gradually instituted performance incentives and accountability mechanisms for staff at all levels; measured performance regularly on a daily and monthly basis; introduced a computer system through which customers could contact MWA

outside of the office via phone, fax, or mail; and initiated a Drinkable Tap Water project where MWA teams went to offices, schools, and households to inspect water quality and pipes and to fix any identified issues (McIntosh, 2014). These reforms improved the utility's financial sustainability, service performance, and customer satisfaction, and the government did not require MWA to privatize in the end (McIntosh, 2014). Afterward, utility leaders and others saw the financial crisis as inducing improvements that have made MWA a celebrated service provider in the region (MWA 2019).

Cholera outbreak in Lusaka. Over the past decades, Lusaka has experienced frequent cholera outbreaks caused by groundwater contamination associated with "drain and bury" pit emptying practices and inadequate drainage (USAID 2010). Beginning in late 2017 and continuing into 2018, a major outbreak resulted in a total of nearly 6,000 registered "suspected cases" of cholera, 92 percent of which were located in Lusaka (Nyambe, Agestika, and Yamauchi 2020). This outbreak concentrated political attention on groundwater protection and sanitation, leading to a national Sanitation Summit in 2018. This has been seen as a key tipping point toward greater visibility, funding, and political will associated with onsite sanitation and fecal sludge management (FSM)—a critical outcome, given the prevalence of these approaches in Lusaka and the contamination caused by unsafe emptying and containment practices (Drabble et al. 2019). Additionally, the outbreak drove a reevaluation of the existing Lusaka Sanitation Programme, which included funding for onsite sanitation and FSM and which had prompted Lusaka Water and Sanitation Company (LWSC) to create a specific unit dedicated to FSM. The reevaluation employed spatial analysis to determine how expansions in sanitation service could most effectively increase resilience and reduce the risks associated with future outbreaks (World Bank 2020). Moving forward, these developments, along with additional drivers including population growth and previously weak coordination, ultimately contributed to the National Water Supply and Sanitation Council's leadership in coordinating and developing the Urban Onsite and FSM Framework for Provision and Regulation (Drabble et al. 2019; WIN 2021). This new regulatory framework clearly mandated LWSC as having responsibility for the entire sanitation chain, including onsite sanitation and FSM, and it also included elements such as standards for onsite facilities, desludging operations, and reuse (WHO 2019). While recent estimates of safely managed sanitation coverage remain relatively low in Lusaka, this regulatory framework is expected to generate improvements as it is put into practice and operationalized over time (Susana n.d.).

In both of these cases, the key driver seemed to involve increased political attention concerning the issue highlighted by the shock, which caused or enabled central actors in the sector to take the initiative and push forward measures that would improve resilience against similar shocks in the future. These patterns align with findings from the literature review regarding the importance of shocks in concentrating efforts and generating progress (McIntosh, 2013; Post & Ray, 2020; WaterAid, 2016c).

Preparation for Ongoing and Future Challenges

Reduction of Nile River flow in Cairo. Egypt's climate is quite arid, with annual rainfall averaging ten millimeters (Attia 1999). Accordingly, the Nile River provides the country's main source of freshwater under an international agreement from 1959 guaranteeing Egypt 55.5 billion cubic meters of annual flow from the river. The country's nearly 100 million inhabitants occupy only 7.7 percent of the available land, concentrated around the Nile Delta (UNICEF n.d.). In Cairo, which is downstream from over 40 cities and towns in Egypt and other countries, 90 percent of the water supply comes directly from the river, while the city's high demand for water has continued to increase (Edo, Sadayeva, and Hassan 2020). Cairo's population is projected to double by 2050, and the current urban population uses approximately 330 liters per person per day—one of the highest rates in the world. Additionally, Cairo's heat island effect and lack of green space increase evaporation and reduces absorption, diminishing the potential for groundwater recharge (Edo, Sadayeva, and Hassan 2020). However, the Grand Ethiopian Renaissance

Dam project is expected to reduce the Nile's annual flow into Egypt by 25 percent in the future, increasing concerns related to water security (Edo, Sadayeva, and Hassan 2020). As a result of these drivers, Egypt has developed plans and strategies aimed at strengthening water resilience and sustainability, in particular, the country's National Vision 2030, which focuses on the national economy and sustainable development, and the National Water Resources Plan 2037, which focuses specifically on improving water security, especially with regard to agriculture (Edo, Sadayeva, and Hassan 2020; EWRA 2018). Within these strategic documents, the national government includes plans and programs related to advancing water purification technology, enhancing water quality control, developing new water supplies, and better managing water demands. Additionally, there are specific provisions for enhancing wastewater treatment to increase reuse in the Greater Cairo Region, where treated wastewater is currently used to cultivate timber and industrial non-food crops (Edo, Sadayeva, and Hassan 2020; EWRA 2018). In sum, these planned measures are designed to increase water resilience in the face of the expected reduction in the country's available supply.

Flooding resilience in San Fernando. The local climate in San Fernando involves wet and dry seasons with substantial swings in water-related challenges. During the dry season, water scarcity is a frequent concern, while the wet season brings typhoons and flooding for approximately 35 percent of the city's population, often exposing people in low-lying areas to health risks (CDIA 2021; WaterAid 2016b). Climate change is expected to increase the frequency and severity of rainfall, intensifying these existing flooding issues, with sea level rise and groundwater salinization as additional concerns (CDIA 2021; WaterAid 2016b). In view of these challenges, San Fernando worked with the Cities Development Initiative for Asia to develop a Green and Integrated Wastewater Management program, aimed at providing appropriate options for improving drainage and sanitation infrastructure, water quality, and the city's institutional capacity to address these issues. The final report, published in 2016, presented a 20-year road map for managing wastewater, drainage, and flood control. For example, seven projects were prioritized for wastewater management. Four of these have been implemented so far: rehabilitation of decentralized wastewater treatment plants and sewerage systems, refurbishment of the centralized septage treatment plant, sealing of "bottomless" septic tanks, and preparation of a Wastewater, Drainage, and Green Development Master Plan with geographic information system data to provide a basis for future plans and programs (CDIA 2021). Also under this program, eleven drainage and flood control projects have been prioritized, with regional departments allocating over 5 million USD for their implementation (CDIA 2021). Additionally, this program has reportedly increased coordination across key city offices, and the City Environment and Natural Resources Office continues to pursue funding for additional measures through the National Sewerage and Septage Management Program (CDIA 2021). Generally, the Green and Integrated Wastewater Management program has highlighted the value of taking a climate resilience approach in selecting and prioritizing projects and infrastructure for investment.

Generally, while a specific shock did not occur to spur progress in these two cases, the existence of clear and relatively well-defined threats, coupled with the experience of having lived through climate-related challenges, seems to have helped focus attention on issues of water security, flood control, and climate resilience. The political nature and nationwide importance of Egypt's reliance on Nile River flows originating in and passing through other countries required national-scale strategic thinking on measures that would increase water supply resilience, for example through demand management, water source diversification, and reuse. In San Fernando, the proactive city government has been taking steps at a local level to plan for increased resilience in the face of rising flood risks due to climate change, while also aiming to leverage available funding and capacity at regional and national levels to support larger-scale investments. In both cases, it seems that **a relatively high level of understanding regarding the existence and potential impacts of future threats played a role in motivating long-term,**

strategic planning at the local or national level designed to increase resilience against those threats.

Across these examples from the historical and pioneering cases, the following characteristics appear to act as key drivers contributing to improvements in resilience, whether in response to a shock or—perhaps most preferably—in preparation for expected future threats:

- A reasonable level of **knowledge regarding how a threat impacts local or national economies and populations.** Spatial and temporal modeling and risk analyses can help to define these impacts and begin to suggest measures to address them.
- **Political attention,** perhaps augmented through the findings of risk analyses, that either directly leads to **strategies, visions, and frameworks** geared toward addressing the issue and improving resilience or creates conditions in which non-political actors such as service providers and regulatory agencies have the **capacity to coordinate and implement internal or sector-wide reforms.**
- **Long-term strategic thinking** that considers the full effects of threats and integrates realistic expectations regarding future service delivery patterns (e.g., continued use of onsite sanitation and need for FSM), while recognizing any existing conditions that may impact the feasibility of localized response strategies and resilience measures (e.g., local attitudes regarding wastewater treatment and reuse as a mechanism for augmenting available water supplies).

APPENDIX C. DETAILED EXAMPLES OF GESI ADVANCEMENTS FROM PIONEERING CASES

Generally, the evidence available from the case studies on gender equality and social inclusion (GESI) was relatively limited, particularly regarding the historical cases—except for Ahmedabad, where women's inclusion in the elected regulatory body as well as the community slum upgrading associations was mandated and integral to the process and outcomes. In the pioneering cases, the team found a few examples of formal policies and efforts to advance GESI considerations related to urban water and sanitation. This appendix distills these examples to offer insight on the approaches currently being taken in these contexts.

GESI-focused policies and strategies in Lusaka. In 2014, Zambia established two key policies focused on GESI considerations across sectors: the National Gender Policy and the National Social Protection Policy. Both of these policies named sanitation as a basic service, to which all have a right, and they focused on sanitation access among vulnerable groups and underserved communities. In particular, they included specific protections for people with disabilities, as well as measures to ensure that women could actively participate in water and sanitation decisions (WHO 2019). Similarly, a national-level strategic document focused on sanitation provision—the 2015 National Urban and Peri-Urban Sanitation Strategy—included language about considering the needs of "women, children, and the physically challenged" through flexible standards for sanitation facilities and technologies. It also aimed to incentivize service delivery in low-income areas through the use of performance-based grants (WHO 2019). At the local level, the water and sanitation utility (Lusaka Water and Sanitation Company [LWSC]) incorporated a Gender Policy, guided by the National Gender Policy, into its 2014–2018 Strategic Business Plan. LWSC also appointed a Gender Focal Point, sitting within the utility's Monitoring and Evaluation Department, to coordinate gender-related activities and mainstreaming. Finally, the utility used its Gender Policy as a foundation for developing a Gender Strategy, which contained detailed activities, costs, and indicators for monitoring (African Development Bank 2015). As of National Water Supply and Sanitation Council's 2021 annual report, 14 percent of LWSC staff were reported to be women, and they were more commonly found in supervisory and managerial roles, as opposed to other types of roles, across LWSC and other commercial utilities in the country. The National Gender Policy calls for a minimum 30 percent representation of women, drawing attention to the fact that the utility has considerable room for progress (NWASCO 2021). However, this example shows that national-level policies and strategies, as well as monitoring of specific GESI-related indicators by the national regulator, have helped push the utility to make efforts toward increasing representation and establishing a focus on gender across its activities.

Improving conditions for sanitation workers in Faridpur. Bangladesh declared manual emptying illegal in the 1980s, but the practice has continued due to a lack of available alternatives, high demand for emptying services, and need for employment opportunities (Zaqout 2018). Sanitation workers in Faridpur often belong to the lowest castes in society and face substantial health risks due to unhygienic conditions and a lack of protective equipment (WSSCC and FANSA 2016; Zaqout 2018). They have also faced discrimination, not being allowed to enter most households and not having access to public facilities where they could wash after work. Payments for informal pit emptying were low across the board, but women sanitation workers were reported to receive less than half of what men earn per job (WSSCC and FANSA 2016). More recently, the increased focus of the municipality on the full sanitation value chain, the formal organization of previously informal workers into cooperatives, and mechanized emptying have led to reduced risks and increased revenues for sanitation workers (Dalberg Global Development Advisors 2017; WSSCC and FANSA 2016). In particular, the public-private partnership

(PPP) models that have been established have increased trust between the members of the emptier cooperatives and the municipality (Saha 2022). The nongovernmental organization (NGO) Practical Action played an important role in helping to drive these developments, prioritizing the well-being of sanitation workers as local and national government actors worked to establish large-scale regulatory frameworks and effective service provision models for fecal sludge management. Notably, however, a number of challenges still remain as priorities to work toward addressing in the future. For example, the existing PPP does not explicitly ensure that emptiers' rights to receive pensions and health insurance are protected, and there are concerns regarding the financial sustainability and independence of the cooperatives, as they continue to receive external support (Saha 2022; Zaqout et al. 2021). Finally, continued discrimination remains an issue, as the cooperative containing a majority of members from a lower caste has lagged behind the other cooperative. Based on observations, researchers have suggested this disparity is related to the cooperatives' differing initial levels of organization and capacity, as well as the biases of clients and municipal officials (Zaqout et al. 2021).

It is difficult to derive key characteristics based on such a small sample size—two examples from the pioneering cases. However, the following elements seemed to have played an important role in creating the potential for progress related to GESI issues in these contexts, and they may be worthy of consideration more broadly:

- Specific **national or local policies and strategies** at least partially focused on explicit GESI issues such as **increased representation** in decision-making processes and among institutional staff, as well as services that consider the **needs and rights of vulnerable groups and underserved populations.**
- **Space for organizations or individuals who champion GESI considerations**; in Faridpur, the NGO Practical Action filled this role, while in Lusaka, the utility has appointed a Gender Focal Point, whose activities are dedicated to mainstreaming these considerations within the institutional culture.

APPENDIX D. SYNTHESIS OF FINDINGS FROM THE LITERATURE REVIEW AND CASE STUDY ANALYSES

As the team reviewed literature, identified factors were categorized into two broad classifications: widely accepted components and unresolved debates. The following tables summarize and highlight how the comparative case study analyses compared to the literature review. Table 14 focuses on widely accepted components that were reinforced, refined, or, in a few cases, not sufficiently discussed by the case literature. Table 15 focuses on how the comparative analyses address knowledge gaps from unresolved literature debates. Many of these findings correspond to the recommendations for future research, which are summarized in Section 5.

Table 14. How the comparative analysis reinforced, refined, or did not address widely accepted components from the literature

Widely accepted component from literature	Insights from historical and pioneering case study analyses	Relevant cases
Governance		
Clear policies, regulations, and accountability mechanisms with room for flexibility	**Clarity** is particularly important regarding: i) **mandates** between different actors and ii) **key performance indicators**.	Abidjan, Ahmedabad, Bangkok, Cairo, Phnom Penh, Porto Alegre, Lusaka, Nairobi
Integration of data into decision-making	**Real-time water quality monitoring** via remote sensors can amplify progress by enabling utilities to rapidly respond to issues, identify problem areas of networks, and increase efficiency in systems already performing well. **Geographic information system mapping** can provide useful information on existing networks for future planning.	Ahmedabad, Abidjan, Bangkok, Phnom Penh
Explicit focus on equity, services, and support for the poor	For water, **connection subsidies** have been critical in improving access among low-income residents. For sanitation, improvements in **fecal sludge management (FSM)** are intrinsically pro-poor because most LIA residents use onsite sanitation. **Performance indicators** and **utility departments explicitly focused on low-income areas (LIAs)** can help to drive improvements.	Connection subsidies: Ahmedabad, Abidjan, Phnom Penh Focus on FSM: Faridpur, Lusaka, Maputo, Nairobi, San Fernando LIA-focused utility departments: Nairobi
Actors		
High levels of community participation and mobilization in LIAs	**Civil society and community groups** play an important role in advocating for and delivering services in LIAs, through organizing delegated management models, political lobbying, and participation in planning and budgeting.	Abidjan, Ahmedabad, Bangkok, Porto Alegre Faridpur, Lusaka, Nairobi
Fair landlord/tenant relationships in LIAs	These are not investigated in much of the case literature, although there is one example of conflicts arising due to differing expectations regarding what landlords should provide and what tenants should be willing to pay for.	Lusaka
Clear coordination and incentives for institutional and political actors	Staff incentives and workforce development strategies can improve transparency, efficiency, and customer relations.	Abidjan, Bangkok, Phnom Penh, Porto Alegre
Service delivery approaches		

Widely accepted component from literature	Insights from historical and pioneering case study analyses	Relevant cases
Integrated water and sanitation planning	Pollution from inadequate sanitation containment, emptying, and/or treatment commonly contaminates water supplies, especially during wet seasons and flood events.	Ahmedabad, Bangkok, Porto Alegre Nairobi, Lusaka, Maputo, San Fernando
Water: focus on addressing non-revenue water (NRW) and intermittent supplies	**Increased metering** and aggressive efforts to **improve bill collection** and **reduce illegal connections**, especially when coupled with institutional reforms to increase the utility's efficiency and transparency, can help to reduce NRW and improve overall performance.	Phnom Penh, Bangkok
Sanitation: focus on regulations for FSM	Developing new **regulatory frameworks for FSM** has been critical to address institutional gaps related to onsite sanitation.	National regulation: Faridpur, Lusaka, Maputo, Nairobi Local regulation: San Fernando
Social, economic, and political context		
Regularization of LIAs and land tenure status	Replacing **land tenure requirements** with requirements for **proof of residency** can at least partially lower barriers for low-income residents to access piped services.	Ahmedabad, Cairo
Supportive political and educational environments	**Political alignment with donor priorities and a sufficient level of stability** are often critical for attracting external funding. Governments can support proactive utilities by providing **autonomy** and explicitly **supporting reforms and user fees (or tariff) adjustments.** Elected bodies can support citizens by institutionalizing **strong participatory elements** that improve equity in service provision. **Greater alignment of educational programs** with local practices can develop leaders and professionals open to inclusive strategies that reach all parts of the city with suitable technologies.	Donor Alignment: Abidjan, Cairo Autonomy and Tariff Reforms: Phnom Penh, Bangkok Participatory Elements: Ahmedabad, Porto Alegre, Faridpur Educational alignment: Bangkok, Phnom Penh
Environmental and resource context		
Policies to manage unplanned LIA expansion, especially when complicated by challenging topography, water tables, or pollution pressures	**Expansion of city boundaries** to ensure that surrounding LIAs are included can help to provide a **clear mandate** for the service provider.	Ahmedabad
Effective formulation and implementation of plans for climate change mitigation and adaptation to build resilience	**Responses to shocks or concerns over future crises** have motivated efforts to increase resilience, flood control, water treatment, water security, and safe sanitation; a focus on **environmental conservation**, perhaps linked with local tourism, can also contribute.	Bangkok, Cairo, San Fernando

Table 15. How the comparative analysis addressed the unresolved debates from the literature review

Unresolved debate from literature	Remaining knowledge gaps from literature review	Insights from historical and pioneering case study analyses	Relevant Cases
Governance			
Realization of legal rights to water and sanitation	Is incorporating an explicit, legal right to water a necessary condition to drive service improvements in low-income areas?	Legal rights to water and sanitation are neither necessary nor sufficient to improve access. They can be obscured by property rights or a lack of clarity around when and how they apply.	No constitutional rights: Abidjan, Bangkok, Cairo, Phnom Penh, Lusaka, Maputo. Faridpur, San Fernando Constitutional rights present: Ahmedabad, Porto Alegre, Nairobi
Corporatization, privatization, and public sector provision	Which service provision models effectively balance financial sustainability with equity? Does public sector coordination or regulation support an effective balance? What institutional reforms are required to introduce this model, and how can governments make these reforms politically acceptable?	Different models can be effective across different contexts. Public provision, public-private partnerships (PPPs), and corporatization can all drive greater equity and financial sustainability and are more politically acceptable than privatization. Under PPPs, public ownership and regulation of assets can support an effective balance.	Local government: Ahmedabad, San Fernando Corporatized Public Utility: Bangkok, Cairo, Phnom Penh, Porto Alegre, Nairobi PPPs: Abidjan, Faridpur
Type of regulation	What factors most effectively encourage accurate public reporting in situations where regulation is less independent?	Government and citizen representation on oversight committees, robust mechanisms for public and customer feedback, and well-aligned internal incentives can promote honesty and transparency in the absence of a regulator.	Ahmedabad, Bangkok, Phnom Penh, Porto Alegre, San Fernando
Split or integrated service provision responsibility	What institutional arrangements can effectively encourage the high levels of coordination required when responsibilities for water and sanitation are split?	The presence of a strong centralized regulator or a dedicated committee composed of representatives from key ministries and other stakeholders can aid in monitoring and oversight, although the cases did not provide much evidence regarding coordination across actors when responsibilities for water and sanitation are split. Institutional and regulatory frameworks focused on FSM can clarify mandates for service providers with integrated responsibilities for sewered and non-sewered sanitation.	Centralized regulator: Abidjan, Cairo, Lusaka, Maputo, Nairobi Dedicated oversight committee: Bangkok, Phnom Penh, Porto Alegre FSM frameworks: Faridpur, Lusaka, Maputo, Nairobi, San Fernando
Actors			
Sustainability of improvements achieved through champions	What methods are effective for institutionalizing changes brought about by champions (e.g., creation of specific policies, development of institutional culture among staff)?	Institutional reforms codified in internal policies and codes of action, along with utility staff incentives, benefits, and mentoring promoting positive institutional culture, transparency, and efficiency.	Bangkok, Phnom Penh, Nairobi

Unresolved debate from literature	Remaining knowledge gaps from literature review	Insights from historical and pioneering case study analyses	Relevant Cases
Water and sanitation approaches			
Full piped coverage or diversity of approaches	What approaches are successful to formalize small-scale suppliers and resellers operating in LIAs?	Incentives for small-scale providers to organize into formal cooperatives or lobbying associations can lead to improved working conditions, financial outcomes, and coordination.	Lusaka, Faridpur
Contextual application of emerging approaches: scheduled desludging, call centers, shared sanitation, container-based sanitation	What are the best ways to integrate emerging approaches into citywide plans? How can financial sustainability be ensured after external startup funding?	Pilot projects and experimentation, often with nongovernmental organizations and/or funding partners, are critical given the diversity of potential approaches, particularly for sanitation. No sufficient evidence from the case literature regarding successful financial sustainability of FSM approaches.	San Fernando, Faridpur, Nairobi, Lusaka, Maputo
Social, economic, and political context			
Methods to achieve affordability and cost recovery	What financing solutions beyond tariffs can be put in place to contribute to cost recovery and equitable services, and what are the institutional frameworks required to make them viable?	Property taxes are often inherently pro-poor but may be feasible only when the municipality (responsible for collecting taxes) is also the service provider; municipal bonds can fund infrastructure investments; national providers can enable cross-subsidization of poorer cities. Some combination of grants and loans is often instrumental in paying for capital investments or major institutional changes, but this should occur in parallel with establishing a long-term plan for improved financial sustainability. In this case, external funding can act as "bridging finance," helping to cover the costs of service improvements while revenue streams come online.	Property taxes: Ahmedabad, San Fernando Municipal bonds: Ahmedabad External Funding for capital costs: Abidjan, Ahmedabad, Bangkok, Cairo, Phnom Penh, Porto Alegre, Lusaka, Maputo, Nairobi, Faridpur, San Fernando
The complex arrangements and realities associated with urban informality	What are the roles and relationships among diverse actors involved in informal processes? How do these processes advantage or disadvantage certain groups?	Insufficient discussion in the case literature	N/A
Environmental and resource context			
Markets and opportunities for reuse	What level and type of demand (e.g., local vs. regional) is needed to develop a sustainable market for reuse? Can additional opportunities related to funding for environmental protection improve profitability?	Needs to improve water security and local non-food crops can enable some level of water reuse. Public acceptance, favorable local markets, and product certification continue to act as bottlenecks to viable recovery and reuse of fecal sludge.	Cairo, Faridpur, Lusaka

REFERENCES

Abers, Rebecca, Igor Brandão, Robin King, and Daniely Votto. 2018. "Porto Alegre: Participatory Budgeting and the Challenge of Sustaining Transformative Change." World Resources Report Case Studies. Washington, D.C.: World Resources Institute.

Abidin, Hasanuddin Z., Heri Andreas, Irwan Gumilar, Yoichi Fukuda, Yusuf E. Pohan, and T. Deguchi. 2011. "Land Subsidence of Jakarta (Indonesia) and Its Relation with Urban Development." *Natural Hazards* 59 (3): 1753–71. https://doi.org/10.1007/s11069-011-9866-9.

ADB. 2012. "The Urban Governance and Infrastructure Improvement Project in Bangladesh: Sharing Knowledge on Community-Driven Development." Asian Development Bank. https://www.adb.org/sites/default/files/publication/29976/urban-governance-infrastructure-project-bangladesh.pdf.

———. 2013. *Philippines: Water Supply and Sanitation Sector Assessment, Strategy, and Road Map*. Asian Development Bank. https://www.adb.org/documents/philippines-water-supply-and-sanitation-sector-assessment-strategy-and-road-map.

———. 2017. "Sector Assessment (Summary): Water and Other Urban Infrastructure and Services." Asian Development Bank. https://www.adb.org/sites/default/files/linked-documents/41403-013-ssa.pdf.

———. 2021. *Inclusive Financial Mechanisms: Improving Access to Sanitation Services for Poor Households*. Manila, Philippines: Asian Development Bank. https://www.adb.org/publications/inclusive-financial-mechanisms-access-sanitation-poor.

African Development Bank. 2015. "Lusaka Sanitation Program – Climate Resilient Sustainable Infrastructure Project Appraisal Report." African Development Bank. https://projectsportal.afdb.org/dataportal/VProject/show/P-ZM-E00-010.

Allen, Adriana, Julio D Dávila, and Pascale Hofmann. 2006. *Governance of Water and Sanitation Services for the Peri-Urban Poor. A Framework for Understanding and Action in Metropolitan Regions*. London: The Development Planning Unit, University College. https://discovery.ucl.ac.uk/id/eprint/52345/.

AMC. n.d. "About the Corporation: Ahmedabad Municipal Corporation." Amdavad Municipal Corporation. Accessed June 9, 2022. https://ahmedabadcity.gov.in/portal/jsp/Static_pages/about_amc.jsp.

AMCOW. 2021. "African Sanitation Policy Guidelines." Abuja, Nigeria: African Ministers' Council on Water. https://amcow-online.org/initiatives/african-sanitation-policy-guidelines-aspg.

Andrews, Matt, Lant Pritchett, and Michael Woolcock. 2013. "Escaping Capability Traps Through Problem Driven Iterative Adaptation (PDIA)." *World Development* 51 (November): 234–44. https://doi.org/10.1016/j.worlddev.2013.05.011.

Angoua, Eliachie Larissa Eméline, Kouassi Dongo, Michael R. Templeton, Jakob Zinsstag, and Bassirou Bonfoh. 2018. "Barriers to Access Improved Water and Sanitation in Poor Peri-Urban Settlements of Abidjan, Côte d'Ivoire." *PLOS ONE* 13 (8): e0202928. https://doi.org/10.1371/journal.pone.0202928.

Athena Infonomics. 2021. "Dakar CWIS City Snapshot." Bill and Melinda Gates Foundation. https://cwiscities.com/.

Athi Water Works. 2020. "Athi Water Works Development Agency." Athi Water Works. 2020. https://www.awwda.go.ke/.

Attia, Fatma Abdul Rehman. 1999. "Water and Development in Greater Cairo (Egypt)." *Revista CIDOB d'Afers Internacionals*, 81–102. https://www.jstor.org/stable/40586151.

Babel, Mukand S., Ashim Das Gupta, and Nina Donna Sto. Domingo. 2006. "Land Subsidence: A Consequence of Groundwater Over-Exploitation in Bangkok, Thailand." *International Review for Environmental Strategies* 6 (2): 307–28.

Bahgat, Gawdat. 2015. "Egypt in the Aftermath of the Arab Spring." *ACCORD* (blog). 2015. https://www.accord.org.za/conflict-trends/egypt-aftermath-arab-spring/.
Baltazar, Dalton Erick, Hidenori Harada, Shigeo Fujii, Maria Francesca Tan, and Shatirah Akib. 2021. "A Comparative Analysis of Septage Management in Five Cities in the Philippines." *Eng* 2 (1): 12–26. https://doi.org/10.3390/eng2010002.
Banks, Nicola, Melanie Lombard, and Diana Mitlin. 2020. "Urban Informality as a Site of Critical Analysis." *The Journal of Development Studies* 56 (2): 223–38. https://doi.org/10.1080/00220388.2019.1577384.
Barraqué, Bernard. 2004. "The Three Ages of Engineering for the Water Industry." *Anuari de la Societat Catalana d'Economia*, July, 135–52.
Bercegol, Rémi de, and Jochen Monstadt. 2018. "The Kenya Slum Electrification Program. Local Politics of Electricity Networks in Kibera." *Energy Research & Social Science*, Energy Infrastructure and the Fate of the Nation, 41 (July): 249–58. https://doi.org/10.1016/j.erss.2018.04.007.
Berg, Caroline van den, and Alexander Danilenko. 2017. *Performance of Water Utilities in Africa*. Washington, DC: World Bank. https://doi.org/10.1596/26186.
Berta, Ibrahiman. 2022. Key Informant Interview - ONEPOnline.
Bhatkal, Tanvi, William Avis, and Susan Nicolai. 2013. "Urbanizing Diseases: Contested Institutional Terrain of Water- and Vector-Borne Diseases in Ahmedabad, India." *Water International* 38 (7): 875–87. https://doi.org/10.1080/02508060.2013.851363.
———. 2015. "Towards a Better Life? A Cautionary Tale of Progress in Ahmedabad." Case Study Report. Urban Poverty. ODI.
Bhatt, Mihir R. 2003. "The Case of Ahmedabad, India." Understanding Slums: Case Studies for the Global Report on Human Settlements 2003. London: UN-Habitat. https://www.ucl.ac.uk/dpu-projects/Global_Report/cities/ahmedabad.htm.
Bhuvan, Krishna, and Nr Hariharanand Ashram. 2002. "Parivartan and Its Impact: A Partnership Programme of Infrastructure Development in Slums of Ahmedabad City." Sewa Academy.
Biswas, Asit K., and Cecilia Tortajada. 2009. "Water Supply of Phnom Penh: A Most Remarkable Transformation." Singapore: Institute of Water Policy Lee Kuan Yew School of Public Policy. https://thirdworldcentre.org/wp-content/uploads/2020/08/Water-Supply-of-Phnom-Penh-A-Most-Remarkable-Transformation.pdf.
Blackett, I., and P. Hawkins. 2017. "FSM Innovation Case Studies - Case Studies on the Business, Policy and Technology of Faecal Sludge Management (Second Edition)." Seattle, USA: Bill & Melinda Gates Foundation. https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2760.
Brahmbhatt, Bijal. 2022. Key Informant Interview - Mahila Housing TrustOnline.
Brinkerhoff, Derick W, and Anna Wetterberg. 2013. "Performance-Based Public Management Reforms: Experience and Emerging Lessons from Service Delivery Improvement in Indonesia." *International Review of Administrative Sciences* 79 (3): 433–57. https://doi.org/10.1177/0020852313491059.
Brosse, Noémie de La, Rosie Renouf, and Suman Kanti Nath. 2017. "Tackling the Second-Generation Sanitation Challenge at Scale: Business Solutions for Inclusive Faecal Sludge Management in Bangladesh." FSM CASE STUDY. WSUP; Practical Action; WaterAid.
Buur, Lars, and Padil Salimo. 2018. "The Political Economy of Social Protection in Mozambique." SSRN Scholarly Paper. Rochester, NY. https://doi.org/10.2139/ssrn.3256333.
Castro, Vivian. 2009. "Improving Water Utility Services through Delegated Management: Lessons from the Utility and Small-Scale Providers in Kisumu, Kenya." Nairobi, Kenya: World Bank Water and Sanitation Program. https://www.wsp.org/sites/wsp/files/publications/Af-imp_through_delegated_mgmt.pdf.
CDIA. 2021. "San Fernando (La Union), Philippines; Green and Integrated Wastewater Management." Cities Development Initiative Asia. https://cdia.asia/wp-content/uploads/2022/01/San-Fernando-v2.2.pdf.

Centre for Advanced Philippines Studies. 2011. "17 Case Studies About Sustainable Sanitation Projects in the Philippines." Philippines: KOICA; UNEP; CAPS. https://www.susana.org/_resources/documents/default/2-1329-philippines-case-studies-1-17.pdf.

CEPT University. 2011. "Reaching the Poor, Slum Networking Project Ahmedabad." Presented at the World Water Week, Stockholm.

———. 2014. "Ahmedabad Slum Free City Action Plan." CEPT University. https://pas.org.in/Portal/document/PIP%20Application/Ahmedabad%20Slum%20Free%20City%20Action%20Plan%20RAY.pdf.

Chong, J., J. Murta, A. Kome, M. Grant, and J. Willetts. 2017. "Exploring Smart Enforcement Within Urban Sanitation." Netherlands: ISF-UTS & SNV. https://www.uts.edu.au/sites/default/files/2017-09/ISF-UTS-SNV_2017_ExploringSmartEnforcementWithinUrbanSanitation.pdf.

Colbran, Nicola. 2009. "Will Jakarta Be the Next Atlantis - Excessive Groundwater Use Resulting from a Failing Piped Water Network." *Law, Environment and Development Journal* 5: 18.

Collignon, Bernard, Régis Taisne, and Jean Kouadio. 2000. "Water and Sanitation for the Urban Poor in Côte d'Ivoire." Technical Report. WSP and Hydroconseil. https://doi.org/10.13140/RG.2.2.25718.86081.

Cook, Joseph, David Fuente, Mike Matichich, and Dale Whittington. 2020. "A Global Assessment of Nontariff Customer Assistance Programs in Water Supply and Sanitation." In *Development Studies in Regional Science: Essays in Honor of Kingsley E. Haynes*, edited by Zhenhua Chen, William M. Bowen, and Dale Whittington, 315–71. New Frontiers in Regional Science: Asian Perspectives. Singapore: Springer. https://doi.org/10.1007/978-981-15-1435-7_17.

Costa, Silvano Silvéiro da, Leo Heller, Luiz Roberto Santos Moraes, Patricia Campos Borja, Carlos H. de Melo, and Denise Sacco. 2006. *Successful Experiences in Municipal Public Water and Sanitation Services from Brazil*. ASSEMAE.

County, N.C. 2014. "The Project on Integrated Urban Development Master Plan for the City of Nairobi in the Republic of Kenya." Nairobi, Kenya: County Government of Nairobi. https://www.kpda.or.ke/documents/Nairobi%20Integarted%20Urban%20Development%20Master%20Plan.pdf.

Cox, Michael. 2015. "A Basic Guide for Empirical Environmental Social Science." *Ecology and Society* 20 (1). https://doi.org/10.5751/ES-07400-200163.

Cross, P, and A Morel. 2005. "Pro-Poor Strategies for Urban Water Supply and Sanitation Services Delivery in Africa." *Water Science & Technology* 51 (8): 51–57. https://doi.org/10.2166/wst.2005.0223.

Cruz, Geoffrey. 2019. *Perspectives of Ecological Sanitation in the Philippines Sub-Theme Category: Development Policy for SDGs*. Philippines: Mapua University. https://www.researchgate.net/publication/334288283_Perspectives_of_Ecological_Sanitation_in_the_Philippines/citation/download.

Daef, M Ayman. 1986. "The Impact of Open Door Policy on Public Service Provisions in Urban Areas of Egypt: A Major Factor Influencing Income Distribution since 1974." Working Paper 29. https://www.ucl.ac.uk/bartlett/development/sites/bartlett/files/migrated-files/WP29_0.pdf.

Dalberg Global Development Advisors. 2017. "Sanitation Worker Safety and Livelihoods in India: A Blueprint for Action." https://s3.amazonaws.com/resources.cwis.com/evidence/files/3-3483-7-1542726131.pdf.

Daniere, Amrita G., and Lois M. Takahashi. 1999. "Poverty and Access: Differences and Commonalties across Slum Communities in Bangkok." *Habitat International* 23 (2): 271–88. https://doi.org/10.1016/S0197-3975(98)00052-6.

Davis, Jennifer. 2004. "Corruption in Public Service Delivery: Experience from South Asia's Water and Sanitation Sector." *World Development* 32 (1): 53–71. https://doi.org/10.1016/j.worlddev.2003.07.003.

Delaire, Caroline, Rachel Peletz, Salim Haji, Joan Kones, Edinah Samuel, Alicea Easthope-Frazer, Eloïse Charreyron, et al. 2021. "How Much Will Safe Sanitation for All Cost? Evidence from Five Cities." *Environmental Science & Technology* 55 (1): 767–77. https://doi.org/10.1021/acs.est.0c06348.

Devoto, Florencia, Esther Duflo, Pascaline Dupas, William Parienté, and Vincent Pons. 2012. "Happiness on Tap: Piped Water Adoption in Urban Morocco." *American Economic Journal: Economic Policy* 4 (4): 68–99. https://doi.org/10.1257/pol.4.4.68.

Dhamasiri, Chuanpit. 1988. "Water Supply in Bangkok Metropolis." In *Water Supply in Fast Growing Cities*. Amsterdam. https://www.ircwash.org/sites/default/files/205.40-88WA-5751.pdf.

Diacon, Diane. 1997. *Slum Networking: An Innovative Approach to Urban Development*. Leicestershire, U.K.: Building and Social Housing Foundation. https://world-habitat.org/publications/slum-networking-an-innovative-approach-to-urban-development-in-india/.

Drabble, Sam, Jacques Nzitonda, Muyinda Abdumaliki, and Kathy Eales. 2021. "Citywide Inclusive Sanitation: Who Is Responsible?" ESAWAS Regulators Association. https://www.wsup.com/insights/citywide-inclusive-sanitation-who-is-responsible/.

Drabble, Sam, and Vasco Parente. 2018. "An Integrated Approach to Peri-Urban Sanitation and Hygiene in Maputo." Topic Brief. Water & Sanitation for the Urban Poor. https://www.wsup.com/insights/an-integrated-approach-to-peri-urban-sanitation-and-hygiene-in-maputo/.

Drabble, Sam, Rosie Renouf, Jonathan Stokes, and Yaver Abidi. 2019. "Systems Reboot: Sanitation Sector Change in Maputo and Lusaka." Discussion Paper. Water & Sanitation for the Urban Poor. https://www.wsup.com/insights/systems-reboot-sanitation-sector-change-in-maputo-and-lusaka/.

Edo, Elena, Goncha Sadayeva, and Nesma Hassan. 2020. "MENA Megacities Approaching Day Zero: A Comparative Study Between Cairo and Istanbul," 33.

ESAWAS. 2022. "The Water Supply and Sanitation Regulatory Landscape Across Africa; Content Wide Synthesis Report." Synthesis Report. Eastern and Southern Africa Water and Sanitation Regulators Association. https://esawas.org/repository/Esawas_Report_2022.pdf.

EWRA. 2010. "Egyptian Water and Wastewater Regulatory Agency (EWRA): Third Annual Report 2009-2010." Egyptian Water and Wastewater Regulatory Agency.

———. 2018. "The 10th Annual Report of the Egyptian Water and Wastewater and Consumer Protection Regulatory Agency 2017-2018." Egyptian Water and Wastewater Regulatory Agency. http://www.ewra.gov.eg/DocumentsLibrary/Library/1/English%20Anual%20Repot%202017-2018.pdf.

Fallavier, Pierre. 2003. *Urban Slums Report: The Case of Phnom Penh, Cambodia*. UN-Habitat. https://urbandatabase.khmerstudies.org/storage/media/214/259d50b1fba7f45dcd245d43f26d8ee7.pdf.

Ferguson, Charlie, Adrian Mallory, Fiona Anciano, Kory Russell, Hellen del Rocio Lopez Valladares, Joy Riungu, and Alison Parker. 2022. "A Qualitative Study on Resource Barriers Facing Scaled Container-Based Sanitation Service Chains." *Journal of Water, Sanitation and Hygiene for Development*, February, washdev2022218. https://doi.org/10.2166/washdev.2022.218.

Ferguson, Dean T. 2014. "Nightsoil and the 'Great Divergence': Human Waste, the Urban Economy, and Economic Productivity, 1500–1900." *Journal of Global History* 9 (3): 379–402. https://doi.org/10.1017/S1740022814000175.

Galaitsi, S. E., Robert Russell, Amahl Bishara, John L. Durant, Jennifer Bogle, and Annette Huber-Lee. 2016. "Intermittent Domestic Water Supply: A Critical Review and Analysis of Causal-Consequential Pathways." *Water* 8 (7): 274. https://doi.org/10.3390/w8070274.

Gambrill, Martin, Rebecca J. Gilsdorf, and Nandita Kotwal. 2020. "Citywide Inclusive Sanitation - Business as Unusual: Shifting the Paradigm by Shifting Minds." *Frontiers in Environmental Science* 7. https://www.frontiersin.org/article/10.3389/fenvs.2019.00201.

Gautam, I.P. 2010. "Insight on City Management: Perspective from Ahmedabad, Gujarat, India." Ahmedabad, Gujarat: Ahmedabad Municipal Corporation. https://web.worldbank.org/archive/website01409/WEB/IMAGES/2010_1_1.PDF.
GDF. 2019. "Development Management and Aid: The Case of Water Supply Sector Reform in Cambodia." Presented at the Grips Development Forum. https://www.grips.ac.jp/teacher/oono/hp/course/lec19_cambodia/cambodia_water1.pdf.
Gebregziabher, Fiseha Haile, and Albert Pijuan Sala. 2022. "Mozambique's 'Hidden Debts': Turning a Crisis into an Opportunity for Reform." *World Bank Blogs* (blog). 2022. https://blogs.worldbank.org/africacan/mozambiques-hidden-debts-turning-crisis-opportunity-reform.
GLAAS. n.d. "Data." UN-Water Global Analysis and Assessment of Sanitation and Drinking Water, Data Portal. Accessed January 16, 2023. https://glaas.who.int/glaas/data.
GSGS. 2018. "San Fernando La Union - FSM Case Study." Global Sanitation Graduate School. https://sanitationeducation.org/wp-content/uploads/2018/01/San-Fernando-La-Union-Report.pdf.
Hall, David, Emanuele Lobina, Odete M. Viero, and Hélio Maltz. 2002. "Water in Porto Alegre, Brazil; Accountable, Effective, Sustainable, and Democratic." In . http://www.psiru.org/sites/default/files/2002-08-W-dmae.pdf.
Harris, Richard. 2017. "Modes of Informal Urban Development." *Journal of Planning Literature*, November. https://doi.org/10.1177/0885412217737340.
Hashimoto, Kazushi. 2021. *Institutional Frameworks for Onsite Sanitation Management Systems*. Vol. 2021. Asian Development Bank. https://www.adb.org/publications/institutional-frameworks-onsite-sanitation-management-systems.
Hinkel, Jochen, Michael Cox, Maja Schlüter, Claudia Binder, and Thomas Falk. 2015. "A Diagnostic Procedure for Applying the Social-Ecological Systems Framework in Diverse Cases." *Ecology and Society* 20 (1). https://doi.org/10.5751/ES-07023-200132.
Hoehn, John P., and Douglas J. Krieger. 2000. "An Economic Analysis of Water and Wastewater Investments in Cairo, Egypt." *Evaluation Review* 24 (6): 579–608. https://doi.org/10.1177/0193841X0002400602.
International Crisis Group. 2015. "Mapping Bangladesh's Political Crisis." https://ciaotest.cc.columbia.edu/wps/icg/0033438/f_0033438_27222.pdf.
International Finance Corporation. 2011. "The Market for Small-Scale Piped Water Systems in Kenya." Market Brief Issue:1. World Bank Group. https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/2022-06/115055-BRI-Kenya-SmallPipedWaterMarket-IFC-July-2011.pdf.
Jones, Oliver, and Angela Kimani. 2021. "Citywide Inclusive Sanitation: How Can Resourcing Be Managed Effectively?" ESAWAS Regulators Association. https://www.wsup.com/insights/citywide-inclusive-sanitation-how-can-resourcing-be-managed-effectively/.
Kawa, Nicholas C., Yang Ding, Jo Kingsbury, Kori Goldberg, Forbes Lipschitz, Mitchell Scherer, and Fatuma Bonkiye. 2019. "Night Soil: Origins, Discontinuities, and Opportunities for Bridging the Metabolic Rift." *Ethnobiology Letters* 10 (1): 40–49.
Kennedy-Walker, Ruth, Jaime M Amezaga, and Charlotte A Paterson. 2015a. "The Role of Power, Politics and History in Achieving Sanitation Service Provision in Informal Urban Environments: A Case Study of Lusaka, Zambia." *Environment and Urbanization* 27 (2): 489–504. https://doi.org/10.1177/0956247815583253.
Kennedy-Walker, Ruth, Jaime M. Amezaga, and Charlotte A. Paterson. 2015b. "The Impact of Community Social Dynamics on Achieving Improved Sanitation Access for the Urban Poor: The Case of Lusaka, Zambia." *Habitat International* 50 (December): 326–34. https://doi.org/10.1016/j.habitatint.2015.09.004.
Khalil, Deena. 2019. "The Flexible Governance of Water in Cairo's Informal Areas." *Water* 11 (8): 1644. https://doi.org/10.3390/w11081644.

Kipper, Regina, and Marion Fischer, eds. 2009. *Cairo's Informal Areas; Between Urban Challenges and Hidden Potentials*. GTZ Egypt. https://www.citiesalliance.org/sites/default/files/2019-07/CairosInformalAreas_fulltext.pdf.
Komives, Kristin, Vivien Foster, Jonathan Halpern, and Quentin Wodon. 2005. "Water, Electricity, and the Poor: Who Benefits from Utility Subsidies?" Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/6361.
Kordach, A., C. Chardwattananon, K. Wongin, B. Chayaput, and N. Wongpat. 2018. "Evaluation on the Quality of Bangkok Tap Water with Other Drinking Purpose Water." *E3S Web of Conferences* 30: 01011. https://doi.org/10.1051/e3sconf/20183001011.
Korea Water and Wastewater Works Association. 2016. "Transformation of the Water Sector (1960 – 2012)." Seoul, Korea. https://www.ib-net.org/docs/Korea_water_sector.pdf.
Kumpel, Emily, Rachel Peletz, Mateyo Bonham, and Ranjiv Khush. 2016. "Assessing Drinking Water Quality and Water Safety Management in Sub-Saharan Africa Using Regulated Monitoring Data." *Environmental Science & Technology* 50 (20): 10869–76. https://doi.org/10.1021/acs.est.6b02707.
LACROIX. n.d. "SODECI : Télégestion réseaux eau potable et suivi qualité avec SOFREL." LACROIX Environment. Accessed July 1, 2022. https://www.lacroix-environment.fr/sodeci-telegestion-reseaux-eau-potable-et-suivi-qualite-avec-sofrel/.
Lauria, Donald T, Omar S. Hopkins, and Sylvie Debomy. 2005. "Pro-Poor Subsidies for Water Connections in West Africa." Working Notes Note No. 3. Water Supply and Sanitation Working Notes.
Lawhon, Mary, Gloria Nsangi Nakyagaba, and Timos Karpouzoglou. 2022. "Towards a Modest Imaginary? Sanitation in Kampala beyond the Modern Infrastructure Ideal." *Urban Studies*, February, 00420980211064519. https://doi.org/10.1177/00420980211064519.
Lawson, J., and H. Chappell. 2018. "Latin American Politics and Society: Water and Politics: Clientelism and Reform in Urban Mexico." *Latin American Politics and Society* 60 (2): 139–41. https://doi.org/10.1017/lap.2018.18.
Lee, Yok-Shiu F. 1998. "Intermediary Institutions, Community Organizations, and Urban Environmental Management: The Case of Three Bangkok Slums." *World Development* 26 (6): 993–1011. https://doi.org/10.1016/S0305-750X(98)00034-5.
Lerebours, Alix, Rebecca Scott, and Kevin Sansom. 2021. "Private Emptiers' Perspectives on the Regulation of Faecal Sludge Emptying Services in Sub-Saharan Africa." *Journal of Water, Sanitation and Hygiene for Development* 11 (5): 785–93. https://doi.org/10.2166/washdev.2021.026.
Lerebours, Alix, Rebecca Scott, Kevin Sansom, and Sam Kayaga. 2021. "Regulating Sanitation Services in Sub-Saharan Africa: An Overview of the Regulation of Emptying and Transport of Faecal Sludge in 20 Cities and Its Implementation." *Utilities Policy* 73 (December): 101315. https://doi.org/10.1016/j.jup.2021.101315.
———. 2022. "Barriers and Enablers to the Regulation of Sanitation Services: A Framework for Emptying and Transport Services in Sub-Saharan African Cities." *Frontiers in Environmental Science* 10. https://www.frontiersin.org/article/10.3389/fenvs.2022.869403.
Libey, Anna, Marieke Adank, and Evan Thomas. 2020. "Who Pays for Water? Comparing Life Cycle Costs of Water Services Among Several Low, Medium and High-Income Utilities." *World Development* 136 (December): 105155. https://doi.org/10.1016/j.worlddev.2020.105155.
Lombana Cordoba, Camilo, Gustavo Caltiel, and Federico Perez Penalosa. 2022. "Utility of the Future, Taking Water and Sanitation Utilities Beyond the Next Level. A Methodology to Ignite Transformation in Water and Sanitation Utilities." Text/HTML. Washington, DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099325005112246075/P1655860d146090dc097dc0165740604044.
Mallory, Adrian, Anna Mdee, Dorice Agol, Leonie Hyde-Smith, Domenic Kiogora, Joy Riungu, and Alison Parker. 2022. "The Potential for Scaling up Container-Based Sanitation in Informal Settlements in Kenya." *Journal of International Development* n/a (n/a): 1–15. https://doi.org/10.1002/jid.3639.

Maltz, Hélio. 2005. "Porto Alegre's Water: Public and for All." In *Reclaiming Public Water*, 29–36.
Manga, Musa, Jamie Bartram, and Barbara E. Evans. 2020. "Economic Cost Analysis of Low-Cost Sanitation Technology Options in Informal Settlement Areas (Case Study: Soweto, Johannesburg)." *International Journal of Hygiene and Environmental Health* 223 (1): 289–98. https://doi.org/10.1016/j.ijheh.2019.06.012.
Mansour, Goufrane, Waliul Islam, and Md. Akhtaruzzaman. 2017. "Situation Analysis of the Urban Sanitation Sector in Bangladesh." WSUP. https://www.wsup.com/content/uploads/2017/09/Situation-analysis-of-the-urban-sanitation-sector-in-Bangladesh.pdf.
Mara, Duncan. 2018. "'Top-down' Planning for Scalable Sustainable Sanitation in High-Density Low-Income Urban Areas: Is It More Appropriate than 'Bottom-up' Planning?" *Journal of Water, Sanitation and Hygiene for Development* 8 (2): 165–75. https://doi.org/10.2166/washdev.2018.101.
Marin, Philippe, Eustache Ouayoro, Matar Fall, and Richard Verspyck. 2009. "Partnering for Water in Côte d'Ivoire: Lessons from 50 Years of Successful Private Operation." Briefing Note 50. Washington, D.C.: The World Bank. https://openknowledge.worldbank.org/entities/publication/88c279a7-fff3-55ed-9e89-23c23d5b5276.
McConville, J. R., E. Kvarnström, M. Ahlström, and C. B. Niwagaba. 2022. "Possibilities for Changing to Resource Recovery in Kampala's on-Site Sanitation Regime." *Resources, Conservation and Recycling* 181 (June): 106275. https://doi.org/10.1016/j.resconrec.2022.106275.
McConville, Jennifer R., Elisabeth Kvarnström, James M. Maiteki, and Charles B. Niwagaba. 2019. "Infrastructure Investments and Operating Costs for Fecal Sludge and Sewage Treatment Systems in Kampala, Uganda." *Urban Water Journal* 16 (8): 584–93. https://doi.org/10.1080/1573062X.2019.1700290.
McGinnis, Michael D., and Elinor Ostrom. 2014. "Social-Ecological System Framework: Initial Changes and Continuing Challenges." *Ecology and Society* 19 (2). https://www.jstor.org/stable/26269580.
McGranahan, Gordon, and Diana Mitlin. 2016. "Learning from Sustained Success: How Community-Driven Initiatives to Improve Urban Sanitation Can Meet the Challenges." *World Development* 87 (November): 307–17. https://doi.org/10.1016/j.worlddev.2016.06.019.
McIntosh, Arthur. 2003. *Asian Water Supplies: Reaching the Urban Poor*. Asian Development Bank. https://www.adb.org/publications/asian-water-supplies-reaching-urban-poor.
McIntosh, Arthur C, ed. 2013. *Pearls of Wisdom in Asian Water Supplies: Lessons Learned from 1000 Years of Collective Experience*. Manila, Philippines: Books on Demand Philippines, Inc. http://booksondemand.com.ph/wp-content/uploads/2013/11/Pearls-of-Wisdom-in-Asian-Water-Supplies.pdf.
McIntosh, Arthur C. 2014. *Urban Water Supply and Sanitation in Southeast Asia: A Guide to Good Practice*. Mandaluyong City, Metro Manila, Philippines: Asian Development Bank. https://www.adb.org/publications/urban-water-supply-and-sanitation-southeast-asia-guide-good-practice.
McIntosh, Arthur C., and Cesar E. Yñiguez, eds. 1997. *Second Water Utilities Data Book: Asian and Pacific Region*. Manila, Philippines: Asian Development Bank. https://fr.ircwash.org/sites/default/files/McIntosh-1997-Second.pdf.
McPhail, Alexander A. 1993. "The 'Five Percent Rule' for Improved Water Service: Can Households Afford More?" *World Development* 21 (6): 963–73. https://doi.org/10.1016/0305-750X(93)90054-D.
Mdee, Anna, and Andrew Mushi. 2021. "Untangling Blame and Responsibility for Service Delivery and Local Governance Performance: Testing a Grounded Social Accountability Approach in Tanzania." *Local Government Studies* 47 (6): 993–1013. https://doi.org/10.1080/03003930.2020.1842735.

Mehta, Meera, Dinesh Mehta, and Jaladhi Vavaliya. 2021. "Urban Drinking Water Security in Gujarat." *Journal of Social and Economic Development* 23 (Suppl 1): S166–80. https://doi.org/10.1007/s40847-020-00122-0.

Mehta, Meera, Dinesh Mehta, and Upasana Yadav. 2019. "Citywide Inclusive Sanitation Through Scheduled Desludging Services: Emerging Experience From India." *Frontiers in Environmental Science* 7. https://www.frontiersin.org/article/10.3389/fenvs.2019.00188.

Menard, Claude, and George Clarke. 2000. "Reforming the Water Supply in Abidjan, Côte d'Ivoire: Mild Reform in a Turbulent Environment." Working Paper 2377. Policy Research Working Paper. The World Bank Development Research Group. https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-2377.

Mills, Freya, Francesca Tilmans, and S.M. Tafsirul Islam. 2017. "Catalysts for Change in Urban Sanitation: Proceedings of an Urban Sanitation and Hygiene for Health and Development (Ushhd) Learning Event." Conference Report. SNV 2017 Urban Sanitation Learning Event. Khulna, Bangladesh: SNV; UTS. https://snv.org/assets/explore/download/2017-urban-san-learning-event-bangladesh.pdf.

Mitlin, Diana, Victoria A. Beard, David Satterthwaite, and Jillian Du. 2019. "Unaffordable and Undrinkable: Rethinking Urban Water Access in the Global South." Washington, D.C.: World Resources Institute. https://www.wri.org/research/unaffordable-and-undrinkable-rethinking-urban-water-access-global-south.

Mitlin, Diana, and Anna Walnycki. 2020. "Informality as Experimentation: Water Utilities' Strategies for Cost Recovery and Their Consequences for Universal Access." *The Journal of Development Studies* 56 (2): 259–77. https://doi.org/10.1080/00220388.2019.1577383.

Mok, Sokha. 2022. Key Informant Interview - WaterAidOnline.

Mukhtarov, Farhad, Elissaios Papyrakis, and Matthias Rieger. 2022. "Covid-19 and Water." In *COVID-19 and International Development*, edited by Elissaios Papyrakis, 157–73. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-82339-9_12.

MWA. 2019. "Annual Report 2019." Metropolitan Waterworks Authority. https://web.mwa.co.th/mobile/download/Annual_Report_2562_eng.pdf.

———. 2021. "MWA Consumer Confidence Report 2021." https://web.mwa.co.th/download/prd01/CCR/2021%20Annual%20Water%20Quality%20Report%20-%20%E0%B8%AD%E0%B8%B1%E0%B8%87%E0%B8%81%E0%B8%A4%E0%B8%A9.pdf.

Mwangi, Patrick Nduati, Lilian Otiego, and Charlotte Ndakorerwa. 2015. "Innovation in Scaling up Access to Water and Sanitation Services in Kenya." WSP World Bank Group. https://devolutionhub.or.ke/file/d027ddb6-innovation-in-scaling-up-access-wate.pdf.

Narzetti, Daniel Antonio, and Rui Cunha Marques. 2021. "Access to Water and Sanitation Services in Brazilian Vulnerable Areas: The Role of Regulation and Recent Institutional Reform." *Water* 13 (6): 787. https://doi.org/10.3390/w13060787.

NCWSC and AWSB. 2009. "Strategic Guidelines for Improving Water and Sanitation Services in Nairobi's Informal Settlements." WSP. https://www.wsp.org/sites/wsp/files/publications/Af_Nairobi_Strategic_Guidelines.pdf.

NHRC. 2021. "Right to Water." National Human Rights Commission India. https://nhrc.nic.in/sites/default/files/Right%20to%20water.pdf.

Norman, Guy, and Richard Cheruiyot. 2021. "Citywide Inclusive Sanitation: How Can Accountability Be Strengthened?" ESAWAS Regulators Association. https://www.wsup.com/insights/citywide-inclusive-sanitation-how-can-accountability-be-strengthened/.

Norman, Guy, Aarti Daryanani, and Andy Peal. 2012. "Sanitation Surcharges Collected through Water Bills: A Way Forward for Financing pro-Poor Sanitation?" Water & Sanitation for the Urban Poor. https://www.wsup.com/insights/sanitation-surcharges-collected-through-water-bills-a-way-forward-for-financing-pro-poor-sanitation/.

Northover, Henry, Shin Kue Ryu, and Timothy Brewer. 2016. "Achieving Total Sanitation and Hygiene Coverage within a Generation - Lessons from East Asia." WaterAid. https://www.publicfinanceforwash.org/sites/default/files/uploads/WaterAid-2016-Achieving_total_sanitation_and_hygiene_coverage_within_a_generation__lessons_from_East_Asia.pdf.

NWASCO. 2021. "Urban and Peri-Urban Water Supply and Sanitation." National Water Supply and Sanitation Council of Zambia. http://www.nwasco.org.zm/index.php/media-center/publications/urban-and-peri-urban-wss-sector-reports/send/12-urban-and-peri-urban-wss-sector-reports/81-urban-and-peri-urban-water-supply-and-sanitation-sector-report-2021.

Nyambe, Sikopo, Lina Agestika, and Taro Yamauchi. 2020. "The Improved and the Unimproved: Factors Influencing Sanitation and Diarrhoea in a Peri-Urban Settlement of Lusaka, Zambia." *PloS One* 15 (5): e0232763. https://doi.org/10.1371/journal.pone.0232763.

Obani, Pedi. 2015. "The Human Rights to Water and Sanitation in Courts Worldwide: A Selection of National, Regional, and International Case Law, WaterLex, 2014, ISBN: 978-2-940526-00-0." *International Environmental Agreements: Politics, Law and Economics* 15 (2): 237–39. https://doi.org/10.1007/s10784-015-9284-7.

Obrist, Brigit, Guéladio Cisse, Brama Koné, Kouassi Dongo, Stefanie Granado, and Marcel Tanner. 2006. "Interconnected Slums: Water, Sanitation and Health in Abidjan, Côte d'Ivoire." *The European Journal of Development Research* 18 (2): 319–36. https://doi.org/10.1080/09578810600708387.

Ockelford, Jeremy, and Ilana Cohen. 2013. "Sustainability Index of WASH Activities & Alliance Evaluation Sustainability Index Country Report for Philippines." Aguaconsult; International H20 Collaboration. http://washplus.org/sites/default/files/philippines_sustainability.pdf.

ODI. 2015. "Community-Driven Development in the Slums: Thailand's Experience." Overseas Development Institute. https://cdn.odi.org/media/documents/9668.pdf.

Orgill-Meyer, Jennifer, Marc Jeuland, Jeff Albert, and Nathan Cutler. 2018. "Comparing Contingent Valuation and Averting Expenditure Estimates of the Costs of Irregular Water Supply." *Ecological Economics* 146 (April): 250–64. https://doi.org/10.1016/J.ECOLECON.2017.10.016.

Ostrom, Elinor. 2007. "A Diagnostic Approach for Going beyond Panaceas." *Proceedings of the National Academy of Sciences* 104 (39): 15181–87. https://doi.org/10.1073/pnas.0702288104.

———. 2009. "A General Framework for Analyzing Sustainability of Social-Ecological Systems." *Science* 324 (5939): 419–22. https://doi.org/10.1126/science.1172133.

Pajimola, Allan Hil, and Maricel Pajimola. 2015. "Environmental Sustainable Development Strategies in the City of San Fernando, La Union." In *1st Quezon City International Conference*, 22. Richmonde Hotel, Quezon City, Philippines. https://papers.ssrn.com/abstract=2686049.

Peletz, Rachel, Andy Feng, Clara MacLeod, Dianne Vernon, Tim Wang, Joan Kones, Caroline Delaire, Salim Haji, and Ranjiv Khush. 2020. "Expanding Safe Fecal Sludge Management in Kisumu, Kenya: An Experimental Comparison of Latrine Pit-Emptying Services." *Journal of Water, Sanitation and Hygiene for Development* 10 (4): 744–55. https://doi.org/10.2166/washdev.2020.060.

Pierce, Gregory, Ahmed Rachid El-Khattabi, Kyra Gmoser-Daskalakis, and Nicholas Chow. 2021. "Solutions to the Problem of Drinking Water Service Affordability: A Review of the Evidence." *WIREs Water* 8 (4): e1522. https://doi.org/10.1002/wat2.1522.

Porciuncula, Alma. 2022. Key Informant Interview - DonorOnline.

Post, Alison, and Isha Ray. 2020. "Hybrid Modes of Urban Water Delivery in Low- and Middle-Income Countries." *Oxford Research Encyclopedia of Environmental Science*, December, 1–29. https://doi.org/10.1093/acrefore/9780199389414.013.679.

Practical Action. 2016. "Public Private Partnerships for Sustainable Sludge Management Services in Faridpur, Bangladesh." Practical Action Publishing. https://answers.practicalaction.org/our-resources/item/public-private-partnerships-for-sustainable-sludge-management-services-in-faridpur%2c-bangladesh/.

Pritchett, Lant, Michael Woolcock, and Matt Andrews. 2013. "Looking Like a State: Techniques of Persistent Failure in State Capability for Implementation." *The Journal of Development Studies* 49 (1): 1–18. https://doi.org/10.1080/00220388.2012.709614.

Rahman, Zarah, Jonny Crocker, Kang Chang, Ranjiv Khush, and Jamie Bartram. 2011. "A Comparative Assessment of Institutional Frameworks for Managing Drinking Water Quality." *Journal of Water, Sanitation and Hygiene for Development* 1 (4): 242–58. https://doi.org/10.2166/washdev.2011.002.

Ranganathan, M. 2014. "'Mafias' in the Waterscape: Urban Informality and Everyday Public Authority in Bangalore." *Water Alternatives* 7 (1): 89–105. https://www.cabdirect.org/cabdirect/abstract/20143336591.

Renouf, Rosie, Sam Drabble, Sibongile Ndaba, Reuben Sipuma, and Jessica Phiri. 2019. "Strengthening the Business Model for FSM Services in Lusaka: A Tariff Review Process." Water & Sanitation for the Urban Poor. https://www.wsup.com/content/uploads/2019/05/PN038-ENGLISH-Strengthening-the-business-model-for-FSM-in-Lusaka-tariff-review.pdf.

Renzio, Paolo de, Paolo Spada, and Brian Wampler. 2019. "Paradise Lost? The Crisis of Participatory Budgeting in Its Own Birthplace." *International Budget Partnership* (blog). 2019. https://internationalbudget.org/2019/11/paradise-lost-the-crisis-of-participatory-budgeting-is-its-own-birthplace/.

Robbins, David, Linda Strande, and Julian Doczi. 2021. "Opportunities in Fecal Sludge Management for Cities in Developing Countries: Experiences from the Philippines." *Technology* 46: 7.

Rusca, Maria, and Klaas Schwartz. 2018. "The Paradox of Cost Recovery in Heterogeneous Municipal Water Supply Systems: Ensuring Inclusiveness or Exacerbating Inequalities?" *Habitat International* 73 (March): 101–8. https://doi.org/10.1016/j.habitatint.2017.03.002.

Safi, Farhad, Claire Furlong, Bhitush Luthra, Suresh Kumar Rohilla, and Damir Brdjanovic. 2022. "Monitoring Progress in Citywide Sanitation." *Frontiers in Environmental Science* 9. https://www.frontiersin.org/article/10.3389/fenvs.2021.751534.

Saha, Uttam. 2022. Key Informant Interview - FaridpurOnline.

Satterthwaite, David, Victoria A. Beard, Diana Mitlin, and Jillian Du. 2019. "Untreated and Unsafe: Solving the Urban Sanitation Crisis in the Global South." Working Paper. Washington, D.C.: World Resources Institute. https://www.wri.org/research/untreated-and-unsafe-solving-urban-sanitation-crisis-global-south.

Sethaputra, Sacha, Theodore Panayotou, and Vute Wangwacharakul. 1990. "Water Resources: Shortage amidst Abundance." *TDRI Quarterly Review* 5 (3): 12–19.

Simukonda, Kondwani, Raziyeh Farmani, and David Butler. 2022. "Development of Scenarios for Evaluating Conversion from Intermittent to Continuous Water Supply Strategies' Sustainability Implications." *Urban Water Journal* 19 (4): 410–21. https://doi.org/10.1080/1573062X.2021.2024582.

Singh, Rozita, Xiao Wang, Juan Carlos Mendoza, and Emmanuel Kofi Ackom. 2015. "Electricity (in)Accessibility to the Urban Poor in Developing Countries." *WIREs Energy and Environment* 4 (4): 339–53. https://doi.org/10.1002/wene.148.

Sinharoy, Sheela S., Rachel Pittluck, and Thomas Clasen. 2019. "Review of Drivers and Barriers of Water and Sanitation Policies for Urban Informal Settlements in Low-Income and Middle-Income Countries." *Utilities Policy* 60 (October): 100957. https://doi.org/10.1016/j.jup.2019.100957.

SODECI. 2022. "SODECI - Société de Distribution d'Eau de Côte d'Ivoire." SODECI. 2022. https://www.sodeci.ci/notre-contrat-eau-potable/www.sodeci.ci.

Spencer, James H., and Bunnarith Meng. 2019. "Resilient Urbanization and Infrastructure Governance: The Case of the Phnom Penh Water Supply Authority, 1993–2007." *Water Policy* 21 (4): 848–64. https://doi.org/10.2166/wp.2019.211.

Stevens, Lucy, Rafiul Islam, and Alexis Morcrette. 2015. "Faecal Sludge Management in Faridpur, Bangladesh: Scaling up through Service Level Agreements." In *38th WEDC International Conference*, 6. Loughborough University, UK: Loughborough University.

https://infohub.practicalaction.org/bitstream/handle/11283/575954/WEDC%20FSM%20in%20Faridpur%20paper.pdf?sequence=1.
Stokstad, Erik. 2008. "Rebuilt From Ruins, a Water Utility Turns Clean and Pure." *Science* 319 (5864): 746–47. https://doi.org/10.1126/science.319.5864.746.
Susana. n.d. "SFD Data." Susana. Accessed June 7, 2022. https://sfd.susana.org/about/sfd-data.
The Economist Intelligence Unit. 2021. "Democracy Index 2020: In Sickness and in Health?" The Economist Intelligence Unit Limited. https://www.eiu.com/n/campaigns/democracy-index-2020/.
Tribbe, Jessica, Valentina Zuin, Caroline Delaire, Ranjiv Khush, and Rachel Peletz. 2021. "How Do Rural Communities Sustain Sanitation Gains? Qualitative Comparative Analyses of Community-Led Approaches in Cambodia and Ghana." *Sustainability* 13 (10): 5440. https://doi.org/10.3390/su13105440.
Trimmer, John T., Roland D. Cusick, and Jeremy S. Guest. 2017. "Amplifying Progress toward Multiple Development Goals through Resource Recovery from Sanitation." *Environmental Science & Technology* 51 (18): 10765–76. https://doi.org/10.1021/acs.est.7b02147.
Trimmer, John T., and Jeremy S. Guest. 2018. "Recirculation of Human-Derived Nutrients from Cities to Agriculture across Six Continents." *Nature Sustainability* 1 (8): 427–35. https://doi.org/10.1038/s41893-018-0118-9.
Trimmer, John T., Hannah A. C. Lohman, Diana M. Byrne, Stephanie A. Houser, Fulgensio Jjuuko, David Katende, Noble Banadda, Assata Zerai, Daniel C. Miller, and Jeremy S. Guest. 2020. "Navigating Multidimensional Social–Ecological System Trade-Offs across Sanitation Alternatives in an Urban Informal Settlement." *Environmental Science & Technology* 54 (19): 12641–53. https://doi.org/10.1021/acs.est.0c03296.
Trimmer, John T., Andrew J. Margenot, Roland D. Cusick, and Jeremy S. Guest. 2019. "Aligning Product Chemistry and Soil Context for Agronomic Reuse of Human-Derived Resources." *Environmental Science & Technology* 53 (11): 6501–10. https://doi.org/10.1021/acs.est.9b00504.
Trimmer, John T., Daniel C. Miller, Diana M. Byrne, Hannah A. C. Lohman, Noble Banadda, Katherine Baylis, Sherri M. Cook, et al. 2020. "Re-Envisioning Sanitation As a Human-Derived Resource System." *Environmental Science & Technology* 54 (17): 10446–59. https://doi.org/10.1021/acs.est.0c03318.
UN FAO. 2021. "AQUASTAT - FAO's Global Information System on Water and Agriculture." Food and Agricultural Organization of the United Nations. 2021. https://www.fao.org/aquastat/en/.
UN Habitat. 2019. "Access to Basic Services in Cities and Urban Areas." Urban Indicators Database. 2019. https://data.unhabitat.org/pages/access-to-basic-services-in-cities-and-urban-areas.
———. 2020. "Rent Regulations in Kenya, Lagos-Nigeria, Botswana and South Africa: A Comparative Analysis." Nairobi: UN Habitat. https://unhabitat.org/rent-regulations-in-kenya-lagos-nigeria-botswana-and-south-africa-a-comparative-analysis.
———. 2021. "Housing, Slums and Informal Settlements." Urban Indicators Database. 2021. https://data.unhabitat.org/.
UNDP and WSP. 1999. "Ahmedabad Parivartan." UNDP-World Bank WSP. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/901321468252673972/ahmedabad-parivartan.
UNEP. 2009. "Kenya Atlas; Chapter 5: Nairobi and Its Environment." United Nations Environment Programme. https://na.unep.net/atlas/kenya/downloads/chapters/kenya_screen_chapter5-end.pdf.
UNICEF. n.d. "Country Background." Accessed July 5, 2022. https://www.unicef.org/egypt/country-background.
United Nations. 2018. "World Urbanization Prospects: The 2018 Revision, Online Edition." 2018. https://population.un.org/wup/Download/.
Urban Management Centre. 2011. "Urban Water and Sanitation in Gujarat." Urban Management Centre. https://www.pas.org.in/Portal/document/ResourcesFiles/pdfs/Urban%20Water%20&%20Sanitation%20Gujarat%20UMC.pdf.

———. 2012. "City Sanitation Plan, Ahmedabad." Ahmedabad, India: Urban Management Centre. https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/3236.
USAID. 2010. "ZAMBIA Water and Sanitation Profile." United States Agency for International Development. https://pdf.usaid.gov/pdf_docs/PNADO942.pdf.
———. 2015. "Resilience at USAID." https://pdf.usaid.gov/pdf_docs/PBAAE178.pdf.
VanRiper, Froggi, Kory C. Russel, Lori A. Cramer, Daniel Tillias, Jessica Laporte, Erica Lloyd, and Sasha Kramer. 2022. "Container-Based Sanitation Services and Attrition: An Examination of Drivers and Implications." *Frontiers in Environmental Science* 9. https://www.frontiersin.org/article/10.3389/fenvs.2021.817142.
Victor, Courtney, Denisse Vega Ocasio, Zaida A. Cumbe, Joshua V. Garn, Sydney Hubbard, Magalhaes Mangamela, Sandy McGunegill, et al. 2022. "Spatial Heterogeneity of Neighborhood-Level Water and Sanitation Access in Informal Urban Settlements: A Cross-Sectional Case Study in Beira, Mozambique." *PLOS Water* 1 (6): e0000022. https://doi.org/10.1371/journal.pwat.0000022.
Viero, Odete M. 2003. "Water Supply and Sanitation in Porto Alegre Brazil." February 20, 2003. https://sswm.info/sites/default/files/reference_attachments/VIERO%202003%20Water%20Supply%20and%20Sanitation%20in%20Porto%20Alegre%20Brazil.pdf.
WASREB. 2018. "CORPORATE GOVERNANCE GUIDELINES FOR THE WATER SERVICES SECTOR 2018." Water Services Regulatory Board. https://wasreb.go.ke/downloads/WASREB%20Corporate%20Governance%20Guidelines%202018.pdf.
———. 2022. "A Performance Report of Kenya's Water Services Sector – 2020/21." Issue No 14. Impact. Nairobi, Kenya: WASREB. https://wasreb.go.ke/impact-report-issue-no-14/.
Water Utility Partnership. 2003. "Better Water and Sanitation for the Urban Poor : Good Practice from Sub-Saharan Africa." 43101. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/14746.
WaterAid. 2016a. "A Tale of Clean Cities: Insights for Planning Urban Sanitation from Ghana, India and the Philippines." London, UK: WaterAid. https://washmatters.wateraid.org/publications/a-tale-of-clean-cities-insights-for-planning-urban-sanitation-from-ghana-india-and-the.
———. 2016b. "A Tale of Clean Cities: Insights for Planning Urban Sanitation from San Fernando, Philippines." London: WaterAid. https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/A%20tale%20of%20clean%20cities%20%20San%20Fernando%20case%20study.pdf.
———. 2016c. "Making Sanitation Happen: Turning Political Will into Action (Policy Brief)." London, UK: WaterAid. https://washmatters.wateraid.org/publications/making-sanitation-happen-turning-political-will-into-action.
Weststrate, Johanna, Alberto Gianoli, Jasper Eshuis, Geske Dijkstra, Idrisse Jorge Cossa, and Maria Rusca. 2019. "The Regulation of Onsite Sanitation in Maputo, Mozambique." *Utilities Policy* 61 (December): 100968. https://doi.org/10.1016/j.jup.2019.100968.
WHO. 2019. "Sanitation Policy and Planning Framework Case Study for Discussion." World Health Organization. https://cdn.who.int/media/docs/default-source/wash-documents/zambia-sanitation-policy-and-planning-case-study-for-discussion.pdf?sfvrsn=64268107_6.
WHO/UNICEF. 2022. "Household WASH Data." Join Monitoring Programme for Water Supply, Sanitation, and Hygiene. 2022. https://washdata.org/data/household#!/.
Wilson, Adrian, and Manuel Carilho Dias. 2016. "Peer Review of Water Supply and Sanitation Services Regulatory System in Mozambique." Eastern and South Africa Water and Sanitation Regulators Association. https://www.aura.org.mz/documentos.html.
WIN. 2021. "Regulating Lusaka's Urban Sanitation Sector." Germany: Water Integrity Network. https://www.waterintegritynetwork.net/2021/07/30/urban-sanitation-regulation-lusaka/.

World Bank. 2009a. "Water in the Arab World: Management Perspectives and Innovations." 49593. Washington DC: Word Bank. https://web.worldbank.org/archive/website01418/WEB/IMAGES/WATER_AR.PDF.
———. 2009b. "Cambodia: Phnom Penh Water Supply Authority: An Exemplary Water Utility in Asia." World Bank PPPLRC. https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/PhnomPenh_ExemplaryWaterUtilityinAsia_EN.pdf.
———. 2019a. "Women in Water Utilities: Breaking Barriers." Washington, D.C.: World Bank. https://www.susana.org/_resources/documents/default/3-3779-236-1582456002.pdf.
———. 2019b. "Evaluating the Potential of Container-Based Sanitation." Washington, D.C.: World Bank. http://hdl.handle.net/10986/31292.
———. 2020. *Zambia Water Supply and Sanitation Sector Diagnostic*. World Bank, Washington, DC. https://doi.org/10.1596/34067.
———. 2022. "World Development Indicators." The World Bank DataBank. 2022. https://databank.worldbank.org/source/world-development-indicators.
———. n.d. "The World by Income and Region." Accessed April 28, 2022a. https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html.
———. n.d. "The World by Income and Region." Accessed April 28, 2022b. https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html.
World Bank Group. 2020. "Providing Sustainable Sanitation and Water Services to Low-Income Communities in Nairobi." Text/HTML. World Bank. February 19, 2020. https://www.worldbank.org/en/news/feature/2020/02/19/providing-sustainable-sanitation-and-water-services-to-low-income-communities-in-nairobi.
WSP. 2002. "Urban Water Supply Innovations in Côte d'Ivoire: How Cross-Subsidies Help the Poor." Field Note. Water and Sanitation Program. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/472381468749780795/urban-water-supply-innovations-in-cote-divoire-how-cross-subsidies-help-the-poor.
———. 2007. "FAQs: Rural Sanitation and Hygiene Practices." WSP.
WSSCC and FANSA. 2016. "Leave No One Behind: Voices of Women, Adolescent Girls, Elderly, Persons with Disabilities and Sanitation Workforce." Bangladesh Country Report. Freshwater Action Network South Asia; Water Supply and Sanitation Collaborative Council. https://www.wsscc.org/sites/default/files/migrated/2016/08/Leave-No-One-Behind-Bangladesh-Country-report.pdf.
WSUP. 2013. "Dealing with Land Tenure and Tenancy Challenges in Water and Sanitation Services Delivery." https://www.wsup.com/content/uploads/2017/08/TB006-ENGLISH-Tenure-Tenancy.pdf.
———. 2018a. "A Journey of Institutional Change: Extending Water Services to Nairobi's Informal Settlements." Nairobi, Kenya: WSUP. https://www.wsup.com/content/uploads/2018/10/10-2018-A-journey-of-institutional-change-Extending-water-services-to-Nairobi%E2%80%99s-informal-settlements.pdf.
———. 2018b. "Institutionalising Pro-Poor Services: A New Key Performance Indicator for Kenyan Utilities." Practice Note. Water & Sanitation for the Urban Poor. https://www.wsup.com/content/uploads/2018/07/PN036-ENGLISH-Institutionalising-pro-poor-service-delivery-KPI-10-Kenya.pdf.
———. 2019a. "Public Finance for Sanitation: Analysis of the Sanitation Surcharge in Akuapem North Municipality." Water & Sanitation for the Urban Poor.

https://www.wsup.com/content/uploads/2018/02/1.-PBrief_Public-finance-for-sanitation-analysis-of-sanitation-surcharge-ANMA.pdf.

———. 2019b. "Public Finance for Sanitation: Analysis of the Sanitation Surcharge in Ga West, 2017-2019." Water & Sanitation for the Urban Poor. https://www.wsup.com/content/uploads/2018/02/2.-PBrief_Public-finance-for-sanitation-analysis-of-sanitation-surcharge-Ga-West.pdf.

Wutich, Amber, Melissa Beresford, and Cinthia Carvajal. 2016. "Can Informal Water Vendors Deliver on the Promise of A Human Right to Water? Results From Cochabamba, Bolivia." *World Development* 79 (March): 14–24. https://doi.org/10.1016/j.worlddev.2015.10.043.

Zaqout, Mariam. 2018. "Informal Sanitation Jobs: The Prospects of Enhancing the Status of Pit-Emptiers in Bangladesh." https://www.researchgate.net/publication/331210052_Informal_sanitation_jobs_the_prospects_of_enhancing_the_status_of_pit-emptiers_in_Bangladesh.

Zaqout, Mariam, Sally Cawood, Barbara E. Evans, and Dani J. Barrington. 2021. "Sustainable Sanitation Jobs: Prospects for Enhancing the Livelihoods of Pit-Emptiers in Bangladesh." *Third World Quarterly* 42 (2): 329–47. https://doi.org/10.1080/01436597.2020.1810560.

Zayed, M.A. 2012. "The Challenge of Greater Cairo Governance." *International Journal of General Engineering and Technology* 1 (2): 19–34.

U.S. Agency for International Development
1300 Pennsylvania Avenue, NW
Washington, DC 20523
Tel: (202) 712-0000
Fax: (202) 216-3524
www.usaid.gov