2025 REPORT

DATA SYSTEMS FOR NON-SEWERED SANITATION IN SUB-SAHARAN AFRICA:

STATUS, CHALLENGES, AND RECOMMENDATIONS

WSH Data Labs
DATA SYSTEMS FOR SANITATION SERVICE DELIVERY

Dev-Afrique

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An Image of a technician collecting water data while a mobile device displays real-time monitoring insights.

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- **Malawi:** Lilongwe City Council (LCC) and Lilongwe Water Board (LWB)
- **Nigeria:** Office of Drainage Services, Lagos State Ministry of the Environment and Water Resources (MoE Lagos), Lagos State Water Regulatory Commission (LASWARCO), (EK-WASRA), Lagos State Wastewater Management Office (LSWMO), and Environmental Health Council of Nigeria (EHCON)
- **Rwanda:** Rwanda Utilities Regulatory Agency (RURA), Water and Sanitation Corporation (WASAC), and Association of Emptiers in Rwanda (ASSERWA)
- South Africa: Department of Water and Sanitation (DWS)
- **Tanzania:** Energy and Water Utilities Regulatory Authority (EWURA)
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ACRONYMS

ASSERWA	Association of Emptiers in Rwanda
GF	Gates Foundation
CWSC	Chambeshi Water and Sanitation Company
CHV	Community Health volunteer
CWIS	Citywide Inclusive Sanitation
DWS	Department of Water and Sanitation
ERP	Enterprise Resource Planning
ESAWAS	Eastern and Southern Africa Water and Sanitation Regulators Association
EWURA	Energy and Water Utilities Regulatory Authority
FS	Fecal Sludge
FSM	Fecal Sludge Management
FSTP	Fecal Sludge Treatment Plant
GIS	Geographic Information System
IRIS	Integrated Regulatory Information System
JMP	Joint Monitoring Programme
KCCA	Kampala Capital City Authority
KIWASCO	Kisumu Water and Sanitation Company
KII	Key Informant Interviews
KPI	Key Performance Indicator
LSP	Lusaka Sanitation Project
LSS	Lusaka Onsite Sanitation System
LSWMO	Lagos State Wastewater Management Office
LASWARCO	Lagos State Water Regulatory Commission
LGWSC	Lukanga Water and Sanitation Company
LWSC	Lusaka Water Supply and Sanitation Company
MAWASCO	Malindi Water and Sewerage Company
M&E	Monitoring and Evaluation
MEL	Monitoring, Evaluation, and Learning
MoH	Ministry of Health
MoW	Ministry of Water
MoWSI	Ministry of Water, Sanitation, and Irrigation
MWDS	Ministry of Water Development and Sanitation
MSMEs	Micro, small, and Medium-Sized Enterprises
NEMA	National Environmental Management Authority

ACRONYMS

NAWASSCO	Nakuru Water and Sanitation Services Company
NSMIS	National Sanitation and Management Information System
NGO	Non-Governmental Organization
NSS	Non-sewered Sanitation
NWASCO	National Water Supply and Sanitation Council
NIS	NWASCO Information System
NYEWASCO	Nyeri Water and Sanitation Company
ODK	Open Data Kit
O&M	Operations and Maintenance
OHS	Occupational Health and Safety
OSS	On-Site Sanitation
PPE	Personal Protective Equipment
RURA	Rwanda Utilities Regulatory Authority
SDG	Sustainable Development Goal
SOPs	Standard Operating Procedures
SS	Sewered Sanitation
SSA	Sub-Saharan Africa
SWSC	Southern Water and Sanitation Company
UN	United Nations
UNICEF	United Nations Children's Fund
WASAC	Water and Sanitation Corporation
WASH	Water, Sanitation, and Hygiene
WASREB	Water Services Regulatory Board
WARIS	Water Regulations Information System
WSUP	Water and Sanitation for the Urban Poor
WURD	Water Utility Regulation Department
WWSC	Western Water Supply and Sanitation Company
WWTP	Wastewater Treatment Plant
WHO	World Health Organization
WSPs	Water Service Providers
WSS	Water Supply and Sanitation
ZEMA	Zambia Environmental Management Agency
ZSA	Zambia Statistics Agency

GLOSSARY **OF TERMS**

Term	Definition
Basic Sanitation Service	Conditions in which a household has access to improved sanitation facilities without sharing them with other households.[1]
Data	Data are objective measures or statistics used in reasoning, discussion, or calculation. Data is not helpful in its raw form, it must be used to draw conclusions and relationships of concepts for it to be insightful. It occurs in several forms, including quantitative, qualitative, and spatial.
Data Analysis	The process of systematically cleaning, transforming, describing, modeling, and interpreting data, generally employing statistical techniques to generate meaningful insights.[2]
Data Culture	An institution's or individual's knowledge, attitudes, beliefs, and practices regarding the use and relevance of data in effective decision-making and operations and performance management.[3]
Data Generation	The process of creating or producing new data.[4]
Data Operationalization/ Utilization	The effective use of insights from data to make decisions and drive business processes such as operations and performance management. [5]
Data Schema	An abstract design that represents the storage of data in a database. It describes both the organization of data and the relationships between tables in a given database. Developers plan a database schema in advance so they know what components are necessary and how they will connect to each other.[6]
Data System	An integrated and efficient framework for managing and organizing data within an institution or ecosystem. It encompasses technology, people, methodologies, architectures, and processes to effectively collect, store, analyze, and utilize data.
Data Value Pipeline	A framework summarizing the core processes of a data system and includes data generation, analysis, operationalization,[7] and system principles. The data system principles include data governance, data quality, data integration and interoperability, data transparency and access, data usability at point of generation, human resource, stakeholder coordination, and financing.
Effluent	A liquid that leaves a wastewater treatment facility, typically after blackwater or fecal sludge has undergone solids separation or some other type of treatment. [8]
Fecal Sludge	Solid and/or liquid waste removed from on-site storage containers, also called septage when removed from septic tanks. [9]
Improved Sanitation Facility	A facility designed to separate human excreta from human contact hygienically. May include flush/pour-flush toilets connected to piped sewer systems, septic tanks, or pit latrines; pit latrines with slabs (including ventilated pit latrines); or composting toilets. [10]

1. World Health Organization and United Nations Children's Fund (2017) Drinking Water Supply and Sanitation Joint Monitoring Programme (JMP); and World Health Organization (2018) Guidelines on Sanitation and Health, Geneva.
2. Data analysis | Definition, Research, & Methodology | Britannica .
3. https://www.gooddata.com/blog/what-is-data-culture/ .
4. https://www.marktechpost.com/2023/02/27/the-concept-of-data-generation/
5. https://www.piloterr.com/dictionary/data-utilization .6. https://www.educative.io/blog/what-are-database-schemas-examples
7. https://devafrique.com/wp-content/uploads/2023/12/Official-Report-of-Nigerias-Geospatial-Value-Pipeline-Assessment.pdf
8. World Health Organization and United Nations Children's Fund (2017) Drinking Water Supply and Sanitation Joint Monitoring Programme (JMP); and World Health Organization (2018) Guidelines on Sanitation and Health, Geneva.
9. ibid.
10. ibid.

Limited Sanitation Service	Conditions where improved sanitation facilities are shared between two or more households.[11]
Off-Site Sanitation	A sanitation system in which excreta (referred to as wastewater) are collected and transported away from the plot where they are generated. An off-site sanitation system relies on sewer technology for transport.[12]
Non-Sewered Sanitation	The provision of off-grid/decentralized sanitation facilities and services to ensure the safe management of human excreta.
Open Defecation	The practice of defecating in fields, forests, bushes, open bodies of water, beaches, or other open spaces.[13]
Peri-Urban	Describes an area located on the outskirts of a city that has both urban and rural characteristics. These areas mark the transition between the countryside and the city, and are often experiencing rapid growth and development.[14]
Safely Managed Sanitation Service	Conditions in which households have access to improved sanitation facilities that are not shared with other households, and in which excreta are safely disposed of in situ or removed and treated off-site.[15]
Sanitation	Access to and use of facilities and services to safely dispose of human excreta.[16]
Sanitation Coverage	The number of people with access to improved sanitation facilities as a percentage of the total population in a utility or municipality's service area.[17]
Sanitation Services	The management of excreta from the facilities used by individuals, via emptying and transport of the excreta for treatment and eventual disposal or reuse.[18]
Sanitation Service Chain	All components and processes comprising a sanitation system – from capture and containment through emptying, transport, treatment (in situ or off-site), and final disposal or end use.[19]
Septic Tank	A watertight chamber made of concrete, fibreglass, PVC, or plastic, through which black-water and greywater flows for primary treatment. Settling and anaerobic processes reduce solids and organics, but the treatment is only moderate.[20]
Sewage	Wastewater containing human excreta (feces and urine), either in dissolved or undissolved form, which has been discharged from toilets or other receptacles intended to receive or retain such human excreta.[21]
Sewerage System	A network of sewer appurtenances intended for the collection and conveyance of sewage generated from each of the connected properties. The sewage is conveyed to a sewage pumping station, where it is pumped to a sewage treatment plant for further treatment and disposal.[22]
Sludge	A mixture of solids and water deposited on the bottom of septic tanks and ponds. The term sewage sludge is used to describe residuals from centralized wastewater treatment, while the term septage is used to describe the residuals from septic tanks.[23]
A worker uses digital tools for data collection in a rural SSA utility setting.	Includes facilities such as pit latrines without slabs, hanging latrines, and bucket latrines.[24]
Wastewater	The spent or used water from homes, communities, farms,[25] and businesses that contains enough harmful material to damage the water's quality. Wastewater includes both domestic sewage and industrial waste from manufacturing sources.

11. ibid.
12. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/sesp/CLUES/Compendium_2nd_pdfs/Compendium_2nd_Ed_Lowres_1p.pdf
13. https://washdata.org/monitoring/sanitation/open-defecation
14. World Health Organization and United Nations Children's Fund (2017) Drinking Water Supply and Sanitation Joint Monitoring Programme (JMP); and World Health Organization (2018) Guidelines on Sanitation and Health, Geneva.
15. ibid. 16. ibid. 17. ibid. 18. ibid. 19. ibid.
20. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/sesp/CLUES/Compendium_2nd_pdfs/Compendium_2nd_Ed_Lowres_1p.pdf
21. World Health Organization and United Nations Children's Fund (2017) Drinking Water Supply and Sanitation Joint Monitoring Programme (JMP); and World Health Organization (2018) Guidelines on Sanitation and Health, Geneva.
22. ibid. 23. ibid. 24. ibid. 25. ibid.

A worker uses digital tools for data collection in a rural SSA utility setting.

EXECUTIVE SUMMARY

INTRODUCTION

Developing countries are increasingly leveraging data and building public data systems to enhance decision-making in the water, sanitation, and hygiene (WASH) sector. However, most of these countries prioritize water data over sanitation data in their decision-making processes.

Workers installing a large concrete water storage system to improve rural water infrastructure.

The sanitation subsector faces numerous data challenges, including insufficient data generation by utilities and municipalities, outdated data, the fragmentation of data across different institutions, and unclear indicator definitions and institutional mandates. Additionally, various actors across the sector view data as an end rather than a tool for improved service delivery, decision-making, and efficient operations and performance management.

These challenges are mostly pronounced at the local level, where non-sewered sanitation (NSS) services are critical but poorly supported by data systems. Unfortunately, no comprehensive assessment has been conducted to understand public data systems and data flows in the NSS sector. This has contributed to slow progress in improving NSS service delivery—a critical need in developing countries, where such services are widely used and at a time when climate change is impacting sanitation negatively.

With support from the Gates Foundation, Dev-Afrique Development Advisors conducted a landscape assessment of NSS data systems across utilities and municipalities in 10 sub-Saharan African (SSA) countries.[26] This study has illuminated existing challenges and enabled the identification of best practices that can guide interventions aimed at strengthening NSS data systems.

The assessment was structured around the sanitation data value pipeline framework, which evaluates data systems based on three fundamental pillars—data generation, data analysis, and data operationalization/ utilization — and additionally references the guiding principles associated with robust data systems. This report highlights the institutional arrangements within SSA's sanitation sector, delves into the sanitation data value pipeline components, associated challenges, and recommendations for stakeholders involved in NSS service provision.

26. Democratic Republic of Congo (DRC), Ethiopia, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia.

INSTITUTIONAL MANDATES

Findings of the assessment show that in SSA, ministries of water and sanitation or infrastructure lead policy development, working closely with other ministries holding policy portfolios such as health, environmental protection, education, or local government. This collaboration ensures a multisectoral approach and alignment with broader national development goals. Despite the widespread use of NSS in the region, sanitation regulation often favors sewered sanitation systems. A range of regulatory models are used to govern the sector in the region. These include regulation by an agency (the predominant model), ministry oversight, contractual agreements, and self-regulation.[27] Urban sanitation service provision typically falls under the jurisdiction of either municipalities or utilities. The responsibilities for sewered and non-sewered sanitation are either split between these two institutions or integrated within one of them. This division of responsibilities, in addition to limited regulation, makes NSS service provision complex.

NSS DATA GENERATION

NSS data generation by utilities and municipalities is largely driven by regulatory or project-specific demands from regulators and development partners, rather than being self-driven. This means that data generation at the utility and municipality levels is driven mainly by reporting obligations rather than internal performance and operations management. This focus on reporting rather than internal insights generation is partly due to utilities/municipalities not defining key performance indicators (KPIs) that align with their decision needs beyond the prescribed regulatory obligations. Another reason is the poor data culture and limited data expertise across several utilities and municipalities. Other reasons for data generation gaps include insufficient funding, unclear NSS mandates among utilities and municipalities, a lack of universally agreed KPI definitions, and limited data system technologies. A combination of paper-based and digital tools—such as mWater, KoboCollect and ODK—are used to collect data within the sector. The more advanced utilities tend to use a combination of such tools, while the least developed use only paper-based methods. Although most utilities and municipalities maintain up-to-date data on sewered sanitation. NSS data is often scarce, with only a few utilities and municipalities having conducted comprehensive baseline mapping of NSS capture, containment, and treatment facilities or fecal sludge management (FSM) facilities in their service areas. Without baseline maps and mechanisms for generating NSS data, many of them rely on external stakeholders and systems like the Ministry of Health, the National Sanitation Management Information System, and the District Health Information System (DHIS) for NSS data on households, schools, health facilities, and hygiene practices. However, these sources often fail to capture critical key KPIs needed by utilities and municipalities. This lack of comprehensive NSS data hinders both the analysis and practical use of information, which is crucial for informed decision-making as well as for effective service and performance management.

Recognizing the need for better integration and coordination across their various departments, a number of utilities and municipalities with systems have initiated the implementation of integrated enterprise resource planning (ERP) systems to consolidate utility data. In most cases, however, these ERP systems are not interoperable with those of external stakeholders and often lack a dedicated NSS data-management module for capturing NSS data. As a result, these utilities store NSS data in standalone systems such as ArcGIS, Excel, or various modules within their data-management systems.

At the national level, countries including Kenya and Zambia have established integrated management information systems to centralize NSS data storage. These initiatives are designed to improve data access and sharing among stakeholders, reduce data duplication, and enhance the overall monitoring of urban sanitation systems' performance and outcomes.

NSS DATA ANALYSIS

Like data generation, data analysis is mainly project-based and consists of basic descriptives rather than nuanced insights. This means that most analyses are attached to specific donor and development partner projects and are not mainstreamed into the utility/municipality processes. Therefore, the type of analysis conducted is mainly limited to each project's scope rather than the broader questions that the utilities/municipalities need to be answered to optimize their operations and performance management. This project-based approach also has consequences on the sustainability of the data practices and staff employed during implementation. Utilities/municipalities have limited to non-existent systematic data cleaning and validation processes,

27. ESAWAS, 2022. The Water Supply and Sanitation Regulatory Landscape Across Africa

coupled with a reliance on manual methods, which often leads to inconsistencies in data quality. While developed ecosystems have evolved to more advanced analytics, such as machine learning and artificial intelligence approaches to drive descriptive, diagnostic, predictive, and prescriptive insights, utilities/municipalities across SSA still use Excel to analyze data. Often, utilities and municipalities do not have a dedicated unit responsible for data analysis. Consequently, individual employees are assigned to manage this task alongside their other primary responsibilities. In many cases, such employees have limited data-analysis capabilities and have other competing priorities, which may in turn lead them to deprioritize complex data tasks.

As utilities and municipalities move toward integrating their data systems and incorporating automation, the quality of NSS data analysis and decision-making is expected to improve significantly. While visualization tools such as GIS are gaining traction, inconsistent NSS data collection and the absence of centralized, real-time dashboards still hinders the generation of actionable insights.

NSS DATA OPERATIONALIZATION/ UTILIZATION

The utilization of NSS data in utilities and municipalities across SSA is predominantly project-driven or for regulatory reporting, focusing mainly on achieving external project objectives and reporting obligations rather than addressing broader performance management and service delivery needs. Accountability mechanisms such as performance contracts, regulatory benchmarking, and customer service commitments may further drive data use, as they require utilities and municipalities to demonstrate tangible service delivery improvements.

Only a select few utilities and municipalities have made progress in operationalizing NSS data through dedicated monitoring and evaluation (M&E) teams. While monitoring, evaluation, and learning (MEL) frameworks and units are vital for sharing knowledge and continuous improvement, utilities and municipalities in SSA tend to primarily implement M&E frameworks, leaving out the learning component.
The focus on only M&E, without the learning, limits their ability to translate insights from the M&E process into decisions, innovation, performance management, and long-term success.

Further, inconsistent data and poor data quality still limit the institutions' strategic planning and monitoring capabilities. Despite recognizing the importance of data for decision-making, many utilities and municipalities are hesitant to invest in data-management systems, in part due to budget constraints. Consequently, they lack the rich information necessary to support well-informed decisions and performance management.

CHALLENGES

An absence of regulation and clear reporting standards for private sector entities and NGOs, resulting in poor data quality and inadequate compliance monitoring.

Utilities and municipalities face multiple challenges that hinder their ability to effectively generate, analyze, and operationalize NSS data throughout the sanitation service chain.

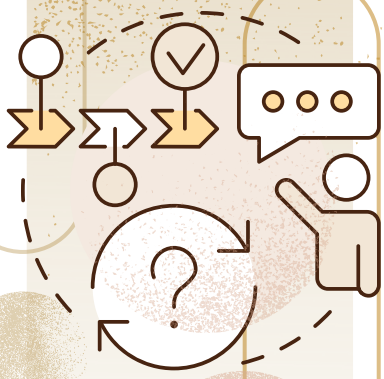
Data generation is hindered by the infancy of data collection methods, lack of any baseline data, inadequate political support and investment, weak data collection management capacities, and fragmented systems for data collection and storage. Moreover, there is an absence of regulation and clear reporting standards for private sector entities and NGOs, resulting in poor data quality and inadequate compliance monitoring. Any data generated further faces challenges during analysis.

Limitations in analytics include the absence of automated validation tools, project-driven analysis approaches as opposed to service provider needs, insufficient skilled personnel to conduct analysis, non-interoperable systems, underutilization and inaccuracies in GIS mapping, financial constraints, and the lack of NSS data systems guiding principles for acceptable data management practices.

Where analysis takes place, data operationalization is further complicated by fragmentation in different organizations, inconsistent quality of analyzed outputs, poor data culture, political interference, limited funding to translate data to action, and underdeveloped MEL frameworks without dedicated units (please refer to Appendix 1 for a summary of the challenges).

Workers installing large underground water storage tanks in a rural setting.

RECOMMENDATIONS



This report offers targeted recommendations to key stakeholder groups. The recommendations are aimed at improving the efficiency and effectiveness of NSS data systems and are summarized below:

1. MANDATE HOLDERS (SANITATION UTILITIES AND MUNICIPALITIES) ARE ENCOURAGED TO:

Establish dedicated MEL teams responsible for translating data into insights that inform utility/ municipality performance and operations management.

Most utilities/municipalities have no dedicated MEL team responsible for managing data and generating strategies to operation-alize it. In utilities/municipalities where MEL teams exist, they are usually project-based rather than mainstreamed into the broader operations, with a few having fully mainstreamed teams. The existing MEL teams also lack the requisite data processing, analysis, and operationalization skills, and they usually do not implement the "Learning" in MEL, just basic monitoring. Due to the cost implications and long-term nature of establishing MEL teams, utilities/municipalities can identify data champions within their existing teams to champion MEL activities as a short-term measure.

Provide regular training and capacity-building programs for NSS data officers to enhance the accuracy and reliability of data collection, analysis, and MEL.

By providing refresher courses, workshops, online training, and establishing mentorship programs that pair experienced data officers with new team members, utilities/municipalities can promote continuous improvement and knowledge sharing, thereby improving data quality.

Design NSS data systems based on and to inform critical utility/municipality decisions rather than collecting generic data not tied to any decision points.

Utilities/municipalities should identify key decision needs for performance improvement and service delivery, define indicators for all critical decisions, and use these to identify data and system specifications to prevent inefficient investment in data collection or analysis that may not ultimately be used.

Prioritize integrating NSS data into broader utility/ municipality data and operations management systems such as ERP systems.

This will prevent data fragmentation and allow for accurate and holistic analysis, high-quality visualization, and evidence-based planning. Ultimately, this integration will enable utilities/municipalities to conduct robust, comprehensive analytics that inform complex, multi-faceted decisions and performance management processes.

Explore diverse and sustainable ways of funding investments in NSS data systems, such as public-private partnerships (PPPs) or other innovative financing models. This will red-uce heavy reliance on traditional funding mechanisms such as donor and government support.

Develop compelling data stories and use cases to build strong NSS service investment cases for approval by politicians and deci-sion makers.

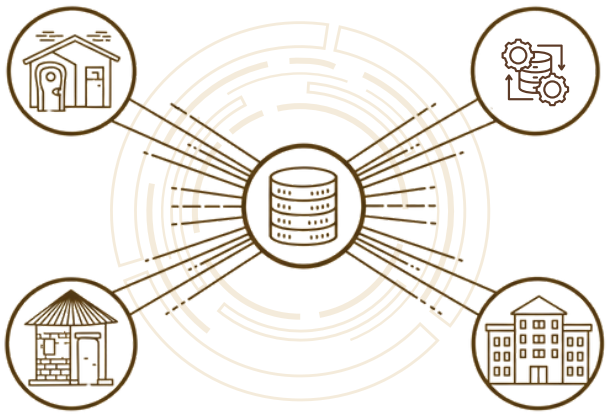
Due to competing priorities, most utilities/municipalities face resistance from politicians and decision-makers regarding NSS interventions. Therefore, it is crucial for utilities/municipalities to create effective data operationalization strategies that present strong investment cases to help ensure that NSS interventions receive the necessary attention and resources. For example, using infographics to demonstrate how NSS supports climate change mitigation and its impact on community health can be persuasive.

Pilot multiple data-use incentive structures such as establishing a strong institutional leadership commitment towards the use of data, developing data policies and implementation strategies, showing clear pathways on how data integrates into decision-making processes, documenting compelling data use success stories, creating recognition programs to reward teams and employees for data use, investing in technology as a vehicle for data use, and devising feedback loops to promote an inclusive data culture. All these interventions will ultimately lead to an improved institutional data-use culture.

Promote cross-learning among and between utilities and municipalities so that they can leverage shared experiences to enhance their own practices and outcomes. The cross-learning initiatives could also include lessons from other like-structured sectors such as health, social protection, and education.

Embed automatic data constraints when implementing NSS data-collection tools. This will improve data quality and reduce the time and work involved in cleaning and validating data.

Develop data systems that bridge the accountability gap between private operators, community based organizations, utilities, municipalities, and regulators. This could significantly enhance accountability and transparency among the stakeholders, thereby ensuring more collaboration and efficient public services.



The illustratretion captures a central data system linking stakeholders like municipalities, utilities, and regulators, promoting transparency, accountability, and efficient public services.

2. REGULATORS OF NSS ARE ENCOURAGED TO:

Collaborate with mandate holders to develop and implement comprehensive data system guidelines and reporting standards that standardize data collection, management, and analysis practices in utilities and municipalities. This can enhance data quality, promote a data-driven management culture, streamline reporting processes, and boost overall transparency and accountability within the WASH sector.

Define and harmonize country- and regional-level NSS output and outcome KPIs across the SSA region. These inclusive KPIs should align with glo-bal frameworks and standards, such as the Joint Monitoring Programme (JMP) and the Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS) initiative, and also remain relevant to local contexts. The harmonization process should also encompass intra and intersectoral collaboration to enhance and promote cross-sectoral collaboration. This ensures consistent, coherent, and comparable data collection and reporting across different sources and contexts.

Integrate regulatory information management systems with existing utility/municipality data systems to promote efficient NSS data transmission. Proactively considering data needs and system integration requirements from the beginning will prevent the creation of isolated regulatory management information systems that do not align with existing utility or municipality systems. Harmonizing these systems can enhance coordination, improve data accuracy, and strengthen decision-making processes, ultimately leading to a more efficient and cohesive WASH sector.

Train and orient utilities and municipalities on NSS indicators, data collection, and the interpretation of results to increase data management and use skills at the subnational level.

Include NSS data outputs into broader sector performance reporting. This will improve utility/municipality understanding of progress in the sector, enhance NSS performance monitoring, and promote the continuous generation of NSS data to inform sector reporting.

Enhance the overall business climate for technology and data-driven enterprises by investing in robust information and communications technology infrastructure, ensuring reliable internet connectivity, and supporting the development of local technology ecosystems. This can attract tech companies and startups interested in developing advanced NSS data collection, analytics, and visualization tools.

Provide training and support on generating, analyzing, and operationalizing SDG-focused KPI data at the utility and municipal levels.

This will strengthen the capacity of utilities and municipalities to generate high-quality, timely, and internationally comparable data, with a particular emphasis on tracking the Sustainable Development Goal (SDG) indicators. Furthermore, it will increase monitoring and reporting accuracy while allowing the impact of programs aimed at achieving the SDGs and the broader objectives of Agenda 2063 to be assessed

Invest in and establish multisectoral co-ordination groups, data hubs, and national data repositories that facilitate cross-sector discussions and promote data integration for the purposes of informed decision-making. This will help ensure that efforts remain co-ordinated and accountable across the entire data-management chain.

3. GOVERNMENTS ARE ENCOURAGED TO:

Prioritize financial support for NSS data systems strengthening to utilities and municipalities. This will give them sufficient funds to procure advanced data collection, analytical, and visualization tools/plat-forms, which typically require very substantial capital investments.

Create an enabling environment for private-sector investment in NSS data initiatives, thereby diminishing heavy reliance on donor support. This should begin by developing clear, supportive policies and regulations that incentivize private-sector participation and establishing PPPs.

4. DEVELOPMENT PARTNERS AND DONORS ARE ENCOURAGED TO:

Support the procurement and development of interoperable NSS data collection, analytics, and visualization tools in utilities/ municipalities. This will facilitate holistic and intuitive decision-making processes and improve data quality. It will additionally promote more effective and coordinated interventions across different levels of service provision.

Provide technical support and conduct capacity-building initiatives to help utilities and munici-palities manage NSS data effectively. Enhancing capacities in this way can foster greater self-reliance and resilience within these organizations.

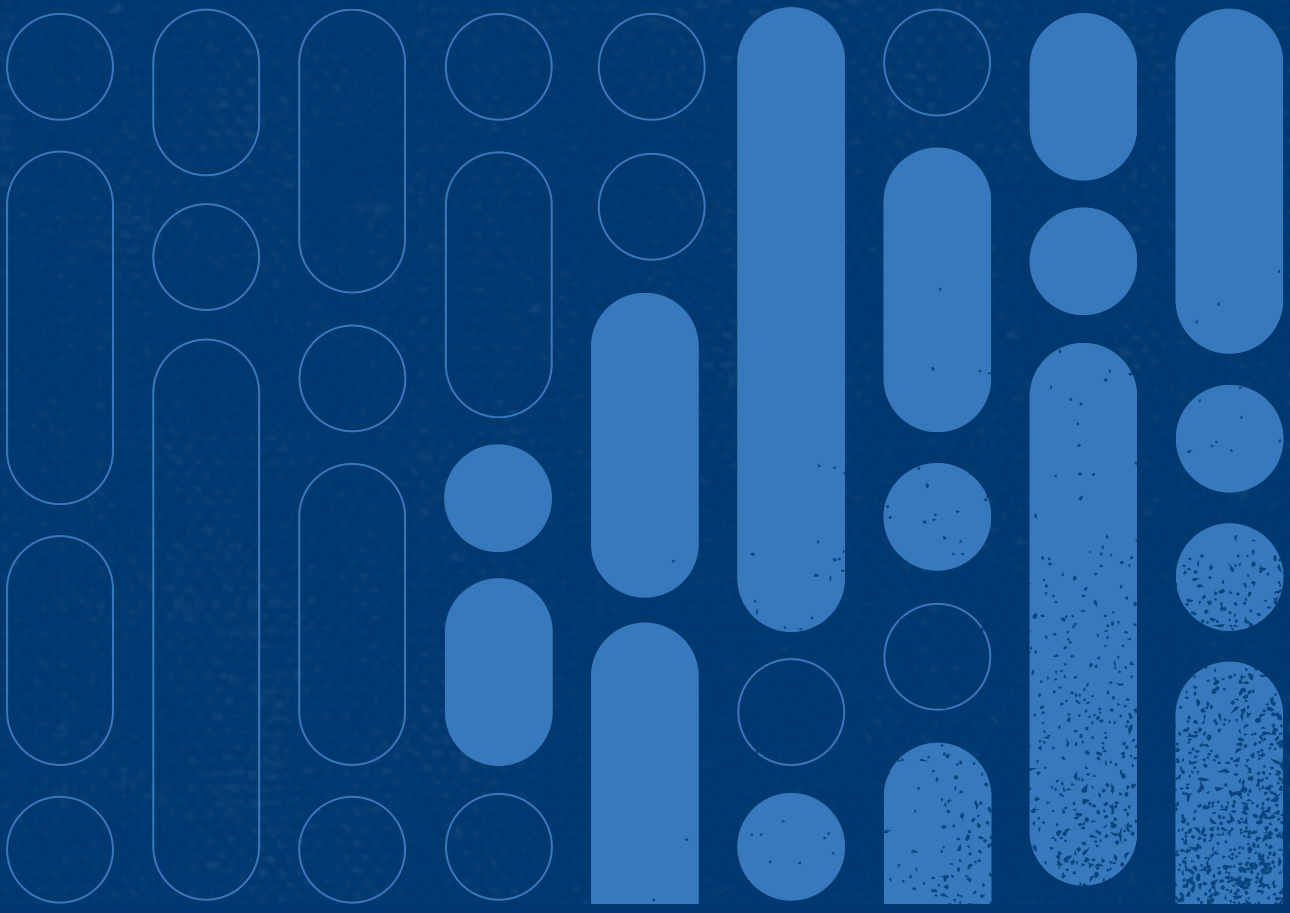
Promote global and regional partnership plat-forms, such as ESAWAS Engage, the Global Water Operators' Partnerships Alliance (GWOPA), VEI, and AfWASA. These platforms offer WASH stakeholders, including utilities and municipalities, the opportunity for peer-to-peer learning and knowledge exchange, ultimately enhancing their capacity and improving service delivery and performance management.

The image represents knowledge transfer and collaboration, key elements in bridging data gaps between stakeholders.

INTRODUCTION

01

This report presents findings from the landscape assessment of non-sewered sanitation (NSS) public data systems in utilities and municipalities across sub-Saharan Africa (SSA).



1.1 OVERVIEW

This report presents findings from the landscape assessment of non-sewered sanitation (NSS) public data systems in utilities and municipalities across sub-Saharan Africa (SSA). Dev-Afrique Development Advisors (Dev-Afrique) conducted this assessment between April and July 2024, with support from the Gates Foundation .

The NSS public data systems landscape assessment adopted a highly consultative and participatory approach, engaging with key stakeholders within the water, sanitation, and hygiene (WASH) sector at the national and subnational levels. Stakeholder interviews were conducted with utilities, municipalities, regulators, and ministries responsible for health and WASH functions, with the goal of eliciting insights on the current state of utility and municipality NSS data systems and identifying areas where improvement is needed. The interviewees included stakeholders from 10 SSA countries: the Democratic Republic of Congo (DRC), Ethiopia, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia.

The assessment identifies gaps and challenges in the generation, analysis, and operationalization of NSS data. These issues persistently hinder utilities and municipalities' efforts to improve service delivery and carry out internal performance management functions.

The landscape assessment also provides recommendations for the identified gaps targeted towards utilities, municipalities, regulators, governments, development partners, and donors. These recommendations can serve as a guide to interventions intended to strengthen the NSS data systems used in the sector for evidence-based decision-making, and can help steer donor investments for this purpose within SSA.

The assessment also serves as a call to action, urging stakeholders to commit swiftly to improving NSS public data systems across SSA. This report has six chapters. Chapter one introduces the topic of NSS, focusing on sanitation challenges in SSA and the role of data systems. The first chapter also outlines the assessment's methodology. Chapter two covers the landscape assessment results. Specifically, it discusses the institutional arrangements within SSA's sanitation sector, the types and sources of NSS data used along the entire sanitation value chain, and the tools and systems used for data generation. It also explores NSS data processing methods, as well as the tools and systems used for data analysis and visualization. Additionally, it delves into the operationalization of NSS data by utilities and municipalities for the purposes of service delivery and internal performance management.

Using case studies, **Chapter three** illustrates the digital transformation journey of comparatively advanced utilities in SSA. **Chapter four** underscores the challenges and barriers faced by utilities and municipalities in the NSS data ecosystem, while **Chapter five** recommends specific measures, segmented by stakeholder group, that could address these challenges. Finally, **Chapter six** summarizes key takeaways from the report, highlights areas for future research, and issues a call to action to all relevant stakeholders.

The site features interconnected pipelines, pumps, and processing units, highlighting efforts to ensure clean water supply and effective sanitation services in the community.

1.2 BACKGROUND

The United Nations (UN) recognizes access to sanitation as a human right that is fundamental to everyone's health, dignity, and prosperity. [28] The 2030 Agenda for Sustainable Development, adopted by UN member states in 2015, outlines a global framework for addressing pressing challenges through 17 interlinked Sustainable Development Goals (SDGs) intended to foster prosperity, end poverty, fight inequality, and protect the environment. [29] Each of the Goals establishes targets with specific indicators as a means for monitoring progress.

SDG 6 seeks to "ensure the availability and sustainable management of water and sanitation for all by 2030." Target 6.2 within this goal aims to "achieve access to adequate and equitable sanitation and hygiene for all and end open defecation by 2030, paying special attention to the needs of women and girls and those in vulnerable situations." This target is tracked through indicator 6.2.1a, the "proportion of population using safely managed sanitation services," the highest service level on the SDG sanitation services ladder.[30]

Unfortunately, several factors have delayed progress in achieving SDG target 6.2. These include inadequate investments, poor sector leadership, weak coordination, and ill-defined institutional structures for inclusive sanitation service delivery at different levels of governance. The sanitation sector's lack of visibility and political champions has further prevented strong policies from translating into increased investments, particularly with regard to pro-poor urban sanitation improvements.

In 2022, just 57 percent of the world's population had access to safely managed sanitation services.[31] This means that 3.5 billion people still lacked safely managed sanitation worldwide, thereby requiring a fivefold increase in current rates of progress to achieve universal access to safely managed sanitation by 2030. [32] In the same year, the situation in SSA was especially dire, as only 26 percent of the population had access to safely managed sanitation. [33]

Despite being recognized as a human right, sanitation often competes with other priorities that have higher political profiles, such as water supply, infrastructure, energy, health, and education. These competing priorities discourage the allocation of human and financial resources to sanitation. Furthermore, SDG 6 progress monitoring is undermined by inadequate data systems and significant data gaps, as WASH sectors within most regions still lack developed data cultures. SSA countries are unlikely to meet the SDG 6.2 target by 2030 unless urgent measures are adopted, including the creation of appropriate financing mechanisms, the strengthening of WASH institutions, the implementation of efficient data systems, and the use of more disaggregated data to support the design and implementation of robust WASH policies and programs at both the national and subnational levels. [34]

SDG 6 SEEKS TO
"ENSURE THE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL BY 2030."

28. https://www.unwater.org/water-facts/human-rights-water-and-sanitation
29 https://sdgs.un.org/goals
30 https://sdgs.un.org/goals/goal6
31 UNICEF and WHO, 2023. Progress on household drinking water, sanitation and hygiene 2000–2022: Special focus on gender. New York.
32 ibid.
33 WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene.
34 2023 Africa Sustainable Development Report: Accelerating recovery from the coronavirus disease (COVID-19) and the full implementation of the 2030 Agenda for Sustainable Development and African Union Agenda 2063 at all levels.

1.3 NON-SEWERED SANITATION (NSS)

NSS is the provision of off-grid/decentralized sanitation facilities and services to ensure the safe management of human excreta. NSS facilities collect, store, and to some extent treat human excreta at or near the point of generation. Unlike sewered sanitation, NSS facilities do not rely on sewer networks, but instead use containment systems such as pits and septic tanks to manage human excreta. Some examples of NSS facilities include pit latrines, ventilated-improved pit latrines, composting toilets, pour-flush latrines, septic tanks, and container-based sanitation.

Through fecal sludge management practices, NSS services ensure that the fecal sludge contained within NSS facilities is emptied, transported, and adequately treated at a fecal sludge treatment plant (FSTP) before safe disposal or reuse. Every NSS service model must follow the complete sanitation service chain (Figure 1) to provide for the safe and hygienic management of human excreta. The service chain refers to the series of processes involved in managing human excreta from its initial generation to its final safe disposal or reuse. It typically includes five key stages: capture and containment, emptying, transport, treatment, and safe reuse or disposal.

The sanitation service chain begins with capture, referring to the type of toilet or user interface (e.g., pedestal, pan, or urinal) that the user interacts with.

The capture stage is followed by containment, at which point excreta is collected in septic tanks, containers, or pits, to prevent environmental contamination. Next is emptying, which involves safely removing the accumulated excreta from containment facilities, and transport, during which excreta are moved to treatment facilities with measures in place to minimize spillages and leakages.

In the treatment stage, excreta undergo processing to remove harmful pathogens. This makes them suitable for safe disposal or reuse as valuable resources such as soil conditioners, briquettes, or biogas, ultimately safeguarding public health and the environment.

For NSS to qualify as safely managed sanitation, the facilities must be unshared and must additionally ensure that human excreta is properly contained and not released into the environment untreated, where it could expose people to pathogens. Safe handling of this kind is possible if;

- the containment facility is not emptied and does not pose a threat of infiltration into the environment, and the human excreta is treated and disposed of in situ;
- the pit or tank is emptied and the human excreta are disposed of in situ; or (iii) the pit or tank is emptied, and the human excreta are transported and treated off-site.

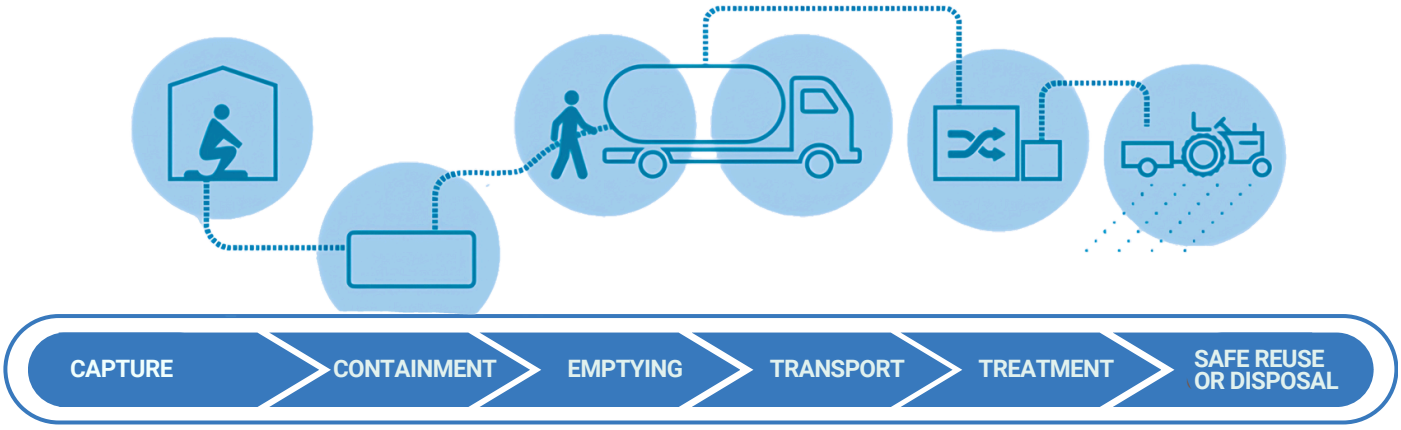


Figure 1: *Sanitation service chain* [35]

35 International Reference Centre for Water and Sanitation (IRC)

1.4 SANITATION CHALLENGES IN SUB-SAHARAN AFRICA

Globally, between 2015 and 2022, the share of the population covered by safely managed sanitation services increased by eight percent, from 49 percent to 57 percent. By comparison, the share of the population in SSA covered by safely managed sanitation increased by only two percent, from 22 percent to 24 percent. In 2022, 10 percent of the SSA population had access to basic sanitation services, 18 percent to limited services, 31 percent to unimproved facilities, and 17 percent practiced open defection.[36]

Notably, in 2022, more people used NSS (46 percent) than sewered sanitation (42 percent) globally.[37] Within the SSA region, the WHO/UNICEF Joint Monitoring Programme (JMP) estimates that only about 13 percent of the population has access to sewered sanitation; conversely, NSS is the dominant form of sanitation, with 47 percent of the region's population using NSS facilities of varying levels of quality. Furthermore, over half of the 1.5 billion people who lack at least basic sanitation services globally live in SSA (762 million). One in five of the region's residents use limited (shared) services, and SSA has the largest number of people (193 million) within a single region practicing open defecation.[38]

The low coverage rates of centralized sewer systems in SSA pose a significant threat to public health and the environment, and is largely attributed to the high capital and maintenance costs associated with such systems, as well as to topographical challenges. These challenges are further exacerbated by rapid rates of population growth and urbanization, which are in turn associated with the proliferation of informal settlements. These informal/unplanned settlements are characterized by high population densities, limited space, unclear ownership rights, insecure land tenure patterns, and a high prevalence of poor residents who are often unwilling or unable to pay for improvements of their sanitation systems. These factors reduce the appeal of capital investments for service providers.

Despite these factors, many countries, including those in the SSA region, have at least minimally increased sanitation coverage for their populations, as shown by the proportional increase in improved sanitation coverage. Between 2000 and 2022, the recorded increase in the overall number of people using improved sanitation services in the form of NSS facilities was far greater, at 1.9 billion people, than the corresponding increase in coverage via sewer connections, at 1.3 billion people.[39]

Evidently, the shift up the sanitation ladder relies heavily on NSS, a fact that further supports the case that greater attention should be paid to NSS services in the SSA region. NSS not only provides immediate and practical solutions for fecal sludge management; it also contributes to public health, environmental protection, and social equity. There is also the potential for NSS to be more resilient to climate impacts than centralized sewer systems. By addressing the sanitation needs of those who typically would not have access to conventional sewerage,[40] NSS is pivotal in efforts to achieve universal access to safe sanitation, as outlined in SDG 6. It is an indispensable component of SSA's citywide inclusive sanitation (CWIS)[41] efforts, which aim to improve sanitation coverage and enhance the quality of life for millions of people.

36 UNICEF and WHO, 2023. Progress on household drinking water, sanitation and hygiene 2000–2022: Special focus on gender. New York.
37 ibid.
38 ibid.
39 UNICEF and WHO, 2023. Progress on household drinking water, sanitation and hygiene 2000–2022: Special focus on gender. New York
40 Strande, L. (2024). Integrating recent scientific advances to enhance non-sewered sanitation in urban areas. Nature Water, 1-14.
41 CWIS is an urban sanitation approach designed to ensure that all individuals have access to equitable, adequate, affordable, and improved sanitation services. This approach encompasses a range of systems, both sewered and non-sewered, and aims to prevent environmental contamination throughout the entire sanitation service chain.

1.5 IMPORTANCE OF DATA SYSTEMS FOR NSS

NSS data systems are a cornerstone for informed decision-making, performance management, and evidence-based financing.

Without robust and reliable NSS data systems, various stakeholder groups are left to make decisions based on assumptions or incomplete information, leading to inefficiencies, inequities, and missed opportunities for improvement. NSS data systems enable these stakeholder groups to collect data on system coverage, performance, and quality to monitor progress toward set and defined KPIs at the utility/municipal, regulatory, ministerial, and global levels. They further facilitate the identification of service delivery inefficiencies by highlighting underserved regions and populations to ensure resources are allocated where they are needed most. These data systems can ultimately facilitate targeted investment toward improved service access, prevent environmental contamination, and enhance public health outcomes.

NSS data systems can facilitate climate change mitigation strategies.

Growing evidence links poorly managed NSS systemst o environmental degradation through greenhouse gas emissions, groundwater pollution, and inefficient waste treatment practices. Therefore, investing in robust NSS data systems can generate data on waste generation, collection routes, and treatment efficiencies for optimizing processes that minimize gas emissions and overall environmental pollution. Also, NSS data systems are contributors to and beneficiaries of climate-resilient approaches such as predicting climate change impacts on sanitation infrastructure for proactive adaptation measures. Therefore, robust NSS data systems should account for the importance of the data they generate in cross-sectoral decision-making processes, e.g., health and environmental protection.

The importance of NSS data could further be enhanced by applying artificial intelligence and machine learning in data system workflows. Integrating artificial intelligence (AI) and machine learning (ML) workflows allows more advanced and faster data analysis to uncover more nuanced insights and make predictions that would otherwise be impossible.

For example, Eawag [42] is implementing a sludge snap app, which employs a machine learning algorithm to characterize wastewater. The app allows the user to take a picture of the sludge, and then the app processes the image to provide rapid onsite predictions of the fecal sludge's characteristics. Using such approaches also enhances operational efficiency by providing real-time insights. AI and ML approaches can use historical data to indicate when a system is likely to fail and allow utilities/municipalities to conduct maintenance before problems arise, reducing costs and preventing service interruptions. These approaches integrate multiple data sources –population density, waste production rates, climatic conditions, transport networks, and distribution of services – to optimize service delivery and improve decision-making and performance management.

Therefore, as the world grapples with challenges that come with urbanization and climate change, NSS data becomes a powerful tool for building resilience. By integrating cutting-edge technologies such as AI and ML, we can unlock the potential of NSS data systems, transforming them into a driver of performance management, innovation, and sustainable development.

Investing in NSS data systems is not just a necessity—it is a transformative opportunity to reimagine sanitation as a force for health, dignity, and a sustainable future for all.

42 Eawag aquatic research, 2024. AI in Water and Wastewater Sectors – Background, Potential & Emerging Applications

1.5 METHODOLOGY

This NSS landscape assessment evaluates NSS data systems among utilities and municipalities in SSA with the goal of guiding interventions strengthening the sector's data systems.

Specifically, the assessment aimed to:

- Understand the institutional setup for NSS service provision in SSA countries;
- Evaluate the generation, analysis, and operationalization of NSS data; and
- Identify NSS data system gaps, weaknesses, opportunities, and best practices.

The assessment utilized a qualitative case study methodology with a participatory approach across three main phases: adaptation and validation of the assessment framework, desk-based research, and interviews with sampled stakeholders as outlined in the sections that follow.

Adaptation and Validation of the Assessment Framework

In the first phase of the assessment, Dev-Afrique used the geospatial value pipeline framework previously employed in 2022[43] to map the critical elements of a data system. In the adapted framework – called the sanitation data value pipeline framework (Figure 2) – the data value chain is informed by the defined intended use of the data., herein this case, the data is needed to inform utility/municipal service delivery, internal performance management, and reporting.

Once the intended use of the data has been defined, the activities that constitute successive elements of the pipeline—in this case, data generation, data analysis, and data operationalization—are set into motion. The sanitation data value pipeline has three layers—the main pillars, subpillars, and data system principles.

1. Main pillars: The main pillars visually summarize the sanitation data system flow through the pipeline, as data generation, analysis, and operationalization.
2. Subpillars: The subpillars summarize the critical elements that must be addressed within each main pillar component for sanitation data to be fully and effectively utilized.

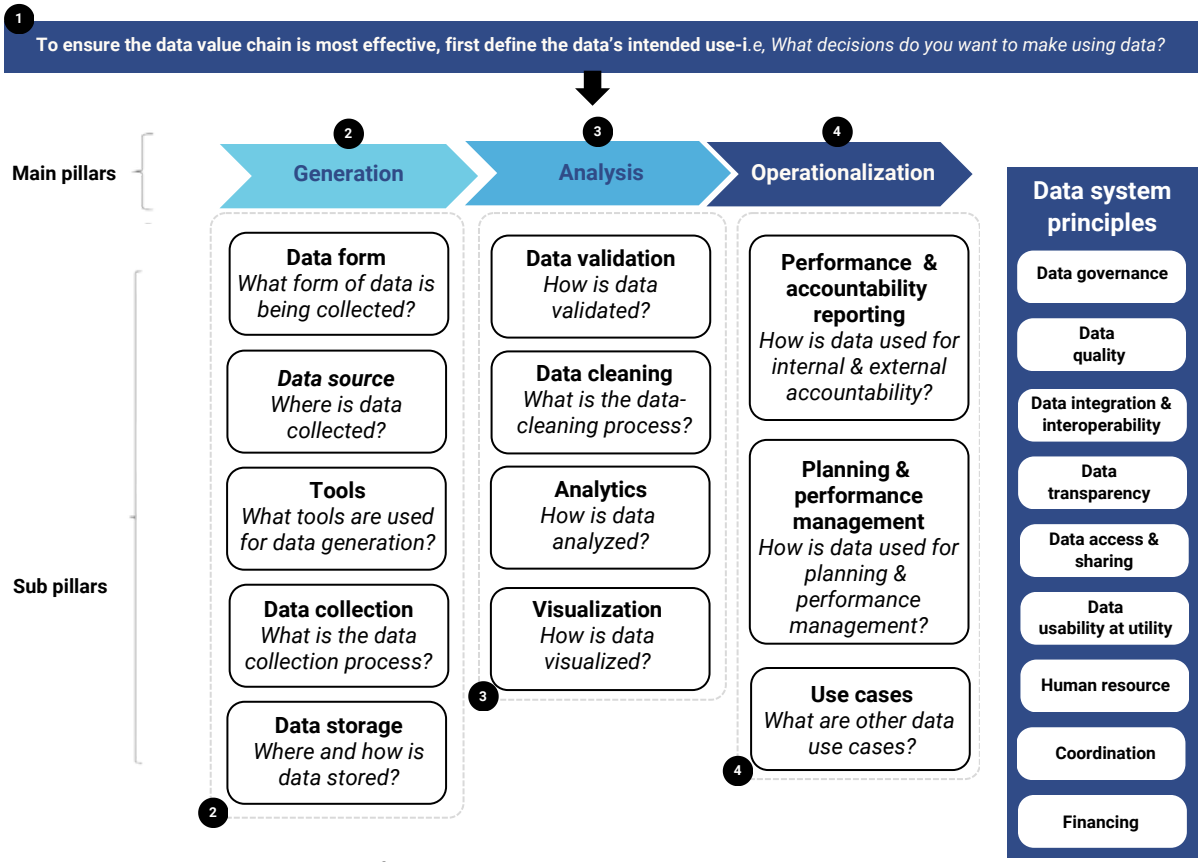


Figure 2: *Sanitation data value pipe line framework*

43 https://devafrique.com/wp-content/uploads/2023/12/Official-Report-of-Nigerias-Geospatial-Value-Pipeline-Assessment.pdf

3. Data system principles:

These principles express the success factors that need to be in place for a sanitation data system to be effective. They include data governance, data quality, data integration and interoperability, data transparency, data access, data usability, human resources, coordination, and financing.

To complement the sanitation data value pipeline, Dev-Afrique mapped out the critical WASH data interaction flow and summarized using a chart (Figure 3). Multiple stakeholders were engaged in brainstorming sessions to adapt and map the WASH ecosystem data interaction chart. The stakeholders involved in our external brainstorming sessions included the Bill & Melinda Gates Foundation, the Eastern and Southern Africa Water and Sanitation (ESAWAS) Regulators Association, and Athena Infonomics. Additionally, Dev-Afrique presented the framework at the ESAWAS Consultative Workshop on Strengthening Regulatory Data and Systems in Zimbabwe (2024) to participants including regulatory authorities from 24 African countries; utilities; development partners and donors such as the World Bank, the African Development Bank (AfDB), UNICEF, and Water and Sanitation for the Urban Poor (WSUP); private-sector actors; and the Pan-African Association of Sanitation Actors (PASA).

Dev-Afrique reviewed multiple WASH data system frameworks — including MEASURE Evaluation's Performance of Routine Information System Management (PRISM) framework, which is frequently used in the health sector—to design the WASH data system interaction chart.

The chart depicts service delivery as the overarching driver for data generation, analysis, and operationalization at the utility/municipal level. Service delivery lies at the heart of sanitation data systems and depends on all the critical activities of utility operations – including technical and commercial functions, financial management, and efforts to strengthen organizational capacities. The need for evidence-informed service delivery and internal performance management calls in turn for data generation, analysis, and operationalization —the three main components of the data value chain. The data value chain is then guided by eight overarching principles that must all be incorporated into the implementation process for the system to function successfully.

Sanitation data systems at the utility/municipal level usually integrate with data systems at the national and global levels to enable effective decision-making processes and support the credibility of national and global monitoring systems. Using a bottom-up approach, data from the utility/municipality flows to the national and global systems. At the national level, the data is used to hold service authorities accountable, report to the sector regulator, and report to the ministry responsible for water and sanitation. At the global level, the data is mostly used for SDG reporting. Utilities/municipalities also rely on global and national insights to inform their KPIs and standards, using a top-down approach.

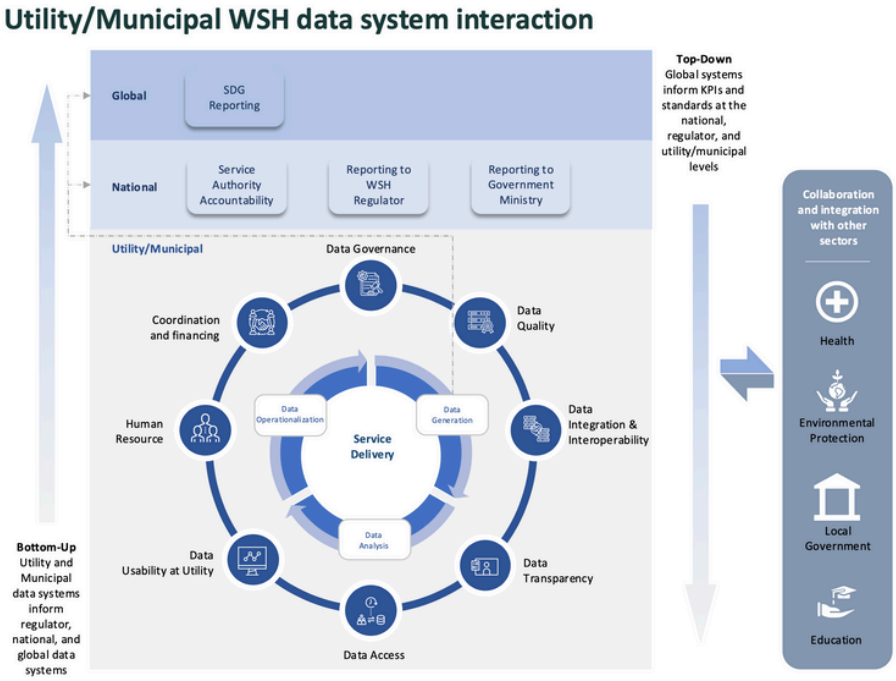


Figure 3: *WASH data system interaction chart*

Given the cross-cutting nature of sanitation, the sector's data ecosystem naturally interacts with other sectors such as health, environmental protection, local government, and education. Accurate sanitation data is crucial for public health and environmental initiatives, as it informs the spread of waterborne diseases and subsequent interventions, environmental management practices that protect natural resources, and guides climate change adaptation/mitigation measures. For example, local governments may rely on this data when engaging in infrastructure development, resource allocation, enforcement of legal/regulatory provisions, and urban planning, all of which impact community services and quality of life. In education, sanitation data informs gaps in sanitation and hygiene services in school environments that could affect student health and eventual learning outcomes.

DESK RESEARCH

Dev-Afrique conducted an initial desk-based review of online articles, WASH stakeholder websites and publications, reports, strategies, standard operating procedures, policies, and scholarly articles to explore existing insights. The team used a combination of multiple search terms and Boolean operators to identify and retrieve relevant literature. Some of the search terms used included "WASH data systems," "NSS data systems," "NSS data," "WASH institutional arrangement," "NSS data collection," "NSS data analysis," and "NSS data use." "NSS" was used interchangeably with the term "on-site sanitation" during the search.

The desk-based review offered preliminary insights into the questions outlined in the research framework, especially those related to WASH institutional structures across the target countries in SSA. However, limited information was available on the core aspects of the NSS data pipeline as implemented by the region's utilities and municipalities—that is, data generation, analysis, and operationalization—or on these institutions' data system principles. This gap is mainly attributable to the infancy of NSS data systems and the consequent scarcity of research in these areas. The subsequent stakeholder interviews added valuable context, enriching the initial findings from the desk review phase. research in these areas. The subsequent stakeholder interviews added valuable context, enriching the initial findings from the desk review phase.

STAKEHOLDER INTERVIEWS

The stakeholder interview sampling frame included 39 stakeholders [44] from West, East, Central, and Southern Africa. Using purposive sampling, Dev-Afrique sampled 28 stakeholders from 10 countries to reach theoretical saturation (see Appendix 2 for the list of sampled stakeholders). These focus countries included the Democratic Republic of Congo (DRC), Ethiopia, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia. These countries were sampled based on relevance to ensure maximum variation in the type of regulation, advancement in NSS service provision, and data system advancement.

Another reason for limiting to only these countries was the non-response from other countries in the sampling frame. The sampled stakeholders were from multiple institutions, including the national ministries of water and sanitation, ministries of health, national regulators, municipalities, and utilities. Although the study was primarily focused on the utility/municipal level, the other stakeholders—ministries of water and sanitation, ministries of health, and water and sanitation regulators—were included to understand the NSS mandate and ecosystem interactions.

DATA ANALYSIS

Insights from the interview transcripts were extracted as codes and used to generate thematic focuses for the different sections of the report. The questions used for the interviews thus shaped these themes. Their insights have been synthesized and form part of the findings of this report.

"ACCURATE SANITATION DATA IS CRUCIAL FOR PUBLIC HEALTH AND ENVIRONMENTAL INITIATIVES"

44 The sample frame consisted of three key stakeholder groups — the WASH ministry, WASH regulator, and the mandated NSS service provider (either a utility or municipality) — from 13 countries across SSA.

LIMITATIONS

The findings of this assessment may not fully represent the overall state of NSS data and data systems across SSA, beyond the 10 countries included in this assessment. However, they may be transferable to countries with similar characteristics and settings – i.e., the type of regulation, advancement in NSS service provision, and data system advancement. While the key insights from these interviews may apply to countries with similar contexts, it is important to recognize that the nuances may differ from setting to setting.

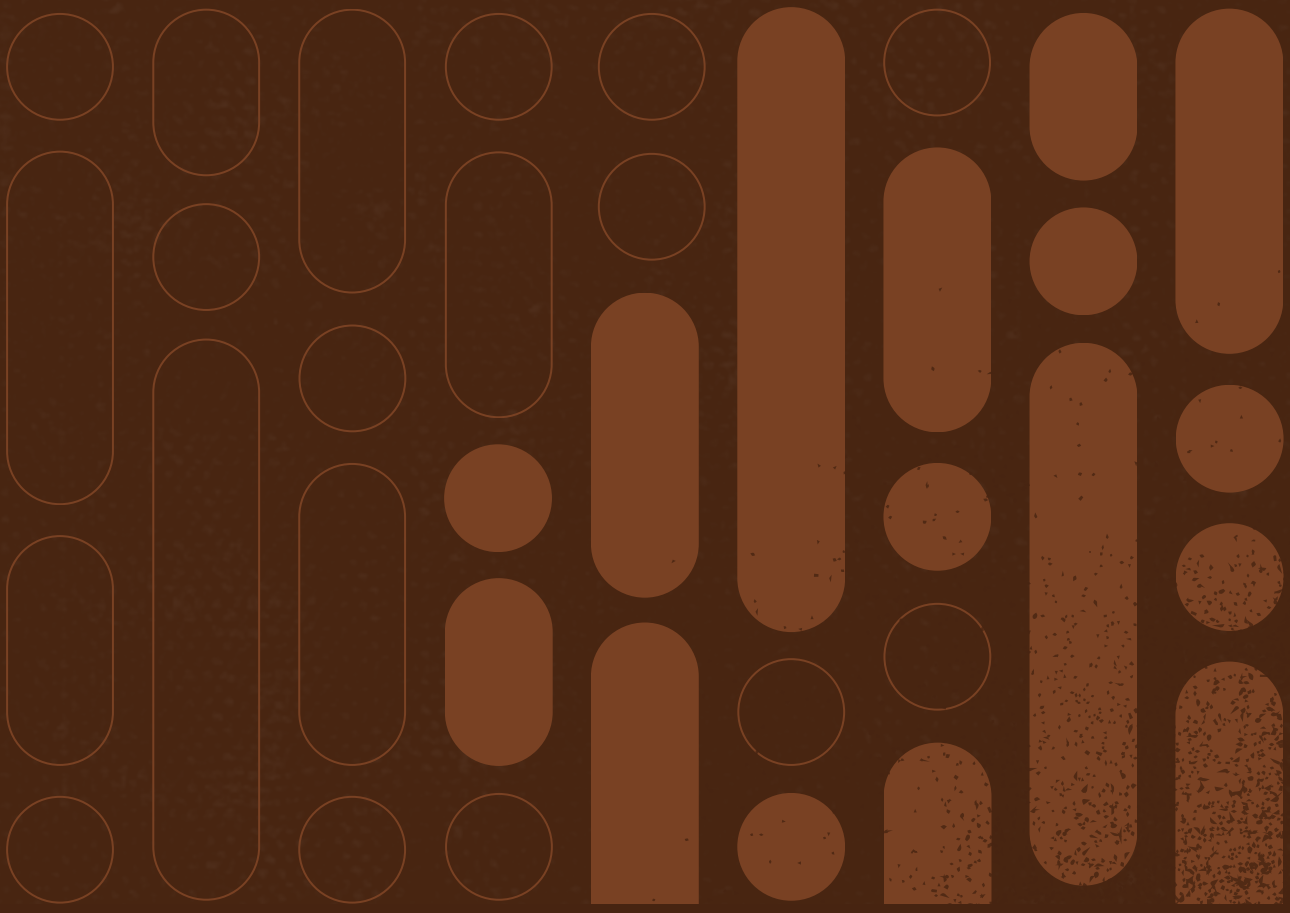
To address this limitation, Dev-Afrique supplemented the stakeholder interviews with desk research, broadening the geographic scope and providing additional perspectives from across SSA. However, availability of online resources on the components of the NSS data pipeline remains limited, as this topic has only recently begun receiving significant attention. Despite this, the research offers valuable insights that can contribute to the ongoing discourse on strengthening NSS data systems across SSA.

Building sustainable public data systems and utilizing geospatial data and digital tools to advance social interventions at the last mile – DRC.

FINDINGS:

02

The findings of this landscape assessment provide an overview of the status of NSS data systems in SSA, focusing on 10 countries.



FINDINGS: LANDSCAPE OF SUB-SAHARAN AFRICAN'S DATA ECOSYSTEM

The findings of this landscape assessment provide an overview of the status of NSS data systems in SSA, focusing on 10 countries. Specifically, the findings highlight institutional arrangements within the sanitation sector; describe NSS data generation, analysis, and operationalization practices; and identify challenges encountered across the ecosystem among the 10 study countries. The study first seeks to describe institutional structures, providing readers with initial insight into the roles and responsibilities of these mandate holders. It then examines how such institutions handle NSS data throughout its lifecycle. The report additionally identifies areas where further effort is needed to optimize the impact of NSS data, both for service delivery and to improve internal performance management at the utility and municipality levels.

2.1 INSTITUTIONAL MANDATES

Clearly defined responsibilities, also referred to as "mandates," form the foundation of all CWIS functions. Clear and inclusive urban sanitation mandates reduce duplication of effort, minimize rivalries between mandate holders, and lessen resource-use inefficiencies. Mandates can be clarified by specifying and enshrining stakeholder roles and responsibilities in legislation and policy documents.[45]

Policy Formulation Mandates for Urban Sanitation

In SSA, ministries of water and sanitation (MWS) and ministries of infrastructure and energy are responsible for policy development, strategic direction, sector oversight, coordination, and the mobilization of resources for the sanitation sector. In most cases, the responsible ministry works closely with ministries of health, environmental protection, local government, and education to provide a multisectoral approach, and to ensure that sanitation policies align with broader health, environmental protection, water resource management, and education goals.

Furthermore, typically working through local or district authorities, ministries of local government serve as an integral part of the implementation structure for inclusive sanitation by developing by-laws, issuing business permits for private operators providing FSM services, and enforcing design standards for NSS facilities.

Regulation Mandates for Urban Sanitation

A well-functioning regulatory system is a key factor in the delivery of safe, equitable, and reliable water supply and sanitation (WSS) services. The role of regulatory actors is to ensure a balance between service quality, the interests of consumers, and the financial sustainability of service providers.[46]

In Africa, many countries' overall regulatory arrangements are biased toward regulating water supply service delivery, with sanitation often receiving considerably less attention. Only about 15 (28 percent) countries out of the 54 countries in Africa have strong legal frameworks for regulating sanitation services. The lack of sufficient legal frameworks in the remainder of these countries is a key constraint to the effective regulation of sanitation services. Furthermore, even though most African countries rely on NSS, greater progress has been made in developing and applying regulations for sewered sanitation.[47]

Across SSA, four dominant regulatory models [48] are used for the regulation of sanitation service provision. These include regulation by agency, regulation by ministry, regulation by contract, and self-regulation.

1. Regulation by agency:

Some countries within SSA have well-established, dedicated, and partially autonomous WSS regulatory

45 Schrecongost et al (2020) Citywide Inclusive Sanitation: A Public Service Approach for Reaching the Urban Sanitation SDGs. Policy Brief. Frontiers in Environmental Science.
46 ESAWAS and WSUP, 2020. Referee! Responsibilities, regulations and regulating for urban sanitation
47 ESAWAS, 2022. The Water Supply and Sanitation Regulatory Landscape Across Africa
48 A predominant regulatory model refers to the regulatory model under which the primary service provider in each country is regulated. In most cases, this refers to how a national or regional utility is regulated

agencies whose mandates are enshrined in national legislation and policy documents. In these countries, the regulatory agencies regulate the utilities or in national legislation and policy documents. In these countries, the regulatory agencies regulate the utilities regulate the utilities or municipalities, which are in turn responsible for providing sanitation services. Some of the countries implementing the regulation by agency model include Kenya (Water Services Regulatory Board), Zambia (National Water Supply and Sanitation Council), Rwanda (Rwanda Utilities Regulatory Authority), Tanzania (Energy and Water Utilities Regulatory Authority), Nigeria (applied at the subnational level through entities such as the Ekiti and Lagos state water and regulatory commissions), Seychelles (Public Health Authority), Cape Verde (National Water and Sanitation Agency), and Mozambique (Water Regulatory Authority - AURA). The strong legal frameworks for WSS regulation in these countries lay the foundation for effective WSS regulation by clearly defining regulatory mandates and empoweringregulatory actors with substantial financial and managerial autonomy. Notably, regulation by agency is the predominant model in 80 percent of the countries in Africa in which NSS services are regulated at scale, covering all or part of the service chain.[49]

2. Regulation by ministry:

Another regulatory model used within the SSA region involves ministries responsible for WSS—or an aspect of WSS—being assigned some or all regulatory responsibilities through national legislation and policy. In such countries, the ministry responsible for WSS performs multiple regulatory roles alongside their typical policy formulation duties, such as developing standards and guidelines, and overseeing the utilities responsible for sanitation service provision. Some of the countries implementing this model include Ethiopia (Ministry of Water and Energy), Malawi (Ministry of Water and Sanitation, Ministry of Health and Ministry of Local Government), South Africa (Department of Water and Sanitation), Eswatini (Ministry of Health), DRC (Ministry of Health and Public Hygiene), Botswana (Department of Water Management and Pollution Control), Madagascar (Ministry of Water, Sanitation and Hygiene), Mauritius (Ministry of Energy and Public Utilities), and Uganda (Water Utilities Regulation Department).

3. Regulation by contract:

In some SSA countries, a public entity (other than an autonomous regulatory agency) and a service provider agree on contractual terms that determine how key aspects of WSS service provision will be defined and controlled, for instance with regard to tariffs and service standards. The public entity is responsible for developing the contracts, including determining key performance indicators and targets, as well as monitoring service providers' performance during the contract period. For its part, the contracted entity provides sanitation services. An example of a country implementing this model is Senegal, through the National Sanitation Agency of Senegal (ONAS).

4. Self-regulation:

Another style of regulation used within the SSA region involves a public utility or unit of local government providing WSS services while being legally mandated to self-regulate their own activities. In such countries, the entity itself performs regulatory activities such as setting performance standards, carrying out performance monitoring, and reporting. Some of the countries implementing thismodel include Djibouti (National Office of Water and Sanitation) and Uganda (Kampala Capital City Authority). In Uganda, the Kampala Capital City Authority (KCCA) self-regulates NSS service provision through a fecal sludge ordinance that details fecal sludge management (FSM) service provision and enforcement guidelines. Meanwhile, in smaller towns, municipal and town councils manage and regulate the provision of NSS services.

The growing momentum around regulation of NSS in a number of SSA countries is a promising and crucial development. Countries like Tanzania, Mauritius, Seychelles, Rwanda, Kenya, Senegal, Zambia, and Egypt have all made significant progress in developing regulations and regulatory mechanisms for NSS services. In each of these cases, significant challenges in ensuring that these mechanisms can be implemented at scale remain. Nonetheless, in recent years, some WSS regulators have made notable strides in regulating NSS service provision.[50]

In Zambia, National Water Supply and Sanitation Council (NWASCO) incorporated NSS and FSM into the regulatory structure in 2018 by launching the Urban On-site Sanitation and Fecal Sludge Management Framework. This framework marked a pivotal step toward embracing inclusive sanitation, as it clarified the roles, responsibilities, and mandates of various institutions involved in OSS and FSM.

49 ESAWAS, 2022. The Water Supply and Sanitation Regulatory Landscape Across Africa
50 IWA and ESAWAS, 2022. Mapping the sanitation regulation framework across Africa

In the process of implementing this urban OSS and FSM services framework, NWASCO:

- Modified utilities' licensing conditions to cover NSS;
- Directed utilities to rebrand themselves from "water and sewerage" to "water and sanitation" companies;
- Developed standard operating procedures and generic organizational structures for the delivery of NSS services;
- Developed inclusive sanitation KPIs/ targets;
- Developed permitting conditions to guide utilities seeking to delegate service provision responsibilities to other service providers;
- Supported data capture by utilities through GIS mapping, including tool standardization and processes for sharing this data with stakeholders;
- Supported utilities in the development of strategies for delivering NSS; and
- Reviewed the web-based NWASCO Information System (NIS) in order to incorporate NSS data.

In Rwanda, unlike in many African countries that place greater emphasis on sewered sanitation, RURA has placed a strong focus on regulating the NSS solutions that are used by an overwhelming majority (96 percent) of its population. Although some challenges persist, the following regulatory interventions are given credit for the country's success in providing over 69 percent of the population in Rwanda with at least "basic" sanitation services:

- The development and enforcement of standards for on-site sanitation facilities and septic tanks. Households are required to obtain construction permits for all containment facilities.
- The regulation of emptying and transportation by RURA via key performance indicators included in the contracts signed between districts and private service providers.
- Development of a draft policy document based on the principles of citywide inclusive sanitation, with the goal of tackling urban sanitation functions comprehensively and further improving sanitation service delivery.

In Tanzania, the Energy and Water Utilities Regulatory Authority (EWURA) is committed to ensuring that inclusive sanitation services meet established standards and are delivered efficiently and equitably.

To achieve these goals, EWURA:

- Developed on-site sanitation and fecal sludge management guidelines (2020), aligning with national and global sustainability objectives, to assist water supply and sanitation authorities (WSSAs) in managing NSS systems;
- Developed water and wastewater quality monitoring guidelines (2020) to standardize water quality management practices across utilities;
- Integrated sanitation KPIs into the annual performance review reports of selected water utilities for the financial year 2020/2021, thus enabling systematic data collection and analysis for the purposes of regulatory oversight;
- Upgraded the Maji Information System (Maji IS) reporting system to capture sanitation data;
- Organized the National Sanitation Forum, which brings together all sanitation stakeholders in Tanzania with the goal of strengthening sanitation management;
- Facilitated capacity development by introducing the Equiserve tool for sanitation service planning, organizing learning visits to NWASCO to introduce sector participants to the sanitation regulatory framework, and providing training for WSSAs on the newly developed sanitation guidelines; and
- Supported the implementation of guidelines for small-scale decentralized wastewater treatment systems (DEWATS), developed by the Ministry of Water. This initiative highlights the importance of DEWATS in enhancing sanitation services, particularly in areas lacking centralized sewer systems, as these systems help address urbanization challenges and infrastructure limitations.

In Kenya, the Water Services Regulatory Board (WASREB) has guided utilities in the provision of inclusive sanitation services by:

- Publishing guidelines for inclusive urban sanitation service provision that encompass NSS, thus supporting the development of a sanitation management policy document that places greater emphasis on NSS;
- Developing a set of inclusive sanitation KPIs; and
- Supporting selected utilities in sanitation baseline mapping.

THE GROWING MOMENTUM AROUND REGULATION OF NSS IN A NUMBER OF SSA COUNTRIES IS A PROMISING AND CRUCIAL DEVELOPMENT.

Upon finalization of the inclusive sanitation KPIs, WASREB plans to review the web-based Water Regulations Information System (WARIS) to incorporate NSS topics.

Urban Sanitation Service Provision Mandates

The two main mandate structures for urban sanitation in SSA are detailed in Table 2. These assign the responsibility for urban sanitation services to the local government (often municipal authorities) or utility, which may be publicly or privately owned.

Additionally, mandates for sewered and non-sewered sanitation may be centralized within a single institution (integrated) or shared/split between the utility and local government (municipalities). Utility jurisdictions are grounded either at the national level or at subnational level, with subnational utilities operating at the city level or broader county, regional, or state levels.

Table 1: *Existing mandate structures for urban sanitation in Sub-Saharan African*

Mandate Structure Type	Mandate for Sewered Sanitation (SS)	Mandate for Non-Sewered Sanitatioon (NSS)	Mandate for SS and NSS, Integrated or Split	Examples
Type 1	National Utility	National Utility	Integrated	Rwanda
Type 2	Subnational Utility	Subnational Utility	Integrated	Zambia, Tanzania, Kenya, Nigeria (Still evolving)
Type 3	National Utility	Local Government	Split	Uganda, Senegal, Malawi
Type 4	Local Government/ Municipality	Local Government/ Municipality	Integrated	Ghana, Mozambique, Ethopia, South Africa

While the service chain for sewered sanitation will generally be integrated within a single institution, the service chain for non-sewered sanitation can be more complex, with responsibilities further divided according to elements of the sanitation chain. For example, the local government may hold responsibility for emptying and transport, with the utility holding responsibility for septage treatment, as is the case in Kampala (Uganda). Figure 4 provides a detailed mapping of urban sanitation responsibilities in SSA, ordered by mandate structure.

The mapping conducted by ESAWAS also clearly demonstrates that while municipalities/utilities may have a role in enforcing standards for the design and construction of facilities at the beginning of the sanitation chain, there is a widespread assumption that individual households should take full responsibility for capture and containment, and that the core institutional responsibilities for NSS begin only at the emptying stage.[51]

51 ESAWAS (2021a) Citywide Inclusive Sanitation: Responsibility

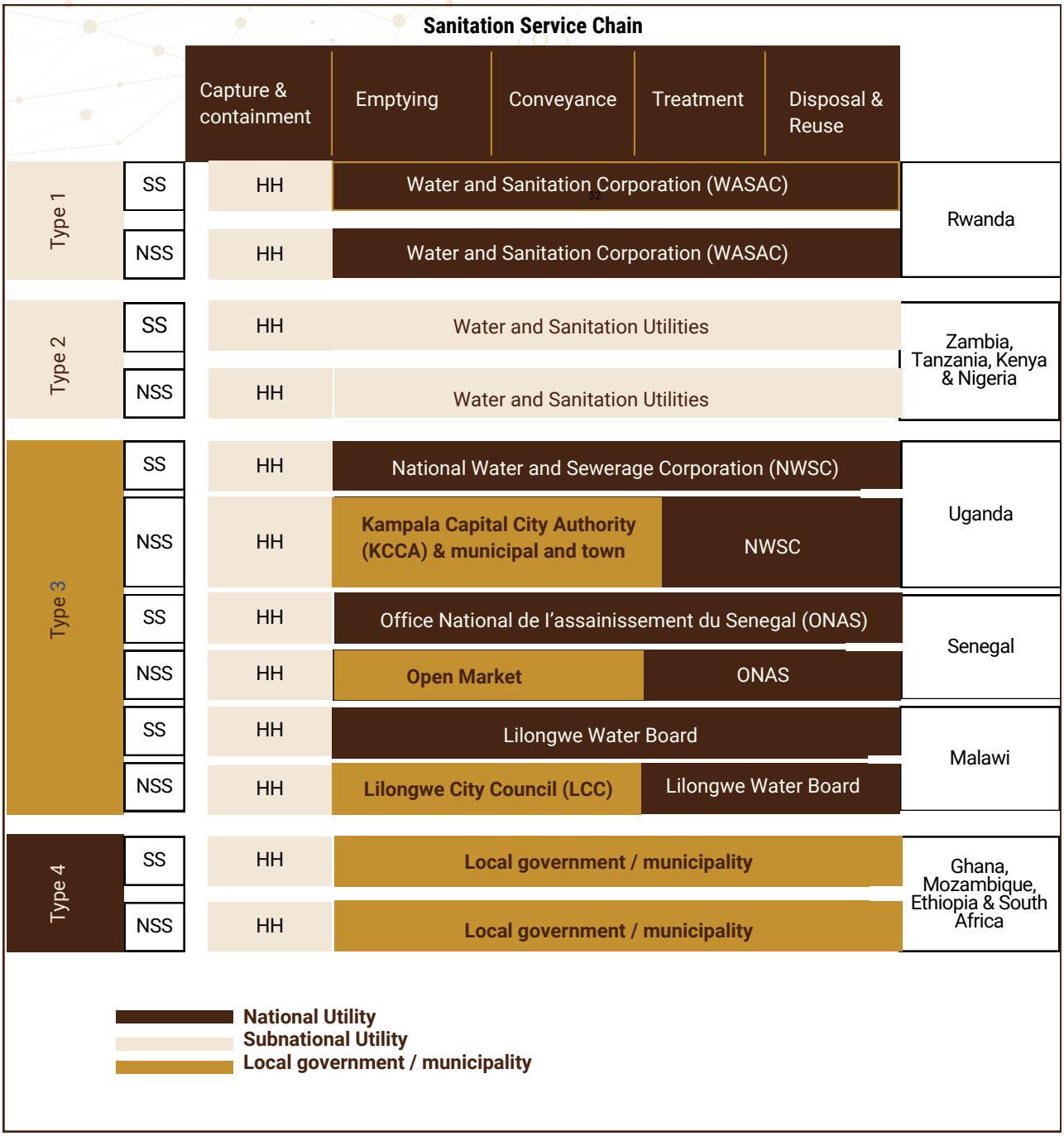


Figure 4: Mapping of responsibilities across bthe urban sanitation service chain in SSA [52]

52 ESAWAS (2021a) Citywide Inclusive Sanitation: Responsibility

2.2. DRIVERS ALONG THE DATA VALUE CHAIN

The presence of robust NSS data would enhance or enable numerous functions, responsibilities, and goals among utilities and municipalities within SSA. For example, good data would help improve service delivery, enhance reports to development partners that support sanitation programs, aid in developing appropriate business models for NSS, help create an institutional data culture, and assist in complying with regulatory reporting requirements.

However, most current efforts to capture NSS data within the ecosystem are not driven by utility or municipal requirements, as most utilities are not yet fully committed to NSS service provision responsibilities. This in turn is due to the persistence of ambiguity regarding mandates in this area. Even in cases where these mandates are clear, a culture of evidence-based decision-making has yet to be fully inculcated within the region's utilities andmunicipalities. Therefore, NSS data is collected mainly on an ad hoc, project-dependent basis, and is not included in data and operations management tools such as enterprise resource planning (ERP) systems.[53]

For example, following NWASCO's operationalization of its regulatory framework and the provision of on-site sanitation (OSS) and fecal sludge management (FSM) services, utilities were required to report baseline data on the status of existing OSS facilities and FSM services within their service areas. Consequently, utilities in Zambia, with support from NWASCO, have taken key steps such as conducting sanitation mapping, institutionalizing the use of GIS for monitoring sanitation services, investing in data-management systems to capture sanitation KPIs, and reporting to NWASCO on a quarterly basis. All of these functions combine to enhance the provision of inclusive sanitation services.

For utilities in countries where regulators have not yet made NSS data submission a regulatory requirement, generation of NSS data is largely driven by development partners through facility improvement programs. For example, for utilities in Kenya and Uganda, mapping of NSS facilities is largely done through sanitation programs such as the BMGF-funded City Wide Integrated Sanitation (CWIS) Program[54] and Upscaling Basic Sanitation for the Urban Poor (UBSUP)[55] ;the improved toilets program supported by VEI, WfL, and FINISH Ink);[56] the public toilets mapping program supported by Sanivation; the container-based toilets program supported by Fresh-Life;[57] or the sanitation data mapping being performed in low-income areas by Seureca and WSUP.[58]

However, in the unique case of the Lusaka Water Supply and Sanitation Company (LWSC), the utility started piloting FSM in two selected low-income communities (LICs) in 2012. Its capacity to manage fecal sludge management services was further strengthened when FSM services were upscaled to cover the entire city in 2020 through the Lusaka Sanitation Project (LSP) funded by the BMGF, the World Bank, KfW and the African Development Bank.

NSS data analysis is usually conducted on a project-basis; it is primarily driven by the need to fulfil project-specific requirements, as many utilities and municipalities undertake data analysis aligned with the scope and objectives of ongoing projects. Similarly, operationalization is often motivated by these projects' demands rather than by a focus on broader service delivery needs. It may also be motivated by accountability mechanisms like performance-based contracts which require utilities such as Nakuru Water and Sanitation Services Company (NAWASSCO), Malindi Water and Sewerage Company (MAWASCO), and Southern Water and Sanitation Company (SWSC) to demonstrate measurable service improvements to their boards of directors. External oversight from regulators like NWASCO, Water Utility Regulation Department (WURD), or WASREB and the use of performance scorecards, as in the case of LWSC, plays a pivotal role in fostering healthy competition within the sector, encouraging utilities to leverage NSS data for the purposes of enhancing service delivery across their service areas. Additionally, increases in transparency due to public accountability measures—such as open communication platforms and regular stakeholder engagements—further drive the use of NSS data in utilities such as SWSC and Western Water Supply and Sanitation Company (WWSC). The generation of data allows these institutions to demonstrate their commitment to customers, optimize internal performance, and build trust by showcasing tangible improvements in service delivery.

53 Enterprise Resource Planning (ERP) is a software or web-based solution designed to help organizations automate and manage essential business processes for improved efficiency. It facilitates the flow of data across various functions within a company, offering a unified system that enhances operational efficiency. ERP systems integrate key areas such as finance, operations, GIS, customer relations, and human resources into a single platform, streamlining overall business activities.
54 https://www.kcca.go.ug/cwis
55 https://waterfund.go.ke/stories/safisan-ubsup
56 https://finishmondial.org/approach/
57 https://fresh-life.org/our-model/impact-growth-rates/
58 https://wsup.com/where-we-work/zambia/improving-sanitation-services/

2.3. DATA GENERATION

In presenting the findings on the NSS data generation landscape assessment, this report follows the key elements of the sanitation value chain—that is, capture and containment, emptying, transportation, treatment, and reuse.

2.3.1 DATA GENERATION AT THE CAPTURE AND CONTAINMEMNT STAGE

Context

Data generation at the capture and containment stage involves the mapping of non-sewered sanitation facilities and treatment plants. This is critical for decision-making, setting measurable targets, and monitoring progress toward enhanced sanitation coverage and sustainability. Generally, most utilities in SSA have up-to-date and readily available data on sewered sanitation, whereas the NSS data necessary to guide service planning—such as the proportion of households with access to septic tanks, latrines, or composting toilets within a given utility/municipality's service area—is limited. In those parts of SSA where NSS data exists, it is largely fragmented and domiciled within other sectoral bodies such as ministries of health, education, or local government. [59]

Types and Sources of NSS Data at the Capture and Containment Stage

Utilities in the SSA region show varying developmental levels of NSS data generation at the capture and containment stage. Utilities and municipalities such as LWSC, NAWASSCO, MAWASCO, and KCCA are at advanced stages of sanitation mapping. These utilities are classified as advanced because they have conducted comprehensive sanitation baseline mapping, which enables them to know the status of existing OSS facilities and FSM services within their service areas. Some of these advanced utilities, including NAWASSCO and LWSC, have gone even further, georeferencing their baseline mapping to allow for easy visualization and storytelling.

On the other hand, other utilities such as SWSC, Chambeshi Water and Sanitation Company (CWSC), Lukanga Water and Sanitation Company (LGWSC), WWSC, Luapula Water and Sanitation Company (LpWSC), Nyeri Water and Sanitation Company (NYEWASCO), and Kisumu Water and Sanitation Company (KIWASCO) are still in the initial phase of defining systems for NSS data collection and management, and have mapped only a few sections of their service areas.

In some instances, utilities have mapped water and sanitation facilities in their service areas, but the collected data is not useful for decision-making. For example, while the Lagos State Wastewater Management Office (LSWMO) carried out baseline mapping in 2022 the local regulator, the Lagos State Water Regulatory Commission (LASWARCO), reported that the collected data was not comprehensive enough for policymaking. In some cases, the NSS data collected at the capture and containment stage is limited to certain types of sanitation facilities and is therefore not fully aligned with the Joint Monitoring Programme (JMP) indicator framework for tracking and evaluating SDG target 6.2.[60] While utilities may be classified as advanced or in the initial stages of NSS data generation at capture and containment, the data collection efforts have largely been supported by regulators such as NWASCO and WASREB, or else by development partners.

At the other end of the spectrum are the utilities and municipalities in countries such as Rwanda, Kenya, Tanzania, Nigeria (Ekiti State), South Africa, Uganda, and Malawi that lack any systems for generating NSS data at the capture and containment stages. These utilities and municipalities, which constitute a majority in the region, have not conducted any form of sanitation baseline mapping, leaving them without data that is essential for planning and decision-making. These include the Water and Sanitation Corporation (WASAC) in Rwanda, Lilongwe City Council in Malawi, Ekiti Water and Sewerage Company in Nigeria, and many other municipalities and utilities across South Africa and Kenya.

In Kenya, more than 85 out of 94 utilities have yet to conduct sanitation baseline mapping of their own, and instead rely on the Ministry of Health for sanitation data on households, schools, and health facilities. Community health volunteers (CHVs) routinely collect NSS data, which is then reviewed by public health officers (PHOs)

59 The Global Report on Sanitation and Wastewater Management in Cities and Human Settlements Copyright © United Nations Human Settlements Programme (UN-Habitat) 2023
60 WHO and UNICEF, 2017. Guidance for monitoring SMOSS: Annex A- Global indicators for monitoring SMOSS. Geneva: World Health Organization and UNICEF

before being validated by county public health officers. Although there are validation checks to ensure data accuracy, the scale and volunteer-based nature of the data collection means that this data primarily focuses on sanitation facility types and thus does not encompass all data parameters within the full sanitation service chain. Data sharing with utilities such as the Nanyuki Water and Sanitation Company occurs at the county level through PHOs, particularly for the capture and containment stages. However, sharing of the different sanitation data types across the two sectors is constrained by the lack of integrated data systems and underdeveloped collaboration frameworks and mechanisms. Addressing these gaps would require the development of robust data-sharing mechanisms and integrated systems enabling collaboration between the health and water sectors. Taking this step would enhance sanitation management and service delivery.

As in Kenya, Tanzania's 82 utilities have not yet conducted comprehensive sanitation baseline mapping, and instead rely on the Ministry of Health for NSS data on households, schools, and health facilities. Here, community health officers collect NSS data at the village level, which is then reviewed by public health officers (PHOs) and entered into the National Sanitation Management Information System (NSMIS) at the district level. This data is subsequently forwarded to the Ministry of Health. Utilities typically obtain raw NSS data from the district level, as well as through a WASH portal provided by the Ministry of Health. However, as part of the government's goal of making systems interoperable, Maji IS will be integrated with NSMIS, ensuring that all data regarding sanitation facilities reported in NSMIS will also be captured and analyzed in Maji IS.

In Malawi, the Lilongwe City Council does not have self-generated data relating to the sanitation facilities within its service area. Instead, the council uses the National Sanitation Management Information System and District Health Information System (DHIS) tool to collect data on sanitation facilities, usage statistics, and hygiene practices across the country. Data collection at district facilities is conducted by health surveillance assistants using paper-based tools. These assistants are responsible for collecting the data and submitting it to district environmental health officers, who then enter the data into the DHIS tool.

NSS Data Generation Process at the Capture and Containment Stage

In utilities that have completed comprehensive sanitation baseline mapping of NSS facilities and FSM services, the data collection process has typically been carried out by project-based sanitation enumerators who conduct door-to-door household surveys using mobile applications such as Kobo Toolbox or mWater. In KCCA, the initial mapping process was performed using paper-based questionnaires, with subsequent database updates resulting from mapping exercises carried out in individual service area zones and divisions, this time using the open-source ODK mobile data collection platform.

After the NSS data is collected, it is manually downloaded, cleaned using Excel, and, in some cases, uploaded to ArcGIS for visualization. Even with the use of these digitized data-collection processes, most utilities have yet to achieve seamless integration with ArcGIS or ERP systems. LWSC, the most advanced of the utilities examined in this assessment, has a GIS linked database comprising all sanitation facilities mapped in Lusaka city. It then sends this to the OSS module of the Lusaka Sanitation System (LSS). This module contains customer information and NSS toilet data that is entered either through baseline mapping or manual data entry as new containment facilities are constructed. However, the LSS operates as a standalone system, and is not integrated with LWSC's ERP system.

Forms of NSS Data Generated at the Capture and Containment Stage

Across all utilities, the types of data captured through sanitation baseline mapping include the following:

- Types and geospatial location of toilet facilities
- Number of users per facility
- Condition and status of containment structures
- Household details including income level and menstrual hygiene management
- Accessibility features for disabled users
- Containment structure details including types, locations relative to the capture facility, and geometry
- Materials used for toilet construction (material type for walls, doors, floors, and roofing.

THE GROWING MOMENTUM AROUND REGULATION OF NSS IN A NUMBER OF SSA COUNTRIES IS A PROMISING AND CRUCIAL DEVELOPMENT.

- Sludge management details such as fill level, frequency of emptying, and whether the pit latrine or septic tank has ever been full
- Response and actions taken when pits or septic tanks are full · Details of pit/septic emptiers or exhausters, and disposal locations for emptied sludge
- Presence and condition of hand-washing stations
- Cleaning and maintenance details including frequency, responsible parties, and materials used.

Collection of this comprehensive range of data supports informed decision-making and the effective management of sanitation services.

To allow for ongoing updates to the sanitation database for facilities within their service areas, utilities like NYEWASCO and SWSC have added a section to the water connection form that captures information on the types of sanitation facilities at the household level.

Fieldworker gathering community insights for a sanitation initiative.

2.3.2 DATA GENERATION AT EMPTYING AND TRANSPORTATION STAGE

Context

Utilities and municipalities engage third parties such as private operators and community-based organizations in emptying and transporting the fecal sludge. The delegation of service provision within this element of the sanitation chain is facilitated through systems in which utilities or municipalities grant permits to private operators and/or sign contracts with them.

Septic tanks in planned districts are typically emptied using mechanized exhauster trucks, facilitated by road access that tends to be better than that found in peri-urban areas. In contrast, peri-urban households tend to rely on manual pit emptiers for toilet desludging. This reliance is partly due to the poor quality of access roads but is primarily driven by the high costs of exhauster truck services, which are expensive relative to average household incomes. Additionally, the fecal sludge in these areas is majorly from pit latrines and tends to be denser, with less water content, making it unsuitable for removal through exhauster trucks.

Utilities/municipalities therefore need data collection systems that support delegated service provision, with the goal of enhancing accountability among private operators. To effectively monitor the operations of these service providers, utilities such as LWSC, NAWASSCO, MAWASCO, and KIWASCO have implemented data tools and FSM Standard Operating Procedures (SOPs). These tools require operators to submit data as they provide services, allowing for consistent oversight and quality control.

In some cases, such as with CHWSC and LGWSC, utilities have permitted private companies to provide pit emptying services even as the utility retains responsibility for transportation, treatment, and disposal. In other cases, as in the case of SWSC and KIWASCO, utilities contract with private service providers for emptying and transportation services, while also maintaining their own fleet of exhauster trucks to serve institutional customers.

Types and Sources of NSS Data at the Emptying and Transportation Stages

NSS data generation at the emptying and transportation stages varies widely across the SSA region. At one end of the spectrum, private operators engaged by advanced utilities like LWSC use digital tools to generate emptying and conveyance data. At the other end, private operators operating in countries such as South Africa have not yet begun conducting any form of data generation or submission to municipalities. Meanwhile, operators working in service areas for utilities like NAWASSCO and KCCA are at an intermediate stage, using a mix of paper-based and digital tools to generate emptying and conveyance data.

While most utilities across SSA still rely on paper-based pit assessment forms, job cards, and manifest forms to collect NSS data from private operators engaged in

emptying and transporting fecal sludge, a few utilities are at advanced stages with regard to digitally generating NSS data on emptying and transportation processes.

In LWSC, the FSM module within the LSS is specifically designed to allow emptying and transportation service providers to capture their operational data. Private operators are required to enter all pertinent details of an emptying job into the LSS, using a mobile app on their phones or tablets, before disposing of the waste at LWSC's treatment plant. Once the service has been provided and all necessary data have been entered into the job card, the system automatically generates a unique identification number for each sanitation facility in the city, known as the toilet number. This number is then recorded on the fecal sludge treatment plant (FSTP) form, which is submitted to the plant operator at the FSTP.

In Kampala, the Weyonje app, a mobile phone application, was developed by KCCA to enable residents within Kampala City to request pit emptying services from licensed sanitation service providers. Additionally, private operators use the Weyonje app to record details of desludging jobs as they are carried out. To discharge waste and complete a job in the Weyonje app, operators must be physically present at the designated dumping bay. A private operator cannot accept a new desludging request until it has completed the current request, a requirement implemented by KCCA to facilitate regulation of emptying, transportation, and dumping activities.

Weyonje is currently operational in Kampala City and in the Northern Umbrella Water Utility service area, with over 19,000 jobs completed through the app so far. Not all private operators are registered on Weyonje, nor do they always keep their devices active during operations. To support the app's functionality, a call center has been established with support from the BMGF-funded FSM project. Call center staffers manually assign customer desludging requests, received via toll-free calls, to private operators. Plans are underway to upgrade the app to link it with the main sanitation baseline database to allow for continuous updating. KCCA additionally operates trucks that provide emptying and fecal sludge transportation services across Kampala's five divisions, serving schools, public toilets, and some households in low-income areas. Currently, the details of the desludging performed by KCCA trucks are recorded manually, but there are plans to integrate these trucks into the Weyonje platform for more streamlined data management.

NAWASSCO employs a combination of paper-based and digital tools to generate data on emptying and conveyance functions. Manual pit emptiers use paper-based pit assessment forms, while client invoicing and payments are processed through the billing module of the institution's ERP system. Additionally, treatment plant operators collect data from exhauster truck operators using the Smart Operation application, which is integrated with the technical module of the ERP. In this system, each exhauster truck has a distinct account, allowing the utility to monitor their monthly operations and compliance with standards.

NSS Data Generation Process at the Emptying and Transportation Stages

When a customer requests desludging service, private operators evaluate the containment facility, recording details about the customer, sanitation facility, and the sludge to be emptied either on a physical form or through a mobile application.

For each desludging job, the job card captures various data points including:

- Client and service provider details
- Location of the sanitation facility
- Number of users of the facility
- Volume of sludge removed
- Photograph of the facility
- Name of the FSTP where the sludge will be deposited
- Date the service was paid for
- Receipt number · Charges for emptying services
- Customer feedback on the emptying method used
- Signature of the client

Once the assessment form or jobcard is completed, an invoice is generated by the utility or private operator, and the customer makes the payment. At the treatment facilities, the data submitted to plant operators includes the source of sludge, the volume of sludge delivered, and the service fee charged to the customer.

Residents document a tanker truck passing through their rural community on an unpaved road.

2.3.3 DATA GENERATION AT TREATMENT STAGE

Context

In the treatment phase of the sanitation value chain, responsibilities for wastewater and septage treatment and safe disposal are assumed by utilities and municipalities. This is a standard practice, observed across all utilities examined in Kenya, Zambia, Uganda, Tanzania, Nigeria, Ethiopia, South Africa, and Malawi.

Among the utilities studied here, some, including SWSC, LWSC, and National Water and Sewerage Corporation (NWSC), have dedicated fecal sludge treatment plants. Others, such as KIWASCO, NAWASSCO, NYEWASCO, and MAWASCO do not have separate fecal sludge treatment plants, and thus treat the fecal sludge together with sewerage at wastewater treatment plants.

Types and Sources of NSS Data at the Treatment Stage

Just as in the emptying and transportation segment of the sanitation value chain, the generation of NSS data at the treatment stage varies widely in quality and scope across the SSA region. At one end of the spectrum, utilities such as NWSC and LWSC are comparatively advanced in using digital tools for generating treatment data, although even these institutions have gaps in their systems. At the other end are utilities such as those in Ekiti State and Rwanda that do not have functional treatment plants, and thus have not begun generating NSS data at the treatment stage. Most utilities are at the intermediate stage of using paper-based tools to generate treatment data, with some gradually transitioning to the use of digital tools.

Utilities like NWSC and KCCA are most advanced in their data collection methods at their treatment plants in Kampala, including Lubigi, Bugoloobi, and Nalukolongo. They electronically record details relating to individual exhauster truck visits, the fecal sludge that has been dumped, laboratory test results, and transactions related to dumping fees and the sale of treated sludge or biosolids. In contrast, most utilities across SSA use paper-based manifests to record data on sludge treatment parameters, which are subsequently stored in hard copy filing systems.

Operation application that integrates with the institution's ERP system. The Smart Operation app serves as a data collection tool that enables plant operators to validate

THE INCREASING FOCUS ON REGULATING NSS ACROSS SEVERAL SSA COUNTRIES MARKS A SIGNIFICANT STEP TOWARDS STRENGTHENING HEALTH SYSTEMS AND ENSURING SUSTAINABLE IMPACT.

the exhauster payment information (dumping fee) from within the system, thus ensuring compliance.Operators then feed details such as the source and volume of sludge into the app. This data is stored in the ERP tool, and the utility can track the daily and monthly activity of each exhauster truck within the system.

In LWSC, upon delivery of fecal sludge to the treatment plant, private operators are required to present an FSTP entry form containing details such as toilet number, the source of the sludge, the volume of sludge, names of the FSM service provider, availability of Zambia Environmental Management Agency and the relevant LWSC license. The plant operator then uses the toilet number to verify the volumes entered in the job card and the FSTP form (in LSS) against the volumes physically delivered to the treatment plant before allowing the service provider to desludge. Upon verification, an FSTP number is created, completing the data loop. Based on the volume of sludge delivered, an invoice is generated, and a receipt is issued upon payment. This is the LWSC's mechanism for ensuring that the institution is obtaining accurate NSS data from service providers. Plant operators access and interact with the LSS using either desktop computers or tablets.

Forms of NSS Data Generated at the Treatment Stage

The types of NSS data collected at treatment plants are largely uniform across the region, and include the following:

- Source and type of sanitation facility and containment structure from which the sludge was emptied
- Daily number of trucks delivering sludge

- Volumes of fecal sludge dumped by each truck
- Volumes of wastewater entering the plant
- Quality of influent
- Transaction amounts from dumping fees and sales of treated sludge
- Volumes of effluent treated
- Volumes of biosolids produced
- Quality of effluent at different treatment stages
- Quality of treated effluent immediately before discharge
- Quality of water downstream after discharge into the receiving environment

Amount of chemical inputsUtilities also track laboratory parameters relating to the raw sludge, sludge going through the treatment process, and the treated effluent. However, in all the utilities examined in this report, the laboratory test processes and procedures are still paper based. Some of the laboratory parameters tracked through the treatment process include pH, total dissolved solids (TDS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total phosphates, nitrate quantity, and microbials presence. After testing, test results are stored either electronically or manually.

Field workers document sanitation data, recording local facility and infrastructure details in a rural assessment.

2.3.4 TECHNIQUES AND TOOLS FOR DATA GENERATION

Table 3 offers an overview of the various data collectors, collection methods, tools, and frequencies of NSS data collection across the NSS sanitation service chain in the SSA region, as identified through the landscape mapping exercise.

Table 2: Methods and tools for data collection acoss the NSS sanitation service chain

Sanitation service chain stage	Data collector	Method of data collection	Tools used in data collection	Frequency of data collection
Types of sanitation facilities (access) and status of contaminent facilities	• Enumerators (survey teams recruited on as-needed basis) • Community Health Promoters (CHPs) (linked to the public Health Department) • Artisans • Enumerators	• Rapid assessment surveys (targeted surveys for new projects) • Sanitation Baseline Survey • Focus Group Discussions (FGDS) • Door-to-door sanitation marketing by CHPs • Customer Identification Surveys (household surveys)	• Manual -Kobo collect/app • mWater app, • https://www.fmvisualize.com • ODK • Customer application form • Electronic Community Health Information System (ECHIS) • Weyonje (for updating baseline database)	On need basis
Emptying	• Private exhausters • Manual pit emptiers	• Waste manifest/tracking form • Job assessment forms • Job card • Mobile app tool • Customer feedback note • Payment receipts	• Smart Operation app, • mWater • Paper forms • Weyonje -LSS	Per trip
Conveyance/ Transport	• Private exhausters	• Manifest/tracking form • Pit assessment forms • Job cards	• Smart Operation app • mWater • Paper forms • Weyonje	Per trip

		• Customer payment receipt • Mobile app tool	• SS	
Treatment (Influent)	Lab Technologist	Sampling	Laboratory form	Daily, Weekly and Periodically
Disposal (effluent)	Lab Technologist	Sampling	Laboratory form	Daily, Weekly and Periodically
Reuse	Commercial	Electronic System	Invoice	On order

2.3.5 DATA STORAGE

Historically, many utilities in SSA have used several different systems to carry out their core functions. For example, commercial and billing systems were separate from financial management, customer relationship management, and technical operations. This has created inefficiencies, as it requires large amounts of data to be moved manually from one system to another, leading to long reporting times and errors in core management information. This is changing as utilities invest in cloud-based enterprise resource planning (ERP) systems to unite the work of the utility within a single digital environment.[61]

While many utilities in SSA today have centralized data-management systems such as ERPs, NSS data is typically not integrated into these systems. Utilities such as SWSC, KIWASCO, NYEWASCO, NAWASSCO, and Nanyuki Water and Sanitation Company collect and store utility data, including sewerage data, centrally through cloud-based ERP systems. However, they lack dedicated NSS data-management modules that would allow them to capture NSS service data within their ERPs. As a result, these utilities store NSS data in standalone systems such as ArcGIS, Excel spreadsheets, or different modules within their NSS data-management systems.

On the other hand, utilities such as WWSC and MAWASCO lack centralized data repositories, and instead store various datasets in isolated systems. For example, billing data is managed in a standalone Sulis system, while sanitation data collected through open-source applications like Kobo is stored in Excel. LSWMO stores the NSS data in hard copy files. This fragmented storage approach underscores the need for these utilities to adopt a more integrated data-management system.

LWSC has made significant strides by developing the LSS to store NSS data. Currently, the LSS operates as a standalone system, like other utility systems at LWSC, including those for engineering design, management, financing, and accounting/budgeting. The LSS stores most of the utility's NSS data, including the GIS sanitation database for all sanitation facilities found in Lusaka province. On the other hand, NSS billing data is stored in another standalone ERP system called EDAMS, which primarily stores water and sewerage data. Due to the high cost of creating a new module within the LSS, the utility opted for a more cost-effective solution by creating the NSS billing module within EDAMS. However, LWSC is in the process of developing an integrated ERP system that is both financially sustainable and technically robust. It will also transform the functionalities of the LSS into a dedicated NSS module within this ERP tool to ensure full integration.

Ewura and NWASCO manage and store aggregated NSS data in their systems—Maji IS and the NWASCO Information System (NIS)—which is shared with key stakeholders, including the ministries of water and sanitation.

In Zambia, the Ministry of Water Development and Sanitation is currently developing the Integrated Management Information System. This system will serve as the central database and data-analysis tool for the water, sanitation, and hygiene (WASH) sector, facilitating the collection, storage, and reporting of data, including for the purposes of global reporting. IMIS will integrate data from all subsectors within the ministry, encompassing water resources management and development, water supply, and sanitation, thereby providing comprehensive information to meet the needs of stakeholders at the national, provincial, district, and ward levels.

61 Water Utility Digitalisation in Low- and Middle-Income Countries, GSMA, 2022

Lilongwe City Council in Malawi uses the National Sanitation Management Information System and District Health Information System tool to store data collected on sanitation facilities, facility usage, and hygiene practices across the country. These two tools are managed by the Ministry of Health.

Team members analyze and document NSS data using digital tools, contributing to project-driven data collection in SSA utilities

2.3.6 DATA SHARING WITH OTHER SECTORS

Given the multisectoral nature of sanitation, data sharing and collaboration among key stakeholders is critical for effective planning and implementation of services and regulations.

In Zambia, at the onset of the baseline NSS mapping process, NWASCO developed a common data collection tool and distributed it among utilities, local government authorities, the Ministry of Health, and the Zambia Statistics Agency (ZSA) through joint implementation teams (JITs). Since then, ZSA has incorporated the information collected by this tool into the national census. Additionally, the Ministry of Health used this tool in a series of 2021 health surveys that were sponsored by WHO/UNICEF. Furthermore, though the LSS acts as a standalone data-management system within LWSC, the utility is in the process of fully integrating it with the external monitoring and evaluation management information systems (M&E MIS) managed by the Ministry of Health (MoH) and the Lusaka City Council (LCC), who are each key players in sanitation service delivery and hygiene promotion in Lusaka province. As such, the LSS serves as an integrated, web-based sanitation M&E MIS that enables LWSC, MoH, and LCC to manage service delivery and monitor access to safely managed sanitation services in Lusaka province. It is owned and managed by LWSC. When LSS was launched in 2019, training sessions were conducted for LCC, LWSC, and MoH staffers. Because the tool is integrated and interoperable with other stakeholder systems, it provides a platform for the key players in the sanitation sector to collaborate and share various pieces of data and information collected within their mandates, thus enabling them collectively to track progress and improvements in access to safely managed sanitation services and hygiene facilities.

For example, the MoH collects data on the prevalence of waterborne diseases in hospitals, hygiene practices, and water quality through the District Health Information System (DHIS). Further, the MoH conducts health surveys every three to five years to gather data on access to water and sanitation services at the household level within communities. This is done through established data collection mechanisms, such as the deployment of environmental health technicians and inspectors who collect data at the district and provincial levels. Water and sanitation utilities often cross-reference their sanitation data with the information collected by the MoH, particularly when their own data is insufficient. Additionally, the LCC conducts public and environmental health monitoring activities, including regular inspections of sanitation facilities, enforcement of sanitation standards, and water quality monitoring through its M&E MIS system, known as SMART PHD, which is integrated with the LSS.

In Kenya, sharing of the various sanitation data types between the water and health sectors is hindered by the lack of integrated data systems and the underdevelopment of collaboration frameworks and mechanisms. The (draft) National Sanitation Management Policy [62] recognizes the need to develop strong compliance monitoring systems to underpin effective sanitation

62 Ministry of Water, Sanitation and Irrigation, 2021. National Sanitation Management Policy

regulation. The policy identifies the lack of an integrated sanitation management information system supported by clear and well-defined performance indicators as a key issue that has weakened effective compliance monitoring and performance reporting at the national level.

The MoH oversees the entire sanitation portfolio in the country, with primary responsibility for coordinating rural sanitation activities. Through the Department of Public Health, it collects data on the types of sanitation facilities available in households, schools, and health facilities. This information is gathered through door-to-door surveys conducted through existing health structures, for instance by community health promoters (CHPs). The aggregated data is then sent to public health officers for validation and approval. Upon request, these officers then share the data manually with water utilities for use in their reports to WASREB.

With support from development partners like USAID, JICA, and UNICEF, the MoH has developed the Real-time Monitoring Information System (RTMIS). This system provides insights into the levels of sanitation services across the country, as defined by the WHO-UNICEF Joint Monitoring Programme (JMP), in both urban and rural settings. Data is collected from households, health facilities, and schools, focusing on the issues of sanitation, hygiene, and nutrition within a comprehensive monitoring and evaluation (M&E) framework featuring over 20 indicators. The RTMIS aggregates quantitative and qualitative data from the county and national levels, allowing for data analysis, visualization, and the generation of reports tailored to various stakeholders' needs.

The RTMIS is being deployed in phases, starting with 15 initial counties. Once fully developed and implemented nationwide, the RTMIS will support monitoring and evidence-based decision-making processes carried out by the national government and all 47 county governments. Additionally, it will provide synthesized reports that can contribute to other global monitoring systems, such as the JMP, the UN-Water Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS) initiative, and the International Aid Transparency Initiative (IATI). In Nigeria, the WASH Information Management System, a UNICEF-supported platform, is managed by the federal government with the aim of enabling data transmission between states and federal authorities. However, this system is not yet operational.

As a result, federal government entities must retrieve data directly from the state level, complicating the data gathering process. Moreover, due to poor data quality and the frequency of reporting challenges, the data does not accurately reflect the reality on the ground. For example, private NSS service providers in Ekiti State report their data to the regulator (Ekiti State Water and Sanitation Regulatory Agency), with the information then forwarded to the Ministry of Infrastructure and Public Utilities. This data is then reported to the Federal Ministry of Water and Sanitation.

In Tanzania, the Ministry of Health developed an electronic National Sanitation and Management Information System (NSMIS) in 2012 to enhance WASH data collection and storage, disseminate information to a broader range of stakeholders, and improve accountability and transparency within the National Sanitation Campaign (NSC).

THE KENYAN RTMIS AGGREGATES QUANTITATIVE AND QUALITATIVE DATA FROM THE COUNTY AND NATIONAL LEVELS, ALLOWING FOR DATA ANALYSIS & VISUALIZATION.

NSMIS is an information system that compiles data on water and sanitation access throughout the country, collected at the local level via standardized paper surveys. Previously, NSMIS data access was restricted to MoH staff, and specific software skills were required to navigate the system. However, a national WASH web portal was created to integrate data from the internal system into a publicly available one. This was the country's first open-source repository for WASH data, and was aimed at facilitating greater information sharing and use, as well as increased government accountability.

Through the WASH web portal, agencies such as Tanzania's National Bureau of Statistics (NBS) can easily access WASH data at the regional and district levels. This helps fill the gaps left by the NBS, which conducts surveys only once every five years. Water and sanitation utilities can also access NSS data from the WASH web portal at both the district and national levels, allowing them to validate this information with local authorities.

2.4 DATA ANALYSIS

2.4.1 METHODS OF DATA PROCESSING

Most utilities and municipalities across SSA have not yet reached the point of systematically cleaning and validating their NSS data, as many are still at the initial stage of collecting NSS baseline data. Currently, these cleaning and validation processes are typically conducted on a project basis or as ad hoc activities without a regular schedule or routine, which compromises data integrity and quality. This lack of routine is primarily due to the significant time and effort required to thoroughly clean and validate large datasets. Furthermore, many utilities and municipalities do not have established policies or standards aimed at guaranteeing data quality, particularly in the absence of routine cleaning and validation processes. Where such guidelines do exist, they often lack the comprehensiveness or rigor necessary to ensure consistent data quality management. Additionally, the absence of uniform data system principles across the sector leaves utilities and municipalities without a cohesive framework to guide their data-management practices effectively.

Utilities and municipalities across SSA generally adopt similar approaches (Figure 5) to ensuring data quality, relying primarily on manual validation and cleaning of NSS data due to the limited availability of tools and systems with automated functionalities. Unlike automated systems that flag or reject inconsistent data, this manual process involves staff members actively verifying and correcting the data. For example, in SWSC and KCCA, data validation and cleaning processes respectively tend to be conducted by supervisors (usually the heads of departments) and M&E officers (with support from biostatisticians), using Excel to confirm that the NSS data is accurate and falls within expected ranges. These employees draw on their knowledge of local conditions to spot errors in the Excel spreadsheets. If discrepancies are detected, supervisors may return to the field to verify the reported data. In utilities such as SWSC and LWSC that are equipped with ERPs or other data-management systems, data is manually validated and cleaned before it is entered into the system. In SWSC, this process involves multiple stages of review; data collected through forms is carefully checked before it enters the ERP system by those authorized to do so, such as a branch manager, a regional manager, or a rural water and sanitation engineer.

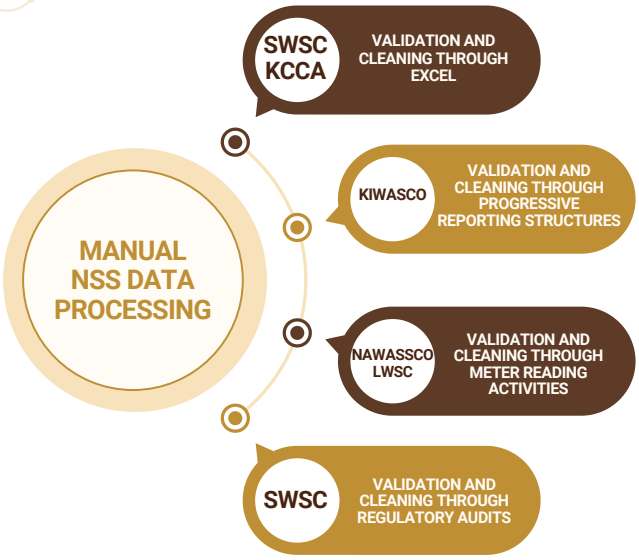


Figure 5: *Typical approach to NSS data processing in utilities and municipalities in SSA, with examples*

Additionally, manual data validation and cleaning is often integrated into multistep reporting structures and meter-reading processes. At KIWASCO, new data sets are repeatedly checked as they progress through different reporting levels, ensuring consistency with previous data. Meanwhile, NAWASSCO cross-references containment data collected via its mobile application with mobile meter-reading data, retaining only information that has been corroborated. Similarly, LWSC uses meter readers to verify customer information.

Regulators also play a role in the manual validation of NSS data within utilities in Zambia. For example, SWSC is subject to audits by its regulator, NWASCO, which conducts on-site visits to review the data in the utility's ERP system. NWASCO can request source documents to verify reported data against the original records, and may even conduct field visits to ensure that the data accurately reflects on-ground realities. This hands-on approach helps to validate the accuracy and reliability of the data reported by utilities.

Utilities and municipalities describe the activities mentioned above as data validation, but they may more accurately be characterized as data verification processes, even though both aim to improve data quality. The distinction lies in the methodology: The processes

being used throughout the region tend to involve comparing the data with a source document or cross-checking it against another system, rather than enforcing adherence to predefined rules or constraints at the time of entry. Very few utilities have implemented integrated validation checks that automatically and continuously reject duplicate or noncompliant data at the point of data entry. However, there are a few notable exceptions where such advanced systems are in place, demonstrating the benefits of such automation. For instance, NYEWASCO utilizes an ERP system that automatically flags inconsistencies such as data that falls outside average ranges. Similarly, LWSC's LSS features built-in validation checks that detect and flag duplicate entries such as existing customer details or phone numbers. These automated checks significantly reduce errors compared to manual processes, and improve data quality by minimizing duplication within the system.

While some utilities and municipalities actively engage in NSS data validation and cleaning— through either manual checks or automatic constraints—there are notable exceptions where these processes are absent. For example, WASAC does not collect any NSS data, thus obviating the need for validation or cleaning. Conversely, MAWASCO and LSWMO do collect NSS data, but lack established procedures for validating or cleaning it. MAWASCO's hesitation stems from uncertainties regarding the specific types of NSS data that should be collected, while LSWMO faces limitations associated with employee capacities. Similarly, NWSC does not validate or clean NSS data collected at the treatment plant, as the data is entered directly into the institution's system without reliance on third-party information.

These variations highlight the differing levels of engagement and capacity among utilities and municipalities with regard to ensuring data quality. Although some utilities and municipalities are making commendable efforts, the processes of data validation and cleaning, where implemented, are often irregular and predominantly manual. This approach increases the risk of errors and raises concerns about the accuracy, completeness, reliability, and validity of the NSS data provided by utilities and municipalities. Such inconsistencies pose significant challenges for the national and global monitoring systems that rely on this data, potentially undermining the credibility of reported figures and impacting overall monitoring and assessment outcomes.

2.4.2 DATA ANALYSIS APPROACHES

Only a few utilities and municipalities in SSA, such as LWSC and KCCA, conduct ongoing analysis of NSS data. This could partly be attributed to the fact that they have M&E teams that support some elements of the data management process. In contrast, most utilities and municipalities perform NSS data analysis primarily on a project basis, which often ties the scope and depth of analysis to specific project needs and requirements. This tendency is likely attributable to the prevalence of donor-funded NSS initiatives in SSA, spurred by the recent push for CWIS. Consequently, the type of analysis performed is frequently narrowly focused, designed to meet the immediate objectives of individual projects rather than broader, ongoing operational needs. As a result, valuable insights that could inform long-term planning and service improvement may be overlooked, thereby limiting the degree to which NSS data within utilities and municipalities is used strategically.

While developed ecosystems have evolved to more advanced analytics such as machine learning and artificial intelligence approaches to drive descriptive, diagnostic, predictive, and prescriptive insights, Excel is the most commonly used platform for NSS data analysis among utilities and municipalities in SSA. It is favored for its cost-effectiveness, ease of access and use, widespread availability, and flexibility. Even utilities that use more advanced ERPs or other data-management systems often still conduct analysis externally in Excel. For example, utilities like LWSC, NAWASSCO, and SWSC regularly export their NSS data from ERPs—or, in the case of LWSC, from the LSS—to perform advanced analytics using Excel.

While adept at data storage and offering basic analytical and report-generating functionalities, ERP systems and other data-management platforms often fall short in their ability to generate deeper insights into patterns and complex relationships expressed across multiple variables.This limitation drives the utilities to rely on Excel, which they can use to perform more nuanced analyses that inform strategic decision-making. This in turn enables them to uncover trends, optimize service delivery, and better understand operational challenges.
Although Excel offers the capability for some advanced statistics, some utilities are unable to go beyond basic analysis when using the platform. For instance, utilities such as LSWMO and MAWASCO have reported conducting minimal analysis using Excel, partly due to limited staff technical capacities. In many utilities,

no dedicated unit is responsible for data analysis; instead, individual officers are assigned this role alongside their primary duties. These officers typically rely on their basic knowledge of Excel, which may not be sufficient for handling complex data tasks. Consequently, complex data tasks may be deprioritized or overlooked, as they are considered to be secondary responsibilities that fall outside the officers' core duties.This underscores the critical need for capacity building and dedicated analytical resources within utilities and municipalities.

Utilities and municipalities such as LWSC and KCCA have taken proactive steps by establishing dedicated M&E and GIS units specifically tasked with the analysis of NSS data. These specialized units are instrumental in conducting comprehensive analysis of NSS services, utilizing both performance metrics and spatial data. Similarly, LSWMO has established an M&E unit, while NAWASSCO, SWSC, and WWSC have dedicated GIS units designed to support the geospatial analysis of NSS data. However, the effectiveness of these units varies. For instance, the capacity of GIS officers in WWSC is somewhat limited, as they are familiar only with the basics of GIS operation. This basic level of expertise restricts their ability to perform more advanced analysis, such as spatial analysis and modelling, that could provide deeper insights into NSS data.

In comparison, MAWASCO has a single dedicated GIS officer, but has not yet leveraged GIS for NSS analysis. The primary reason for this is that the institution has not yet integrated NSS data into its GIS platforms. The utility has only recently acquired a GIS system, and is still in the process of entering water data. As a result, it is as yet unable to utilize GIS's advanced capabilities to enhance its NSS data-analysis processes.

The region's utilities and municipalities also use other platforms beyond Excel and GIS for NSS data analysis. Kobo is widely used across various utilities and municipalities for its data analysis and customized report generation capabilities. However, Kobo's transition to a commercial model with restrictions on free users has led many utilities to seek alternative solutions. LWSC utilizes SPSS for its advanced statistical analysis capabilities, and KCCA uses the Weyonje app and call center. The need to explore different platforms reflects the ongoing quest for effective, accessible, and cost-efficient tools to enhance data-analysis capabilities in utilities and municipalities.

In addition to internal use of these platforms, NSS data analysis also occurs externally through third-party systems. For example, in Zambia, utilities gain insights from their NSS data via analysis on the NIS, which is managed by the national regulator. SWSC representatives note that when they submit their NSS data to the regulator through the NIS, the system generates reports that are highly beneficial. They extract this information for internal use and include it in their annual reports, as these regulator-approved reports carry significant credibility. Similarly, Tanzanian utilities have access to the analytic insights derived from their regulator's data-management system, Maji IS, which has the capacity to analyze NSS data based on the sanitation KPIs outlined in the OSS-FSM guidelines.

Utilities and municipalities often lack the integrated NSS data and interoperable data systems needed to conduct comprehensive analysis. Consequently, NSS data remains scattered across different platforms and departments, and is analyzed in silos. This fragmentation can be attributed to a range of factors including historical practices in which different departments adopted separate systems without a unified strategy, budget constraints that prevent investment in comprehensive interoperable tools and systems, and a lack of overarching data governance strategies promoting unified data management.

For instance, LWSC captures different aspects of NSS data in two systems: the majority in the LSS, and billing data in EDAMS. However, because these systems do not communicate with each other due to the high cost of integration, the data housed within each must be analyzed separately, leading to fragmented insights. Similarly, NAWASSCO lacks a dedicated NSS module in its ERP; as a consequence, NSS data is scattered across various other modules, including technical and billing modules. The utility also must download NSS data from data collection tools such as mWater into Excel to be cleaned before it is then uploaded into the institution's ArcGIS platform for analysis and visualization. This is as a result of financial constraints in procuring additional ArcGIS licenses that allow for the automatic upload of NSS data. In MAWASCO, inconsistencies in NSS data often arise because different departments manage their data in different ways—either manually or by using various technological systems.

Sanitation inspectors conduct a field assessment of non-sewered facilities in a rural community, reviewing documentation while residents observe nearby.

This variation in data-management practices complicates efforts to maintain data consistency. The lack of integration and interoperability between departmental data systems not only increases the risk of data duplication, but also compromises the reliability and integrity of the analyses. Consequently, insights derived from such data may not represent a holistic and accurate representation of reality.

Utilities and municipalities are increasingly recognizing the importance of integrating NSS data into their core data systems, and of ensuring system interoperability as a means of enhancing data-analysis and decision-making effectiveness. In response, some have begun taking proactive measures to improve the status of their systems. For instance, LWSC has initiated
the development of an integrated ERP system designed to consolidate all utility data, including NSS data, into a single centralized platform. Similarly, NAWASSCO is planning to develop a dedicated NSS module within its ERP system, and intends to procure additional ArcGIS licenses that will enable the automatic upload of collected NSS data to the platform for analysis.

These efforts will offer significant advantages and add considerable value when they are implemented. By centralizing NSS data and enabling seamless interaction between systems, utilities can carry out analyses that are more comprehensive and accurate, reduce the risk of data duplication, and ensure greater consistency and accuracy in reporting.

This integration will also support better decision-making, ultimately leading to enhanced service delivery.

2.4.3 APPROACHES TO DATA VIZUALIZATION

Data on capture and containment facilities is the most commonly visualized type of NSS data across SSA, largely due to the baseline mapping exercises conducted by the region's utilities and municipalities. Utilities such as LWSC, KCCA, SWSC, WWSC, KIWASCO, and NAWASSCO utilize GIS to visualize these facilities. The limited use of GIS for this purpose among other utilities and municipalities can be attributed to several factors, including the lack of integration of NSS data into GIS platforms, pending integration between ERP systems containing such data and GIS platforms, the absence of geospatial coordinates in initial mapping exercises, and the fact that georeferenced capture and containment data from baseline maps has not yet been fully transferred into GIS systems in many institutions.

Other platforms used to visualize NSS data include common tools such as Excel, Kobo, and ODK Kit; specialized platforms like the Weyonje and call center apps in KCCA; and project-related platforms like the Fmvisualize platform used in NAWASSCO. While Kobo offers GIS mapping functionalities, utilities such as MAWASCO use the tool primarily for data collection, and have not yet leveraged its potential for data visualization. However, Kobo's commercialization has imposed data storage limits on free users, prompting utilities to explore alternative options for data visualization.

Power BI is set to become a platform used for NSS data visualization in the near future. KCCA has developed a Power BI dashboard and is in the process of integrating data from various platforms, including NSS data, into this centralized system. By leveraging Power BI's advanced visualization features, KCCA aims to improve strategic decision-making and increase data visibility across different departments, fostering a more cohesive and informed approach to managing the utility's operations.

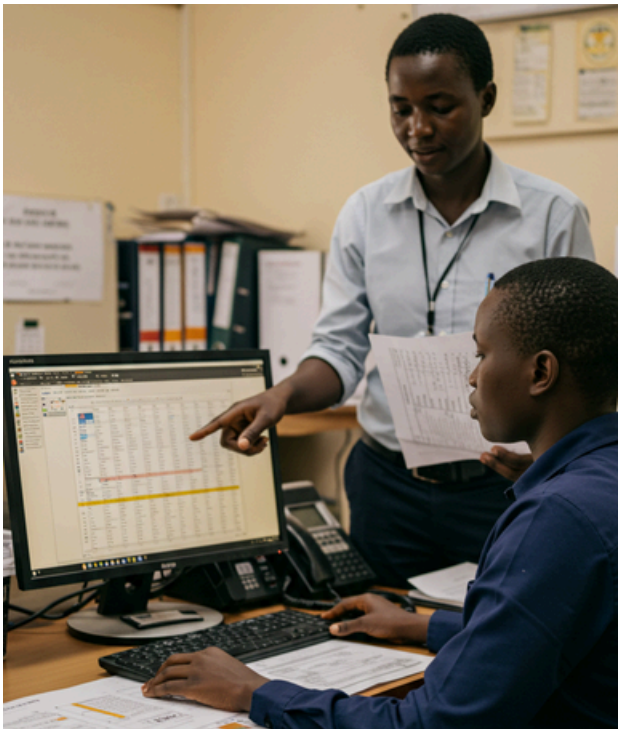
Inconsistent data collection and a shortage of skilled data collection personnel hinders utilities and municipalities from producing accurate NSS data visualizations, and prevents them from mapping new NSS facilities that are not already cataloged in their systems. For example, at LWSC, manual pit emptiers have not been trained to record geospatial data and enter it into the LSS during their operations. Similarly, NAWASSCO has yet to implement GPS tracking for licensed exhauster truck operators, limiting the utility's ability to monitor the locations of serviced containment facilities accurately.

Furthermore, KCCA's Weyonje application faces challenges with regard to intentional data omission by emptiers, who suspect that the authority's requests for information are aimed at increasing their tax burden. KIWASCO's dependence on third-party information for sanitation data compromises the accuracy of the utility's NSS data visualization. At SWSC, inaccuracies in the sanitation facility coordinates submitted by undertrained enumerators have led to discrepancies, with reported locations sometimes appearing outside mapped settlements or clustering disproportionately on one side of the map when visualized.

Accurate NSS data visualization is critical, as it enhances the ability to detect patterns, monitor trends, and identify critical issues, thereby improving the efficiency and impact of interventions. This was recently demonstrated in Zambia during the Cholera outbreak in Lusaka Province. LWSC utilized GIZ's GIS maps to pinpoint the disease hotspots; this information was in turn instrumental in directing targeted interventions and effectively controlling the spread of the disease. Such examples underscore the way that accurate data visualization can both support strategic planning and play a pivotal role in addressing public health emergencies.

Significant work remains with regard to mainstreaming NSS data visualization practices across utilities and municipalities. Currently, none of the entities examined have a centralized dashboard able to provide real-time NSS data insights. This lack is primarily due to the associated financial costs. A real-time dashboard could be instrumental in highlighting inequalities in NSS service provision, which is an ongoing issue in the WASH sector. By continuously providing dynamic, disaggregated data, a dashboard could reveal gaps and disparities across different regions, communities, or demographic groups, thereby aiding in making service distribution more equitable.

Utilities and municipalities aspire to implement centralized systems that can automatically analyze NSS data, generate actionable insights, and create customizable dashboards with real-time information, thus facilitating rapid and effective decision-making. However, for such systems to be effective and fulfill their purpose, utilities and municipalities must first ensure that they are consistently collecting the NSS data that feeds automatically into the systems. Successfully realizing this system of data collection and analysis would represent a major step forward in enhancing data-driven planning, service delivery, and internal performance management.



Sanitation Workers using (MEL) systems to drive smarter decisions and better sanitation services.

2.5 DATA OPERATIONALIZATION

2.5.1 NSS DATA UTILIZATION FOR SERVICE DELIVERY

In most utilities and municipalities across SSA, the use of NSS data to improve service delivery is predominantly geared toward fulfilling project objectives, as a substantial portion of the data collected is driven by specific project requirements. This project-oriented focus means that NSS data collection, analysis, and utilization are primarily aligned with the goals and deliverables of externally funded initiatives. This approach often leads to a fragmented understanding of overall service delivery needs, as the NSS data is not collected or analyzed holistically with the goal of identifying broader trends or gaps outside the project's purview.

Project-based NSS data has informed project-specific service delivery needs in utilities and municipalities in several ways. For example, it has facilitated the targeted use of marketing tools and resources in specific communities, guided the construction of improved toilet and containment facilities, and helped justify the provision of subsidies for the construction of containment facilities. It has additionally enabled the identification of cholera hot spots and allowed subsidies for emptying services and relief packages to be targeted to vulnerable households during COVID-19 and cholera outbreaks.

However, project-specific NSS data is not always used exclusively for project-specific purposes in utilities and municipalities. Data collection and analysis efforts often cease once a project concludes, as most utilities and municipalities have not yet implemented mechanisms to update and integrate this data into their routine operations on an ongoing basis.

However, utilities such as LWSC and MAWASCO have indicated that they sometimes refer to past project datasets for broader decision-making purposes. Yet over time, these datasets increasingly fail to reflect current conditions and operating contexts accurately, limiting their relevance and reliability for ongoing decision-making. Consequently, LWSC takes additional steps before making any decisions, for instance by asking its M&E team to review the data.

Utilities and municipalities in SSA have yet to reach the level at which their NSS data is consistently and effectively used to guide and inform development plans, infrastructure investment decisions, service delivery, or innovation beyond the scope of specific project objectives. Only a few entities such as KCCA and LWSC have made notable progress in this area by integrating NSS data into their internal operations and establishing robust M&E frameworks to ensure accountability. However, even these relatively advanced utilities and municipalities face difficulties such as fragmented data collection and analysis practices and inconsistent data updates. These factors have restricted their ability to fully leverage data for strategic planning. As a result, while some progress has been made, there remains a widespread need for more systematic ongoing data collection and integration to support robust service delivery improvement initiatives.

WHILE PROJECT-SPECIFIC NSS DATA AIDS TARGETED INTERVENTIONS, MOST UTILITIES LACK MECHANISMS TO UPDATE AND INTEGRATE IT FOR ONGOING DECISION-MAKING.

Nonetheless, utilities and municipalities in SSA make use of whatever NSS data is available to them to inform certain internal decisions such as identifying the appropriate focus area for interventions, highlighting gaps that need to be addressed, seeking sourcing for project funds, selecting the kind of community outreach programs to deploy, penalizing emptiers that illegally dispose fecal sludge, developing business models, constructing improved pit latrines as a way of encouraging residents to build their own improved NSS facilities, planning staff expansions, procuring more exhauster trucks, and building more treatment plants in order to treat increasing volumes of fecal sludge. Thus, in addition to reporting data to their respective regulators, most utilities and municipalities also use NSS data to make decisions outside the context of specific projects, at least to the extent their financial capacities allow.

Some utilities make decisions and deliver NSS services without relying on NSS data, whether project-based or otherwise. For instance, WASAC operates without a baseline map or any ongoing NSS data collection, but still provides unplanned and emergency support to enhance NSS service delivery. This support is typically financial or technical, and is driven by immediate needs rather than data-driven insights. As an example, WASAC has provided financial assistance from its internal budget to public schools unable to afford emptying services. Additionally, it has developed standardized septic tank designs for transit centers that serve as temporary accommodations for people.

A number of other accountability mechanisms may further drive the use of NSS data to enhance service delivery in SSA. For example, the reliance on performance-based contracts and scorecards has likely played a significant role in encouraging utilities and municipalities to use NSS data. Utilities such as MAWASCO, NAWASSCO, and SWSC have signed performance-based contracts that hold them internally accountable to their boards of directors. Under these agreements, they are required to report to their boards on the basis of specific metrics, and are expected to demonstrate tangible improvements in NSS service delivery within these areas. In such cases, having access to NSS data is essential in order to realize sustainable service improvements, and helps the utilities maintain their positions in a competitive and regulated environment.

The use of NSS data to enhance utilities and municipalities' service delivery is in some cases also driven by external regulatory authority oversight. Regulators such as NWASCO in Zambia, WASREB in Kenya, and WURD in Uganda require utilities to submit NSS data that relate to regulatory KPIs every quarter. The data are then published in annual sector performance reports that are accessible to the public. Additionally, WASREB recently introduced a monthly data submission cycle for billing and technical data from utilities. In KCCA's case, the authority is appraised of relevant information on a quarterly or semiannual basis.

To ensure compliance with regulatory guidelines, LWSC carries out monthly monitoring and verification of the emptying services provided by private operators throughout Lusaka city. This is done using a performance scorecard, which includes KPIs related to Occupational health and safety (OHS), customer management, and safely managed sanitation.LWSC monitors these KPIs monthly and assigns scores to reflect the performance of each private operator. The scorecard aligns with the permitting guidelines issued by the regulator and is part of the permits issued by LWSC to all operators providing emptying services in the city of Lusaka.

This level of regulatory scrutiny holds utilities and municipalities accountable for the quality and effectiveness of their service delivery. It also provides them with a benchmark for comparing their performance against other utilities, fostering healthy competition within the sector. This competitive environment motivates utilities and municipalities to enhance their service delivery by identifying areas for improvement and adopting best practices from others.

Utilities and municipalities' commitments to making information available to their customers in the context of accountability efforts serve as another driver for the use of NSS data to improve services. For example, in Zambia, SWSC emphasizes the importance of transparency by reporting through the service charters and by establishing community interaction platforms, such as the community water watch group. This group consists of six to eight customers from the service area who volunteer to assist with monitoring service delivery. They also raise awareness among community members about their rights and the service they can expect from the utility. Similarly, WWSC ensures that reports such as the annual sector performance report published by NWASCO are shared on accessible platforms like WhatsApp, thus allowing customers to see how their utility is performing compared to others. The utility also engages with existing and potential customers through processes of stakeholder dialogue, thus allowing the public to discuss utility performance. The public can also report utilities not meeting service levels to NWASCO by calling the toll-free call center to register a complaint.

Overall, utilities and municipalities in SSA recognize the critical role of data in informing their decision-making processes, despite inconsistent data collection practices. As one stakeholder put it, "Even if most of them love using that data, they do not love to invest in collecting that data." This statement summarizes the attitude of many utilities and municipalities toward NSS data collection and use in SSA—in part because data collection initiatives tend to be expensive for utilities and municipalities already facing limited NSS budgets. These

Institutions are today constrained in their ability to make well-informed decisions pertaining to service delivery, due to the simple fact that they cannot utilize what they do not have. Therefore, limited data availability inherently restricts the scope of their decision-making processes.

Nonetheless, some utilities and municipalities are becoming more intentional in their efforts to collect and utilize NSS data. As they undertake baseline mapping surveys and start to create strategies for routine data collection, they are already envisioning the impact of regular, reliable data flow on their ability to improve NSS services. For instance, after NAWASSCO completes the analysis of its baseline mapping project, the organization is planning to leverage this data to develop a long-term strategy for advancing communities within its service area to the highest level of the JMP sanitation service ladder. For its part, WWSC is gathering data on the total volume of fecal sludge generated in order to accurately determine the number of exhauster trucks needed to meet the demand for emptying and transporting services effectively. In Rwanda, the recent NSS service provision restructuring will drive WASAC to begin systematically collecting, analyzing, and utilizing NSS data to better inform its decision-making and service delivery strategies.

2.5.2 NSS DATA UTILIZATION IN INTERNAL PERFORMANCE MANAGEMENT

NSS data also plays a crucial role in monitoring, evaluation, and learning (MEL) activities, which are vital for managing internal performance within utilities and municipalities across SSA. Effective MEL fosters continuous improvement and allows for the comprehensive ongoing evaluation of various interventions, no matter whether these interventions are project-specific or part of regular operational activities. To ensure effective MEL, several critical components must be in place, including a robust MEL framework[63]—a systematic approach to tracking a project's progress (Monitoring), understanding its impact (Evaluation), and using those insights to improve your implementation and future initiatives (Learning) —with well-defined indicators, appropriate data collection tools, and a clear schedule for data collection; dedicated and trained human resources; and data analytics tools. Naturally, the data collected must also be of high quality.

Unlike standard M&E frameworks and units, MEL frameworks and units are particularly essential for facilitating the sharing of knowledge, experiences, and lessons learned, which can significantly enhance the effectiveness of future projects and maximize impact. However, utilities and municipalities in SSA tend to primarily focus on implementing M&E frameworks and units, which may restrict their capacity for learning and adaptation, ultimately compromising the potential for innovation, growth, and long-term success. Furthermore, they usually perform just basic monitoring. For example, MAWASCO, LWSC, NAWASSCO, and KCCA have developed and integrated NSS M&E frameworks into their strategic plans. These frameworks provide the institutions with a structured approach to monitoring their progress, evaluating their achievements, and identifying areas that require further attention or are to be carried over into subsequent planning cycles. This approach additionally ensures that the institutions remain accountable to regulators or customers, giving them greater insight into their own performance levels and pushing them to strive consistently for better service delivery outcomes.

Nonetheless, despite the presence of these M&E frameworks, only one of the aforementioned utilities and municipalities—LWSC—has established a dedicated M&E unit that is fully mainstreamed into the utility's broader NSS operations. In contrast, utilities/municipalities like KCCA have established an M&E unit that is not integrated into its broader NSS operations but rather operates on a project basis. In the absence of such dedicated units, it is harder for utilities and municipalities to ensure the proper handling and maintenance of NSS data, and to track progress toward established targets consistently. This lack of prioritization can lead to gaps in data management and oversight, as the responsibility for M&E may be diffused across multiple roles, and even overlooked until it becomes critically necessary. Consequently, without a focused team to drive these efforts, there is a risk that data-driven decision-making processes will be undermined, reducing their impact on performance management.

However, with or without an NSS MEL framework, utilities and municipalities monitor several aspects associated with NSS service. Examples of the key indicators that are monitored by utilities and municipalities in SSA include the number of households serviced, the number of males and females among serviced households, the number of households reached with improved toilet facilities, the

63 https://globalschoolsforum.org/sites/default/files/2023-12/mel_framework_-_explanation_0.pdf

number of exhauster truck operators licensed and monitored at disposal facilities, the number of pit emptiers registered and licensed, the volume of fecal sludge collected citywide, the volume of fecal sludge collected in informal settlements, percentage increase in quantity of desludging equipment, amount of investment (in USD) in the local sanitation sector, number of participants attending knowledge/information dissemination events, number of utility research publications, average frequency of desludging, and the degree to which treated effluent complies with regulatory standards before disposal.

If utilities and municipalities in SSA intend to manage their performance effectively, they must put a high priority on gathering the high-quality data necessary for effective MEL. Unfortunately, data quality in utilities and municipalities is often compromised for several reasons. As highlighted earlier in this report, there are no established data quality standards within utilities and municipalities or the broader WASH sector. This gap leaves many utilities and municipalities struggling to maintain the integrity and accuracy of their data.

Another key contributor to poor data quality is the manual transfer of NSS data from paper-based data collection tools to digital systems, or between systems that are not interoperable. Both of these are common practices within utilities and municipalities in the SSA region, increasing the risk of errors. While digital tools can significantly mitigate these risks through the use of automatic data validation and cleaning functions, only a few utilities and municipalities have implemented such checks within their systems. The lack of adequately trained NSS data collectors and the irregularity of data collection, validation, and cleaning further undermine the integrity of the incoming NSS data that are used for performance monitoring.

The implication of all these factors for internal performance management in utilities and municipalities is that even in the best-case scenario, in which robust MEL frameworks and dedicated units are available, the value of MEL activities is significantly diminished when data quality is poor. This undermines the ability to accurately measure progress against established targets, in turn making it difficult to assess the effectiveness of service delivery, identify areas needing improvement, respond promptly to emerging challenges, and justify investments.

The repercussions also extend beyond local-level monitoring and performance management; they affect national and global systems, such as those used for national planning and SDG reporting, which depend on reliable data from utilities and municipalities at the local level. When local data does not accurately reflect reality, it calls the reliability of global NSS statistics into question, suggesting that the current figures for the SSA region may not fully capture the true state of progress.

Engaging local communities to improve sanitation and hygiene through awareness and infrastructure support.

CASE STUDIES

03

These examples illustrate how **NAWASSO** and **LWSC** have leveraged digital tools and integrated systems to enhance service delivery, optimize their operations, and improve internal performance management.

CASE STUDIES

This chapter presents case studies that highlight the digital transformation journeys of NAWASSCO and LWSC, two of the SSA region's relatively advanced utilities. These examples illustrate how the two institutions have leveraged digital tools and integrated systems to enhance service delivery, optimize their operations, and improve internal performance management. The aim of presenting these case studies is to demonstrate the transformative impact of digitalization while also highlighting areas that still require improvement. Additionally, the chapter underscores key lessons learned throughout these journeys, offering valuable insights that may serve to guide other utilities and municipalities in the region as they advance their own digitalization efforts.

3.1 DIGITAL TRANSFORMATION JOURNEY: NAWASSCO, KENYA

From Paper Trails to Digital Solutions

NAWASSCO's digitalization journey (Figure 6) began in the early 2010s, when it introduced a mobile billing and payment system. Prior to 2002, NAWASSCO used a manual billing system. Over the years, the utility gradually moved into the digital space. NAWASSCO started using QuickBooks in 2003. It added billing, inventory, and procurement systems built on an Informix database in 2004, and introduced mobile billing and payment functions through M-Pesa in 2010. Notably, NAWASSCO was the first water company in Kenya to provide for payment of bills through M-Pesa.

Between 2011 and 2019, the focus shifted to improving meter-reading efficiency, introducing GIS mapping, and expanding customer relationships and engagement, including with a web and social media presence. NAWASSCO introduced mobile meter reading in 2012; acquired cloud hosting services for its data in 2013; introduced the Maji voice system for customer complaints in 2014; and conducted GIS mapping of its service area in 2018. However, the data stored within these various systems were siloed, and required integration.

NAWASSCO DATA MANAGEMENT SYSTEMS JOURNEY

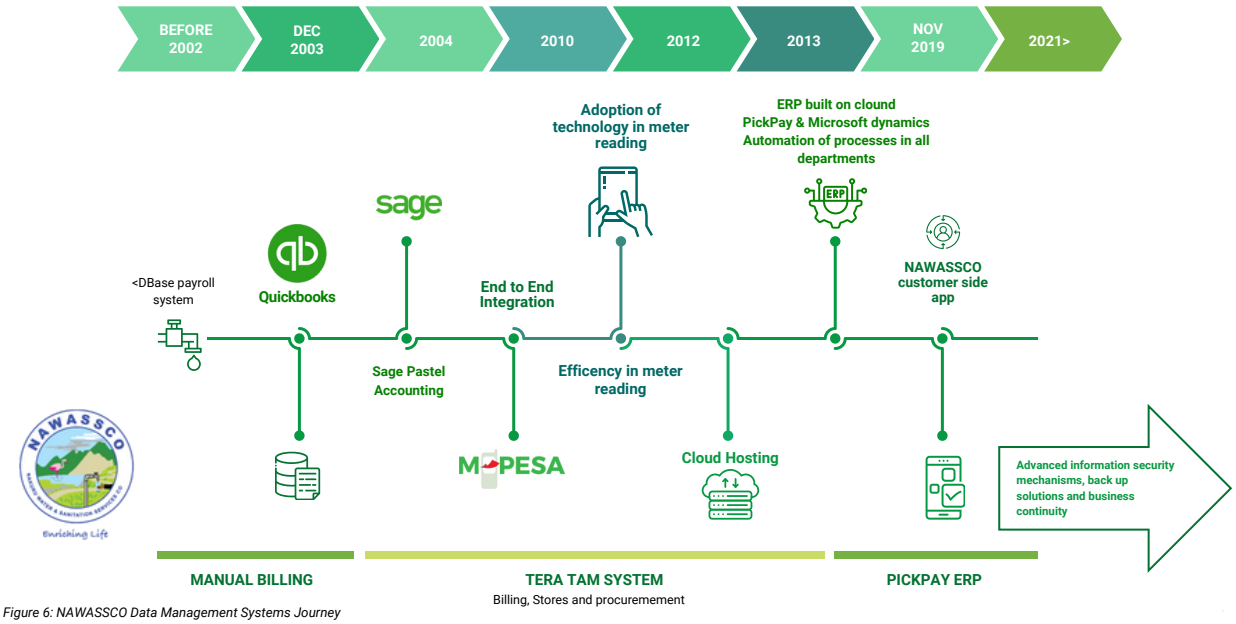


Figure 6: NAWASSCO Data Management Systems Journey

In 2019, NAWASSCO acquired an ERP system built on Microsoft Dynamics and PickPay. The ERP tool integrated systems across all major departments, including finance, human resources, procurement, inventory management, billing, technical operations, and project management. The utility has steadily upgraded the ERP system since that time, and began introducing customer-facing apps and portals in 2021. It additionally invested in advanced information security mechanisms and backup solutions to ensure data safety and provide for business continuity. In 2020, the utility transitioned its water kiosks to a prepaid system, and introduced a call center to enhance its customer support functions. The following year, in 2021, it piloted an automatic meter-reading system, enabling remote meter readings via radio signals, thus eliminating the need for meter readers to physically enter households.

NSS Data and Data Systems

NSS data collection, storage, and analysis is handled by different systems within NAWASSCO. A mix of paper-based and digital tools such as mWater, Kobo Toolkit, and ODK are used to collect NSS data. Paper-based tools, such as the pit assessment forms used by manual pit emptiers, currently constitute a minority share. The NAWASSCO ERP system does not have a module dedicated to NSS data. Rather, it stores NSS data elements in various other modules, such as the technical and billing modules. The lack of a dedicated NSS module renders evidence-based decision-making more challenging for utility managers, as they cannot use the ERP system to develop a comprehensive picture of NSS quality and functions within their service area. Analysis of NSS data is usually project-based, and typically takes place using either Excel or ArcGIS.

NAWASSCO recently acquired an ArcGIS license that allows staffers to visualize the data collected in the field. The platform is integrated with the utility's ERP system. It organizes field data into maps and dashboards that include information on current NSS services (such as truck discharge visits, trips by exhausters, and containment and capture facilities) and other service data. While the utility has successfully achieved seamless data integration with ArcGIS for certain aspects of its NSS data, such as data from the Smart Operation app for exhausters, it has yet to realize this goal with other standalone data collection tools. For example, the utility uses mWater to collect NSS and fecal sludge management data. mWater is a standalone open-source application, meaning that the data collected is not linked directly to ArcGIS or the utility's ERP system.

NAWASSCO HAS A POSITIVE DATA CULTURE, AS EVIDENCED BY THE UTILITY'S PROCUREMENT OF VARIOUS DIGITAL DATA-MANAGEMENT SOFTWARE PACKAGES OVER THE YEARS

Therefore, NSS data still need to be manually downloaded, cleaned, and uploaded before they can be integrated with ArcGIS.

A number of roadblocks to optimizing NSS data flows remain. These include the cost of procuring the additional ArcGIS licenses that would enable field officers collecting data to enter it directly into the integrated ArcGIS platform, as well as the absence of an NSS schema in the ERP system. NAWASSCO intends to upgrade its ArcGIS license and build an NSS schema on the existing PickPay database to accommodate NSS data, and thus facilitate a more seamless process of data collection and analysis within the existing ERP system.

The utility has effectively leveraged its NSS data to make informed decisions that have significantly enhanced service delivery. For instance, it now conducts self-driven situational assessments, which have in turn been instrumental in shaping and guiding donor-funded interventions. Through the strategic use of this data, the utility has been able to proactively identify needs, optimize resource allocation, and ultimately improve the efficiency and impact of its services. As one example, NAWASSCO carried out a sanitation situational assessment within Rhonda, a low-income area in Nakuru County. The aim was to identify the community's sanitation needs and prioritize interventions in order to expand residents' access to safely managed sanitation. The assessment provided the utility with sufficient NSS data to inform the UBSUP program, and allowed it to improve the sanitation situation in this area.

Lessons Learned

NAWASSCO has a positive data culture, as evidenced by the utility's procurement of various digital data-management software packages over the years. It has experienced no major resistance from staff to the introduction of the ERP system or other digital tools.

However, as the utility transitions from traditional paper-based tools to a fully digitalized and integrated ecosystem, it has learned a number of key lessons that have significantly shaped its approach. The following recommendations are based on its experience:

1. Establish clear standard operating procedures (SOPs) before transitioning:

Before implementing any new system, it is crucial to develop and document clear and detailed SOPs. Defining existing processes thoroughly ensures a smoother transition from manual to digital systems. NAWASSCO found that where SOPs had been well-documented, this migration was seamless. However, in areas lacking clear procedures, the utility faced significant challenges.

2. Standardize term definitions and indicators:

It is essential to ensure that terms and indicators are clearly defined both within the utility and across the sector. Clear definitions ensure that all data collection and reporting efforts are aligned, making sure that the data collected accurately reflect on-the-ground realities. Ambiguity in definitions can lead to the production of misleading information and misinformed decisions.

3. Conduct a comprehensive process of stakeholder identification and engagement:

When designing any digitalization intervention, it is critical to conduct a comprehensive process of stakeholder identification and engagement. Drawing up a clear engagement plan requires understanding stakeholders' interests and requirements. This process ensures that diverse perspectives and needs will be considered within the transition, and that the intervention will be designed to meet the needs of all involved parties.

4. Designate departmental "champions" to manage technical communication:

Selecting "champions" from each department to serve as liaisons for technical issues is critical. Funneling all communication with the system provider through these individuals helps to prevent the confusion generated by multiple sources of feedback and allows for a more coordinated and efficient problem-solving process.

5. Ensure that the system provider will provide ongoing support:

Ongoing support from system providers has been instrumental in helping the utility make a successful digital transition, especially in the case of the ERP system. This support should not be viewed as a one-time effort, but instead as a continuous process that adapts to the utility's evolving needs.

6. Allocate/source funding for data systems:

While Infrastructure development often takes precedence in NSS interventions, it is equally important to allocate funding for data systems. When reviewing and setting tariffs, utilities and municipalities sometimes fail to take long-term financial planning for digitalization and investments in digital infrastructure into account. By prioritizing the development of a digitalization strategy, including funding for data systems, a utility can ensure that it has financial support for the digital tools needed for operational efficiency and accurate data collection. No matter how "small" the tool initially acquired is, there should always be a plan for optimization as the institution begins to collect more complex data and carry out more complex tasks.

7. Integrate data systems across the utility and sector:

Integrating data systems within the utility, as well as with systems maintained by other key stakeholders, is vital in order to facilitate information sharing and reduce data-collection duplication. A unified approach to data management fosters collaboration, improves efficiency, and ensures that all stakeholders have access to the same accurate data. Integrating data systems within the utility will also prevent NSS data from becoming siloed. This in turn will make decision-making more effective, improve service quality, and enhance internal performance management.

8. Ensure staff job security:

Where digitalization leads to changes in jobs and roles, there must be a plan in place for retraining or redeployment. Effectively redeploying staff and providing reassurances regarding job security are essential components of a successful digitalization strategy.

9. Continue investing in digitalization across function:

Decision-makers within the institution should visibly prioritize and model evidence-based approaches, thus reinforcing their importance throughout the organization. Fostering this culture can lead to more informed decisions, greater accountability, and ultimately improvements in service delivery.

10. Encourage decision-makers to lead by example:

Decision-makers within the institution should visibly prioritize and model evidence-based approaches, thus reinforcing their importance throughout the organization. Fostering this culture can lead to more informed decisions, greater accountability, and ultimately improvements in service delivery.

The image showcases Nawasco's two water supply infrastructures near Fairmount Mount Kenya Safari Club. The older treatment facility produces 1,000m³/day, while the newer facility has a capacity of 11,000m³/day.

Harnessing technology to track and improve sanitation efforts in rural communities.

3.2 DIGITAL TRANSFORMATION JOURNEY: LWSC, ZAMBIA

From Paper Trails to Digital Solutions

LWSC's digital transformation began in 1990, when it started its operations (Figure 7), initially relying on paper-based processes and monolithic systems until 2000. From 2001 to 2010, it transitioned to semi-automated processes with centralized data processing, remaining data-entry heavy. Between 2011 and 2024, LWSC progressed to integrated systems with distributed processing and paperless workflows.

LWSC's digitalization efforts have significantly streamlined several core utility functions. For instance, between 1990 and 2010, the utility's customer processes were manual, with paper-based payments, face-to-face service applications, and switchboard complaint handling. From 2011 to 2024, LWSC digitalized these services, adopting cashless payments, e-billing and receipting, self-meter reading, and digital platforms for customers to apply for services and make complaints. These included online portals, mobile apps, and social media, significantly improving service efficiency and customer experience.

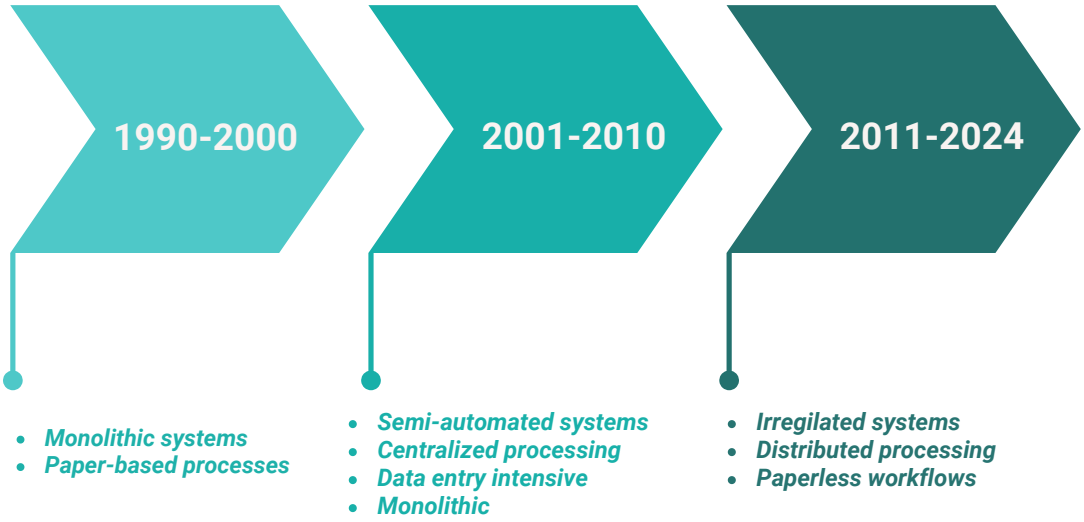


Figure 7: LWSC Data Management Systems Journey

Between 1990 and 2010, internal processes such as payroll, HR, and supply chain were largely paper-based. Payroll used paper payslips, HR handled leave, claims, and commutation on paper, and supply chain management relied on paper requisitions and manual tender processes. From 2011 to 2024, digitalization efforts modernized these processes. Payroll shifted to e-payslips, HR adopted e-leave applications and commutations, and supply chain management introduced e-tendering and digital requisitions and order processing, streamlining operations across the board.

Furthermore, between 1990 and 2010, LWSC's commercial processes, such as meter reading and billing, relied on manual systems with paper-based inputs; bill printing, packing, and sorting; and manual reconciliation of billing and general ledger. The utility used A4 receipts on dot matrix printers and manual receipts were posted into the system. By 2011-2024, digitalization advanced with real-time meter reading being rolled out, e-billing, e-reminders for defaulting customers, and billing and general ledger integration with the financial systems. Receipting has also become cashless, eliminating cashiers and reducing malpractices while handling cash.

Finally, between 1990 and 2010, maintenance involved two-way radios in communicating failures, walk-in customers, and manually logging faults in the Faults book, while repair materials were managed through manual requisitioning and not linked to job cards. From 2011 to 2024, LWSC transitioned to an EDAMS-based Computerized Maintenance Management System (CMMS) and a customer call center for maintenance. Additionally, in the integrated ERP system the utility will develop, repair materials will be managed through an online requisitioning system and linked to job cards. Stores will also be integrated with CMMS, allowing for better visibility and accountability of materials consumption.

NSS Data and Data Systems

The Lusaka Sanitation System (LSS) is an integrated, web-based sanitation M&E MIS that enables LWSC and its key partners—the MoH and LCC—to manage service delivery and monitor access to safely managed sanitation services in Lusaka province. It was developed in 2019 to manage NSS data and allow LWSC, MoH, and LCC to track progress and improvements towards access to safely managed sanitation services and hygiene.

The LSS is a standalone system that stores most of the utility's NSS data, including the GIS sanitation database for all sanitation facilities found in Lusaka province. On the other hand, NSS billing data is stored in another standalone ERP system called EDAMS, which primarily stores water and sewerage data. Due to the high cost of creating a new module within the LSS, the utility opted for a more cost-effective solution by creating the NSS billing module within EDAMS. Without integration and interoperability of these systems, NSS data is collected and analyzed separately. The LSS itself has tools for basic analytics and report generation, but more in-depth analysis is usually done using Excel or SPSS.

The LSS has three main modules for NSS data entry: (i) the OSS Receipting Module, (ii) the FSM Module, and (iii) the M&E Module. The OSS Receipting Module contains customer information and OSS toilet data, entered through baseline mapping or data entry during the construction phase. This module also produces auto-generated toilet numbers for each constructed toilet.The FSM Module is dedicated to the manual emptying service providers engaged by LWSC. They are required to input all relevant data into the LSS via a mobile app on their phones or tablets before they can dispose of their waste at the utility's treatment plant. Unfortunately, the system has not incorporated VTOs, making data capture incomplete. Finally, the M&E Module monitors and evaluates sanitation and hygiene interventions in Lusaka. It includes all relevant KPIs for the three institutions. Data collectors from all three institutions use project tablets to upload data directly into the LSS. A two-step verification and approval process ensures data accuracy before reports are generated for decision-making.

To address the interoperability issues between the LSS and EDAMS, LWSC is developing a fully integrated ERP system based on the EDAMS software. This system will consolidate all utility business processes and data, including NSS data. The LSS functionalities will be enhanced and included as an NSS module within the new ERP. This integration aims to resolve existing limitations, such as the LSS's inability to manage large sanitation mapping datasets, facilitate procedures like scheduled desludging and FSTP receiving (including weighbridge integration and payment for dumping fees), and capture data on end-product sales. Additionally, the new ERP will improve data quality, integrity, and the management of heterogeneous datasets across the utility.

LWSC has effectively harnessed its NSS data, enabling the utility to make well-informed decisions that have significantly improved both service delivery and reporting in Lusaka. Specifically, through the LSS' FSM module, LWSC has streamlined the collection and updating of data pertinent to both local conditions and JMP indicators throughout the sanitation service chain. This module includes a requisition register, assessment form, job card, and FSTP form, which are instrumental in overseeing the performance of contracted manual emptying service providers.

LWSC HAS HARNESSED ITS NSS DATA, ENABLING THE UTILITY TO MAKE WELL-INFORMED DECISIONS THAT IMPROVED REPORTING IN LUSAKA.

The comprehensive data collected through these forms enables LWSC to mitigate payment risks for service providers, guarantee the completion of emptying services, accurately account for the volume of fecal sludge removed, and ensure its final transportation to treatment facilities. This rigorous approach not only minimizes the risk of environmental contamination through the improper discharge of fecal sludge but also enhances the overall efficiency and reliability of sanitation services in the area.

Lessons Learned

LWSC has a positive data culture, as demonstrated by the utility's transition to digital processes over the years. However, as the utility continues to transition to a fully digitalized and integrated ecosystem, it has learned a number of key lessons that have significantly shaped its approach. The following recommendations are based on its experience:

1. Prioritize data quality:

The foundation of any successful project or operation is high-quality data. Before embarking on new initiatives or making significant decisions, it is imperative to clean and organize datasets, records, workflows, and processes. This preliminary step ensures that decisions are based on accurate, reliable information, leading to better outcomes and more efficient operations.

2. Allocate adequate budgets to data system initiatives:

Financial planning is critical for the smooth execution of projects, especially when unforeseen circumstances arise. Establishing an adequate budget that includes provisions for potential risks ensures that data system initiatives can proceed without interruption, even when unexpected incidents occur.

3. Procure essential hardware promptly:

Integrating new software without the necessary supporting hardware can severely hinder its effectiveness. To avoid such pitfalls, it is crucial to procure the required hardware well in advance. This foresight prevents delays in implementation and ensures that the utilization of new software is fully realized from the outset.

4. Involve end-users in system development:

For technology implementations to be successful, end-user buy-in is essential. By involving end-users in the development process and obtaining their sign-off on system requirements, organizations can foster a sense of ownership among those who will use the system most. This involvement not only aids in smoother adoption post-deployment but also reduces resistance and increases satisfaction with the new system.

Harnessing technology to track and improve sanitation efforts in rural communities.

5. Train and build the capacity of end-users:

As technology evolves, so does the need for continuous learning. Allocating a dedicated budget for training ensures that users can effectively utilize new systems and technologies. This investment in knowledge transfer and capacity building is essential for maintaining productivity and enhancing the skill set of the workforce.

6. System-based verifications facilitate better efficiency:

Manual verifications, such as those performed using applications like Excel, are prone to errors and can be time-consuming. By implementing system-based verifications through the LSS, the utility achieves greater efficiency and transparency. These automated processes reduce the likelihood of errors and free up valuable time that can be spent on more strategic tasks.

7. Clearly define system terms of reference (TORS):

Ambiguity in the TORs and scope of work can lead to misunderstandings, re-work, and frustration among both developers and end-users. By clearly defining these elements from the outset, all parties have a mutual understanding of expectations, deliverables, and timelines, which facilitates smoother execution and minimizes scope creep.

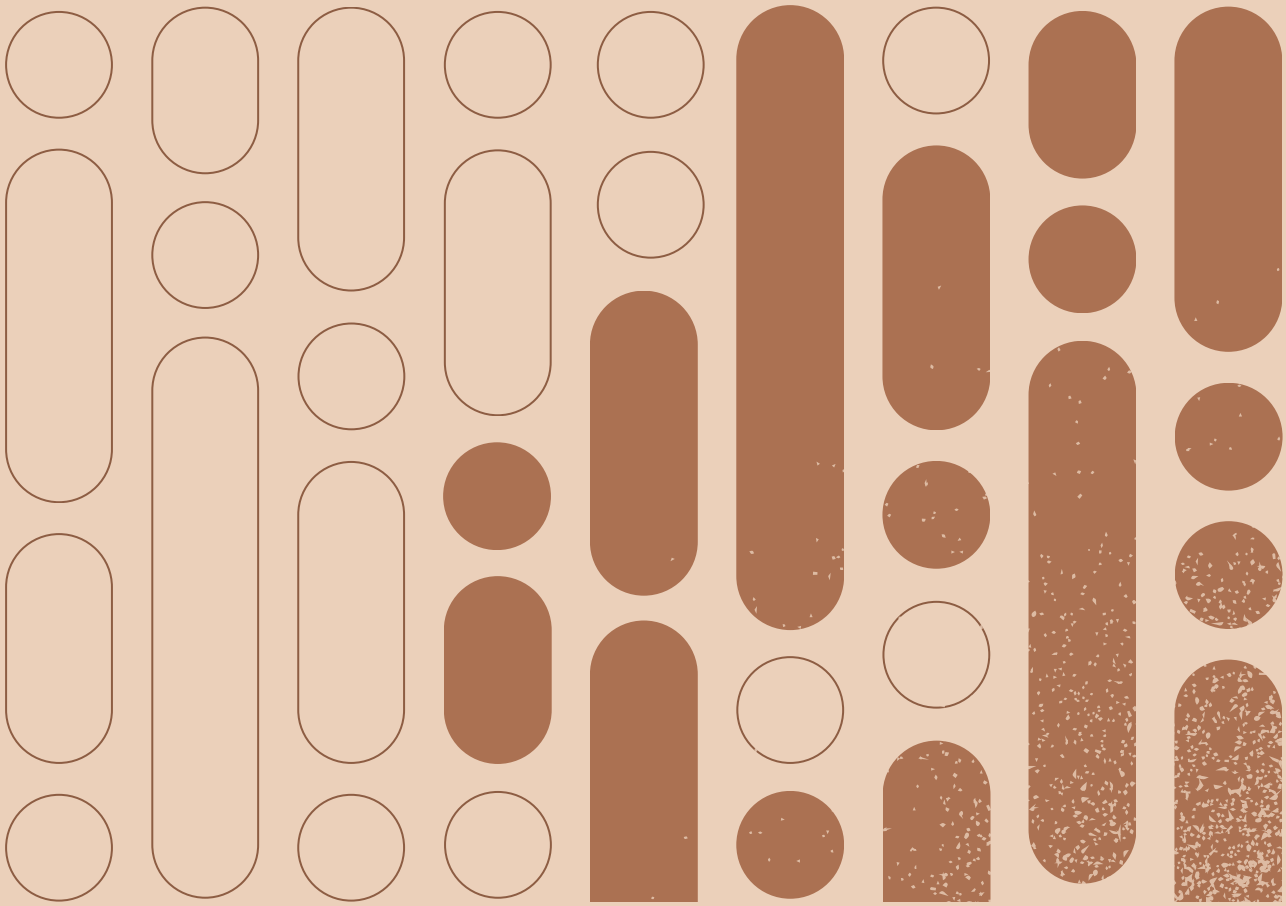
8. Manage knowledge transfer amid staff changes:

Staff transfers pose significant challenges to the sustainable transfer of knowledge and continued system usage. To mitigate these challenges, organizations must implement strategies for effective knowledge management and ensure that systems and processes are well documented. This approach ensures continuity and maintains operational efficiency, even in the face of staff changes.

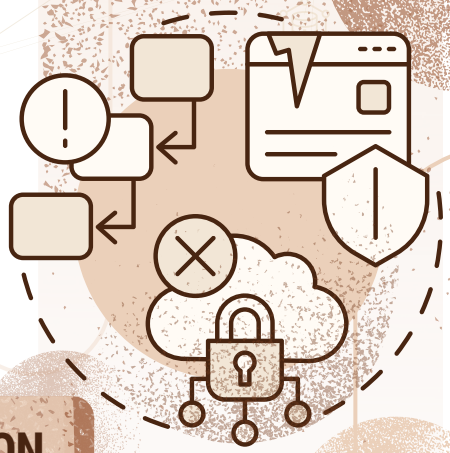
CHALLENGES

04

Utilities and municipalities face multiple challenges that hinder their ability to effectively generate, analyze, and operationalize NSS data throughout the sanitation service chain.



CHALLENGES



4.1 BARRIERS TO EFFECTIVE DATA GENERATION

1. Infancy of NSS Data Collection Methodologies and Systems:

Although many utilities and municipalities in SSA have established data collection methodologies and systems for sewered sanitation, NSS data collection methodologies and systems remain in the early stages of development. While a few regulators such as NWASCO, EWURA, and WASREB are making progress in developing regulatory mechanisms for NSS services, including inclusive sanitation KPIs, most WSS regulators in the SSA region have yet to create data collection guidelines, policies, or standards. Standards of this kind are essential for ensuring the uniformity, consistency, relevance, and interoperability of NSS data; each of these factors are in turn necessary to facilitate evidence-driven decisions in the sector. Consistent methodologies and standards would also help ensure that data collected at the local level align with JMP definitions for SDG reporting.

2. Lack of Baseline NSS Data:

While it is an essential step in the process, creating comprehensive baseline data on sanitation facilities and FSM services has proven challenging for many utilities and municipalities throughout SSA due to the high financial outlays associated with the task and the limited technological capabilities within these institutions. Given the resource-intensive nature of this undertaking, it is important to create clear organizational mechanisms, responsibilities, and schedules for establishing and updating baseline data.

3.Inadequate Political will and Investment:

A lack of political support for projects, insufficient budget allocations, and weak oversight of NSS services often impede NSS data generation and subsequent achievement of service delivery objectives. In many cases, governments have yet to recognize the importance of investing in effective data systems, and do not make sufficient financial resources available for their development. Funding from development partners often goes to project-based and associated systems that lack long-term sustainability. This neglect leaves service providers dependent on fragmented and outdated data sources that are not well-suited to the task of informing service delivery decision-making.

4. Weak Data Capacities:

Data capacities encompass the skills, knowledge, attitudes, and behaviors of data producers, users, and intermediaries. In many cases, utilities and municipalities lack the internal expertise needed to generate NSS data effectively. Most personnel involved in data collection are not specialists, and often treat NSS data responsibilities as secondary. Typically, staff members who handle data are drawn from other departments such as ICT. While some may receive in-house training, most learn on the job, which ultimately impacts the quality of the data.

5. Fragmentation of NSS Data Collection:

This fragmentation is primarily due to the absence of data-sharing practices and national coordination mechanisms among sanitation stakeholders, including local authorities and entities from the WASH and health sectors. Critical NSS data may exist in one sector (e.g., health), while stakeholders in other important sectors such as water, education, or the environment remain unaware of it. Establishing national coordination mechanisms with clear protocols for data collection, sharing, and action would help eliminate these barriers.

6. Fragmented NSS Data Storage Systems:

NSS data is often stored in isolated systems such as ArcGIS, Excel, or hard copy files. Consequently, utilities and municipalities struggle to integrate this information with other utility data contained in centralized data-management systems such as cloud-based ERP systems. Furthermore, in instances where data-collection systems like the LSS are in place, the comparatively long time required for service providers to gather data and input it into the system presents operational challenges.

7. Lack of Regulation and Clear Reporting Framework for Private-Sector Service Providers:

Private operators play a significant role in providing NSS emptying and conveyance services, but many operate on an unregulated basis. This makes it more difficult to create systems enabling them to interface with mandated water and sanitation utilities and municipalities. For example, in Kenya, regulated utilities cover only about 50 percent of the population. The remaining areas, which are served by informal utilities and by extension unregulated private sanitation service providers, are effectively blank spots in terms of NSS data. Therefore, it is crucial to bring these private service providers into a regulatory framework and ensure sustainable reporting on their operations.

8. Poor Data Quality from Private-Sector Service Providers:

Utilities and municipalities depend on private-sector service providers such as manual pit emptiers and exhauster trucks for data on sludge volumes and sources. However, the quality of this data is often compromised, as these providers typically use paper-based files to collect and store operational data. This makes it challenging for them to submit consistently high-quality data. Implementing an electronic platform for service providers to input their data on an ongoing basis, thus enabling this data to be transmitted electronically to the utility or regulator, would help address this accountability gap.

9. Inadequate Compliance Monitoring:

Compliance monitoring of utilities and municipalities with the goal of improving performance reporting is currently weakened by factors including inadequate funding for regulatory agencies, inadequate human resources and institutional capacities within such agencies, political interference, and the lack of an inclusive national sanitation management information system. Regulators have a significant challenge in obtaining reliable local-level data needed to support accurate reporting on the SDG indicators and to understand existing investment gaps fully.

A sanitation worker digitizes field data at the office, transferring paper records into a database system to track and monitor non-sewered sanitation services.

4.2 BARRIERS TO EFFECTIVE DATA ANALYSIS

1. Lack of automated data validation tools:

Most utilities and municipalities do not have tools or systems with features that automatically validate NSS data at the point of entry. This gap increases the risk of poor data quality due to errors and duplication, and significantly increases the time required for manual data cleaning and verification.

2. Project-Driven Analysis:

In many cases, the NSS data analysis actually conducted by utilities and municipalities is narrowly focused on meeting the immediate requirements of donor-driven projects. This is due to these entities' limited financial and institutional capacities to collect, analyze, and manage NSS data consistently as a means of addressing their ongoing operational needs. The lack of such consistent data processes makes it difficult to engage in effective long-term strategic planning and undermines service delivery quality.

3. Insufficient Skilled Personnel:

Utilities and municipalities tend to lack staff with well-developed skills in areas such as the validation, cleaning, analysis, and visualization of NSS data using sofware like Excel and GIS. This reduces the quality and integrity of the insights generated, hindering effective decision-making. Additionally, the absence of dedicated units for NSS data analysis in many utilities and municipalities means that these tasks are often assigned—as secondary responsibilities—to officers who lack the necessary expertise, further compromising the effectiveness of the data analysis.

4. Absence of Interoperable Data Systems:

The lack of integrated and interoperable NSS data systems within utilities and municipalities results in siloed data management, making it difficult to engage in a comprehensive and holistic approach to analysis and obtain real-time insights. This fragmentation undermines efforts to improve service delivery in a coordinated way.

5. Underutilization of GIS Capabilities:

Many utilities and municipalities fail to fully leverage the analytical and visualization capabilities of GIS systems for NSS data for several reasons including limited skills, lack of integration of NSS data into GIS platforms, and high cost of rocurement. This means they are missing out on valuable opportunities to conduct more effective spatial analysis, a task that is critical for efficient NSS service planning and decision-making.

6. Inaccurate GIS Mapping:

Inconsistent data-collection practices and a shortage of personnel trained in geospatial data collection hamper utilities and municipalities' ability to maintain the accurate GIS maps needed for NSS data visualization. As a consequence, they are forced to depend on outdated or inaccurate maps that cannot reliably support strategic planning and decision-making.

7. Financial Constraints:

Financial constraints prevent many utilities and municipalities from acquiring advanced and interoperable tools for NSS data analysis. Even institutions that have invested in GIS or data-management systems struggle with the recurring costs of upgrades and maintenance, which can become unsustainable and strain their financial resources over time.

8. Absence of NSS Data System Guiding Principles:

The absence of established guiding principles for the use of data systems within utilities, municipalities, and the broader WASH sector leaves these entities without clear guidance on acceptable data-management practices. In the absence of a standardized framework, there is no consensus on what constitutes acceptable data practices; this in turn leads to inconsistencies in data collection, analysis, and reporting approaches both across and within individual institutions. This lack of uniformity undermines efforts to ensure data quality, as utilities and municipalities are often left to determine their practices independently. This can result in inefficiencies, errors, and a lack of alignment on best practices.

THE ABSENCE OF AUTOMATED DATA VALIDATION TOOLS IN SSA UTILITIES INCREASES ERRORS, DUPLICATION, AND THE TIME SPENT ON MANUAL DATA CLEANING, AFFECTING DATA QUALITY.

4.3 BARRIERS TO EFFECTIVE DATA OPERATIONALIZATION

1. Fragmentation of NSS Data:

Due to the lack of integration between technological systems and the consequently fragmented nature of NSS data, decision-making and planning functions are often carried out in isolation. Without cohesive, regularly updated data on NSS functions and facilities, and with analyses conducted in silos—sometimes using out-dated information—managers and policymakers are forced to make decisions on service delivery and performance management without a comprehensive view of the overall situation.

2. Limited Funding for Implementation of Data Insights:

Utilities and municipalities often face financial constraints that limit their ability to implement plans based on insights derived from data analysis. A lack of funding prevents critical NSS projects from moving forward, hampering efforts to upgrade infrastructure, expand services to underserved areas, or address identified issues effectively. Consequently, utilities and municipalities are forced to become heavily reliant on donor funding.

3. Political Interference:

In some cases, politicians interfere with resource allocation decisions, prioritizing their own agendas over data-driven, evidence-based investment in areas where additional resources would have the most impact. In some cases, such figures may actively obstruct NSS projects by spreading misinformation or discouraging communities from adopting essential NSS services. This political interference can lead to delays, reduced effectiveness, or even the complete abandonment of crucial projects, undermining service delivery and reducing the efficiency of resource use.

4. Limited Operationalization of NSS Data:

Utilities and municipalities frequently fail to integrate NSS data into their normal operations, focusing instead on project-based data collection and analysis. This challenge is compounded by the absence of a strong culture of evidence-based decision-making within many utilities and municipalities. As a consequence, such institutions have limited capacity to make well-rounded and informed decisions that consider both short-term project objectives and broader, long-term service delivery goals. This in turn reduces service delivery quality and internal performance management effectiveness.

5. Inconsistent Data Quality:

The lack of consistently high-quality data presents a significant challenge by undermining effective MEL efforts both at the local level and within the broader WASH sector. The absence of reliable data makes it difficult for utilities and municipalities to track progress accurately, identify gaps, assess the impact of interventions, derive the meaningful insights necessary to enhance service delivery, optimize resource allocation, secure financing for NSS initiatives, or manage internal performance effectively.

6. Limited MEL Frameworks and Dedicated MEL Units:

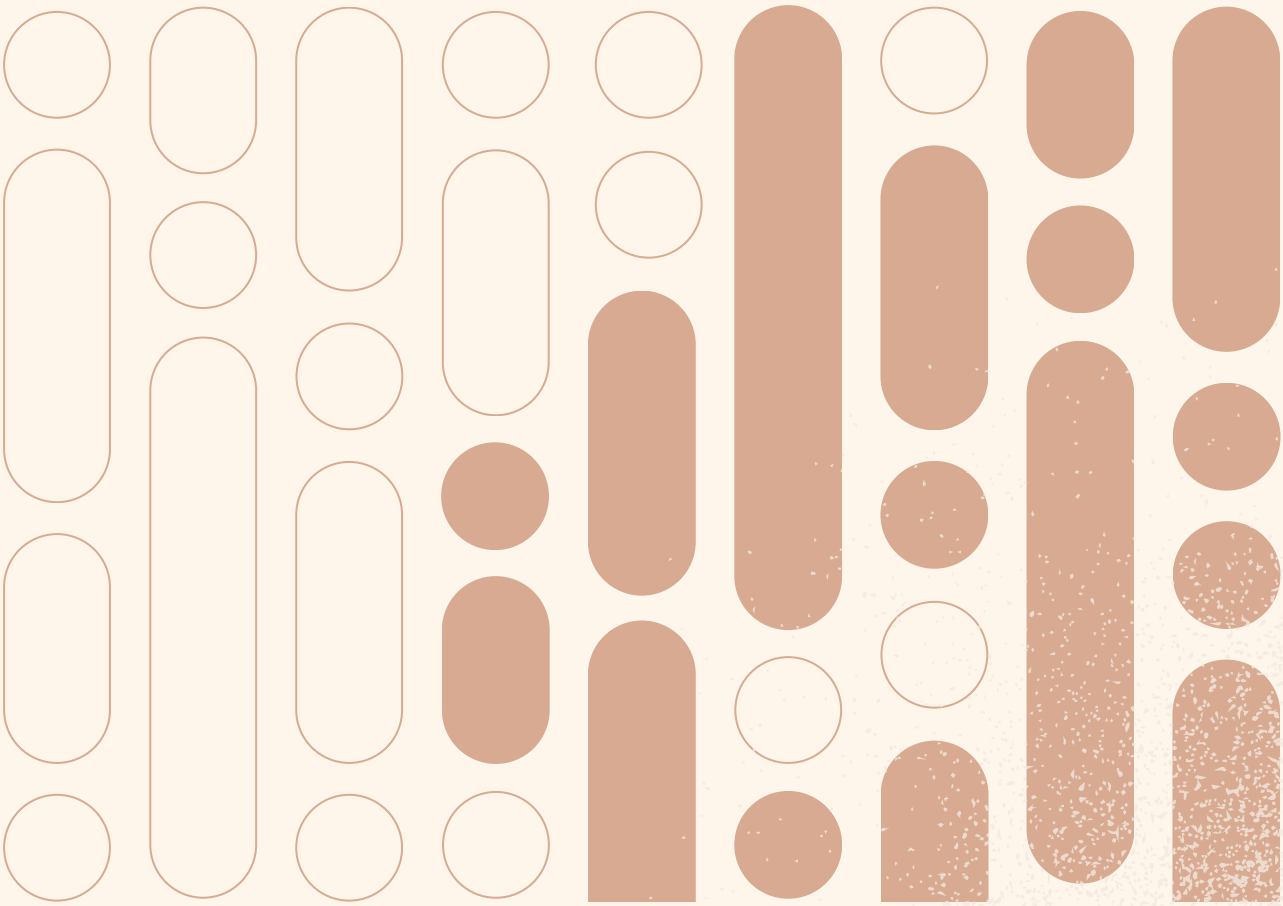
Without robust MEL frameworks, utilities and municipalities struggle to establish clear performance indicators, track progress effectively, promote continuous learning and improvement, and ensure accountability. Additionally, the absence of dedicated MEL units in many utilities and municipalities results in a lack of specialized teams able to manage data collection, analysis, and reporting in a consistent manner. These shortcomings lead to oversight gaps, reductions in data quality, inadequate performance monitoring, and missed opportunities for timely interventions, hindering the overall effectiveness of service delivery and making it more difficult for utilities and municipalities to realize their long-term objectives.

Sanitation service managers analyze performance data during a team meeting, reviewing metrics and charts that track non-sewered sanitation operations.

RECOMMENDATIONS

05

Stronger Data, Smarter Decisions! Mandate holders—establish dedicated MEL teams, invest in training, and integrate data into utility systems. Let’s turn insights into impact for better sanitation services!



5.1 RECOMMENDATIONS FOR MANDATE HOLDERS (SANITATION UTILITIES AND MUNICIPALITIES)

1. Establish Dedicated MEL Teams:

Utilities and municipalities should establish dedicated MEL teams responsible for translating data into insights that inform their performance and operations management. Such teams should also implement robust MEL frameworks that include clear timelines and SMART (specific, measurable, achievable, relevant, and time-bound) indicators that are clearly defined to prevent abstract outputs. Most utilities/municipalities have no dedicated MEL team responsible for managing data and generating strategies to operationalize it. In utilities/municipalities where MEL teams exist, they are usually project-based rather than mainstreamed into the broader operations, with a few having fully mainstreamed teams. The existing MEL teams also lack the requisite data processing, analysis, and operationalization skills, and they usually do not implement the "Learning" in MEL, just basic monitoring. Due to the cost implications and long-term nature of establishing MEL teams, utilities/municipalities can identify data champions within their existing teams to champion MEL activities as a short-term measure.

If established, specialized and well-trained MEL teams can provide deeper insights, help improve data quality, and conduct performance monitoring functions consistently and competently.

2. Invest in Training and Capacity Building of Data Officers:

Utilities and municipalities should provide regular training and capacity-building programs for NSS data officers to help ensure that data-collection, data-analysis, and MEL processes are more accurate, reliable, and consistent. By providing access to refresher courses, workshops, online courses, and certifications for continuous learning, and by creating a mentorship program that pairs experienced data officers with new team members, utilities and municipalities can foster a culture of continuous improvement and knowledge sharing, thereby improve data quality.

3. Design NSS Data Systems Based on and to Inform Critical Utility/Municipality Decisions:

When designing NSS data systems, it is important for utilities and municipalities to base the designs around the purposes that the data will be used for. This may include functions such as planning, budgeting, policy formulation, accountability, influencing the public or policymakers, reporting, or program/asset/service management. This will help prevent inefficient investment in the collection or analysis of data that may not ultimately be used. By working beforehand to identify which data types and corresponding indicators data users will need to make decisions, the NSS data system can be designed as efficiently as possible.

4. Integrate NSS Data Into Broader Utility/ Municipality ERP Systems:

Utilities and municipalities should prioritize the integration of NSS data into broader utility/municipality data and operations management systems such as ERP systems. This also contributes towards the operationalization of NSS data and ensures that data collection and analysis are not driven solely by individual project needs. This integration should be viewed as a top priority for these systems from the outset. In addition, institutions should also adopt data standards and protocols that facilitate easy data sharing, integration, and interoperability. This will prevent data fragmentation and allow for accurate and holistic analysis, high-quality visualization, and evidence-based planning. Ultimately, this integration will enable utilities/municipalities to conduct robust, comprehensive analytics that inform complex, multifaceted decisions and performance management processes.

5. Explore Diverse Funding Sources:

Utilities and municipalities should explore diverse and sustainable ways of funding investments in NSS data systems. Ideally, service providers will need to conduct comprehensive surveys, purchase and maintain advanced analytical tools and visualization platforms (e.g., ERP and GIS systems), and ensure that systems are interoperable. Funding such initiatives could involve PPPs or other innovative financing models. This will reduce heavy reliance on traditional funding mechanisms such as donor and government support.

6. Build Strong Investment Cases for NSS through Compelling Data Narratives:

Most utilities/municipalities face resistance from politicians and decision-makers regarding NSS interventions due to competing priorities. Therefore, to secure their approval for investments in NSS services, it is crucial for utilities and municipalities to develop effective data operationalization strategies through compelling data stories and use cases that present strong investment cases. This advocacy approach for NSS services will contribute to ensuring that these vital interventions receive the attention and resources they deserve amidst competing interests. For example, using infographics to demonstrate how NSS supports climate change mitigation and its impact on community health can be persuasive.

7. Incentivize the use of Data to Promote a Robust Data-Use Culture:

Utilities and municipalities could pilot multiple data-use incentive structures such as establishing a strong institutional leadership commitment towards the use of data, developing data policies and implementation strategies, showing clear pathways on how data integrates into decision-making processes, documenting compelling data use success stories, creating recognition programs to reward teams and employees for data use, investing in technology as a vehicle for data use, and devising feedback loops to promote an inclusive data culture. All these interventions will ultimately lead to an improved institutional data-use culture.

8. Promote cross-learning between utilities and municipalities:

In many cases, the experience of one utility/municipality with NSS data systems will hold valuable lessons for others. For example, institutions could share information relating to price and quality benchmarks for different data systems. This allows utilities/municipalities to leverage shared experiences to enhance their own practices and outcomes.

9. Embed Data Constraints in order to Enhance Quality:

When implementing NSS data-collection tools, utilities and municipalities should make sure to embed automatic data constraints that provide for a high level of data quality and reduce the amount of time and work involved in cleaning and validating data. Specifically, this involves implementing mandatory data validation rules within the data collection systems, thus ensuring consistency and accuracy at the point the data is entered. Moreover, institutions should regularly review and update their data entry guidelines to incorporate best practices.

10. Develop Data Systems that Close Accountability Gaps relating to Private-Sector Operators:

Under the CWIS framework, many utilities and municipalities have delegated the functions of emptying and transportation to private-sector entities through a permitting/licensing system. While this is a positive step, it has created an accountability gap between private operators, community-based organizations, utilities, municipalities, and regulators. Private operators often fail to submit data to utilities and municipalities, and when they do, the quality of this data cannot be validated. To address this issue, utilities and municipalities must be innovative in developing data systems that enhance accountability among all service providers, regardless of their level, leading to more collaboration and efficient public service delivery.

5.2 RECOMMENDATIONS FOR REGULATORS

1. Establish WASH Data System Guidelines and Reporting Standards:

To improve the effectiveness and efficiency of utilities and municipalities in the WASH sector, it is essential that regulators collaborate with the mandate holders to develop and implement comprehensive data system guidelines and reporting standards for consistency and reliability throughout the sector. These guidelines should standardize practices for data collection, management, and analysis; and support data governance and accountability practices. In turn, by adopting clear principles of this kind, utilities and municipalities can enhance data quality, support informed decision-making, and promote a data-driven management culture. Guidelines of this kind can also help align stakeholder efforts, legitimize WASH data, streamline reporting processes, and boost overall transparency and accountability within the WASH sector.

2. Define and harmonize inclusive and context-relevant sanitation indicators:

As this report shows, global NSS KPIs and methodologies are not a strong focus within the SSA region, and they are not well integrated into local and national monitoring systems. To enhance data quality and availability, it will be crucial to define and harmonize country- and regional-level NSS output and outcome KPIs across the SSA region. These inclusive sanitation indicators should align with global frameworks and standards such as the Joint Monitoring Programme (JMP) and the Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS) initiative. However, they should also remain relevant to local contexts. The harmonization process should also encompass intra and inter-sectoral collaboration to enhance and promote cross-sectoral collaboration. By establishing uniform indicators and standardized definitions, regulators can ensure consistency, coherence, and comparability in data collection and reporting across various sources, levels, and contexts.

3. Promote integrated regulatory systems:

Having a well-functioning data management system at the regulatory level is insufficient on its own. Utilities and municipalities must also establish compatible systems that integrate seamlessly with those operated by the regulators. Regulators should, therefore, proactively consider data needs and system integration requirements from the beginning, to prevent the creation of isolated regulatory information management systems that do not align with existing utility or municipality systems. By harmonizing these systems, regulators can enhance coordination and promote automatic and efficient NSS data transmission from utility/municipality data management systems to their regulatory systems. This, in turn, could improve data accuracy and strengthen decision-making processes, ultimately leading to a more efficient and cohesive WASH sector.

4. Conduct regular data-management training:

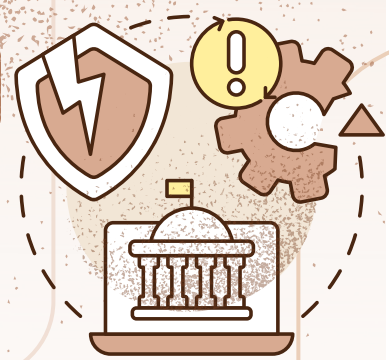
Providing utilities and municipalities with training and orientation sessions focused on indicators, data collection, and the interpretation of results will increase data management and use skills at the subnational level.

5. Disseminate NSS data insights:

Regulators should include NSS data outputs into broader sector performance reporting. This will improve utility/municipality understanding of progress in the sector, enhance NSS performance monitoring, and promote the continuous generation of NSS data to inform sector reporting.

REGULATORS SHOULD ESTABLISH WASH DATA SYSTEM GUIDELINES TO STANDARDIZE DATA COLLECTION, IMPROVE QUALITY, AND ENHANCE ACCOUNTABILITY ACROSS THE SECTOR

5.3 RECOMMENDATIONS FOR GOVERNMENTS



1. Prioritize NSS data investments:

Governments should prioritize NSS data system investments to ensure that adequate resources are allocated to utilities and municipalities managing service provision. This would give utilities and municipalities sufficient funds to procure advanced data collection, analytical, and visualization tools/platforms, which typically require very substantial capital investments. Furthermore, governments should take a long-term approach to strengthening data production and use. The sector's monitoring activities should be provided with regular, predictable funding, with a clear allocation within the national budget, and donors should align behind strong government leadership in this area.

2. Create a conducive enabling environment for private-sector investment:

Governments should focus on creating a conducive enabling environment to attract private-sector investment for NSS data initiatives. This would also diminish reliance on donor support. Doing so should begin with the development of clear and supportive policies and regulations that incentivize private-sector participation. To further attract private-sector investment, governments should establish PPPs that foster collaboration between government agencies and private companies. By ensuring that risks and rewards are shared, these partnerships can encourage private entities to invest in NSS data infrastructure.

3. Support business conditions for technology to thrive:

Governments should focus on enhancing the overall business climate for technology and data-driven enterprises. This includes investing in robust information and communications technology infrastructure, ensuring reliable internet connectivity, and supporting the development of local technology ecosystems. By creating a supportive environment for tech innovation, governments can attract tech companies and startups interested in developing advanced NSS data collection, analytics, and visualization tools.

4. Provide training and support on SDG-focused KPIs:

Data gaps remain a major challenge for tracking the SDGs in Africa. Currently, almost half of all African countries lack sufficient data for one-third of the associated indicators. Consequently, governments must provide training and support on the generation, analysis, and operationalization of SDG-focused KPIs at the utility and municipality levels. This will strengthen the capacity of utilities/municipalities to generate high-quality, timely, and internationally comparable data, with a particular emphasis on tracking the SDG indicators. Furthermore, it will increase the accuracy of monitoring and progress reporting efforts, while also allowing the impact of programs aimed at achieving the SDGs and the broader objectives of Agenda 2063 to be assessed.

5. Invest in coordination, collaboration, and accountability mechanisms in sanitation data-management activities:

To enhance the quality, availability, and use of sanitation data, governments should invest in and establish multisectoral coordination groups, data hubs, and national data repositories that facilitate cross-sector discussions and promote data integration for the purposes of informed decision-making. These groups must clearly define the various involved actors' roles and responsibilities, from local data collection to aggregation at the national level. This will help ensure that efforts remain coordinated and accountable across the entire data-management chain.Promoting data integration and fostering collaboration among stakeholders such as governments, NGOs, private-sector entities, and academic institutions will allow governments to leverage the diversity, complementarity, and synergies inherent in sanitation data. Engaging data stakeholders and users in this process will further strengthen transparency, encourage active participation, and ensure that data-management activities align with the needs and expectations of all involved, in turn making planning and decision-making more effective.

5.4 RECOMMENDATIONS FOR DEVELOPMENT PARTNERS AND DONORS

1. Fund interoperable data tools and systems:

While continuing to fund projects aimed at increasing access to improved NSS facilities, development partners and donors should also focus on supporting the procurement and development of interoperable NSS data collection, analytics, and visualization tools in utilities/municipalities. By prioritizing funding for advanced data systems, they would help ensure that NSS data is not collected and analyzed in silos, and can instead be easily visualized on real-time dashboards. This would in turn facilitate holistic and intuitive decision-making processes, and lead to improved data quality. It would additionally promote more effective and coordinated interventions across different levels of service provision.

2. Build local-level capacity:

Development partners and donors should provide technical support and conduct capacity-building initiatives to help utilities and municipalities manage NSS data effectively. This support could include training programs, workshops, and access to best practices. By enhancing the capabilities of utilities and municipalities in this way, development partners and donors can foster greater self-reliance and resilience within these organizations.

3. Promote a culture of data use in the sanitation sector:

Development partners and donors can promote a culture of data use in the sanitation sector through evidence-based financing mechanisms. They can achieve this by ensuring that funding decisions are contingent on the demonstration of data use to support proposed interventions from utilities/municipalities. By prioritizing investments backed by credible data, development partners and donors can incentivize utilities/municipalities to improve their data collection, analysis, and reporting practices.

4. Promote global partnership platforms:

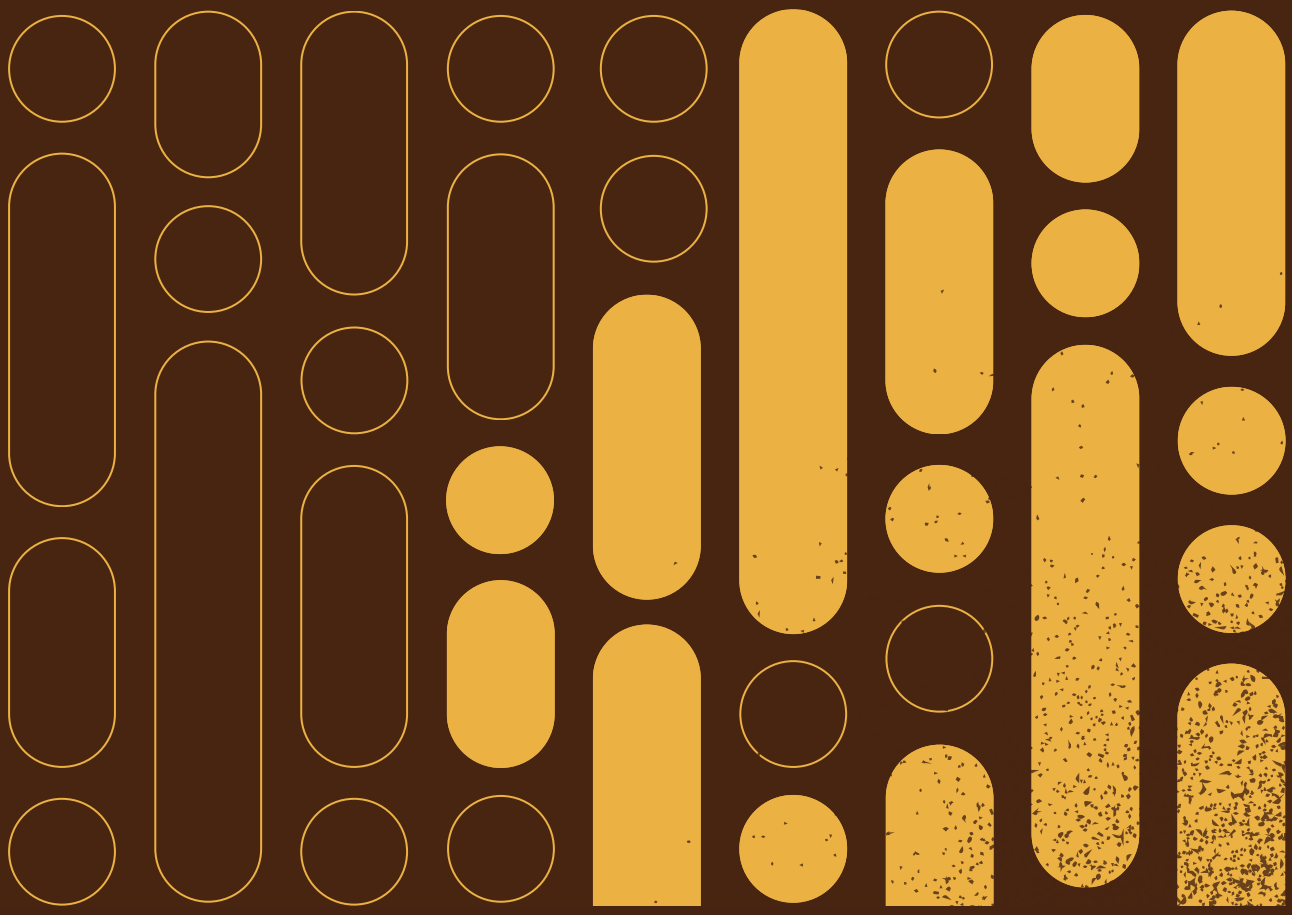
Development partners and donors should promote global partnership platforms, such as ESAWAS Engage, the Global Water Operators' Partnerships Alliance (GWOPA), VEI, and AfWASA. These platforms offer WASH stakeholders, including utilities and municipalities, the opportunity for peer-to-peer learning and knowledge exchange, ultimately enhancing their capacity and improving service delivery and performance management.

Sanitation service supervisors analyze GIS mapping and performance data on digital dashboards, tracking non-sewered sanitation operations across their service area.

CONCLUSION

06

This report summarizes the key insights from the from the landscape assessment of non-sewered sanitation (NSS) public data systems in utilities and municipalities across sub-Saharan Africa (SSA).



6.1 SUMMARY OF FINDINGS

THE KEY INSIGHTS FROM THE REPORT ARE LISTED BELOW:

01 Within the SSA region, the mandate for NSS service provision lies mostly with utilities. Most such entities gained responsibility for NSS service provision in recent years, owing to the push for CWIS.

02 The sanitation governance landscape in most countries across SSA is fragmented between the health, environment, water, and sanitation sectors. This means that sanitation data generation is also fragmented between these sectors, typically without robust data-sharing or integration mechanisms.

03 Most utilities and municipalities lack comprehensive NSS baseline data. The data available is either piecemeal, with attributes dependent upon requirements defined by partners or donors, or lacks credibility due to its collection through third-party emptying service providers, therefore making validation difficult.

04 While some utilities do collect data on sanitation facilities within their service areas, these efforts are mostly focused on household capture facilities and public sanitation facilities. Very few utilities have gone beyond pure access data to collect data fully aligned with the WHO/UNICEF Joint Monitoring Programme (JMP) SGD 6.2 indicators such as the status/condition of NSS containments, the suitability and accessibility of NSS containment facilities, or the questions of whether NSS containment facilities are emptied, who empties the containment facilities, where waste is disposed after transportation, and whether the waste is eventually treated.

05 Most utilities and municipalities have delegated emptying and transportation functions to private-sector entities through a permitting/licensing system. The private-sector operators and community-based organizations are only weakly accountable to the utilities or municipalities through performance reporting. This represents a significant data generation gap. Private operators submit little data to the utilities and municipalities, and there is no way of validating the quality of the data that they do provide.

06 In most countries across SSA, the local ministry of health uses existing health structures, including community health systems, to collect data on the state of sanitation at the household level. Local government authorities also collect some forms of sanitation data through their public health, rural water, and sanitation units. However, the sharing of the different sanitation data types between water and health authorities and local governments is limited by the fact that data systems are not integrated, and collaboration frameworks/mechanisms are still weak.

07 Within utilities and municipalities, the collection of NSS data is performed using a mix of paper-based and digital tools, making data management cumbersome and time consuming. The collected data is stored in ERP systems, Excel workbooks, or hard copy files.

08 Most utilities and municipalities store, manage, and analyze their NSS data in platforms that are neither integrated nor interoperable. This lack of system integration and interoperability has led to analysis and decision-making being conducted in silos. However, a few utilities have started to shift toward integrating their NSS data and data systems, with the goal of facilitating holistic analysis and well-informed decision-making, and thus improving service delivery and internal performance management functions. These shifts are being complemented by significant financial backing provided by donors.

09 The data type most often used for visualizations within SSA utilities is data on NSS facilities, with some institutions using GIS for this purpose. In some cases, erroneous GIS mapping by undertrained data collectors has resulted in inaccurate visualizations of these facilities on the maps. Thus, considerable room for improvement remains with respect to NSS data visualization capacities, especially in the area of disaggregating data in order to address service inequalities.

10 The task of improving NSS data quality within utilities and municipalities demands urgent attention. Utilities and municipalities within the SSA region largely do not yet subject NSS data to comprehensive cleaning and validation processes, as most such institutions are just venturing into the data-collection phase. The risk of errors is heightened through the use of paper-based data-collection tools, digital data-collection tools with limited automatic validation functions, and the deployment of undertrained staff to carry out data collection and analysis. These factors collectively mean that the quality level of data produced at the local level is often low, a fact that in turn has negative implications for national monitoring and global SDG reporting functions.

11 Some utilities clearly understand the value of NSS data with regard to informing service delivery decisions. However, their ability to use this data to enhance decision-making at the local level is limited by a number of factors, including the lack of standardized NSS indicators, the lack of regulatory guidance regarding specifically which types of NSS data should be generated, constraints on the financial resources needed to facilitate data generation, and underdeveloped institutional data-use cultures. Because of these factors, aggregated data is used to guide policy in some areas, but is rarely used to support utilities in their service planning and service delivery decisions.

12 While utilities and municipalities recognize the value of data and utilize it when available, their approach to data collection often lacks commitment. Despite acknowledging its importance, many institutions exhibit a less than enthusiastic attitude toward collecting and managing data. In many cases, this is because they are aware that their funds are limited, and that the costs of undertaking data-collection activities are high. Moreover, they are conscious of the lack of clearly defined inclusive sanitation KPIs and the absence of defined NSS data collection standards.

13 Within the SSA region, Excel is the platform most frequently used by utilities and municipalities to analyze NSS data. Moreover, such analysis typically takes place within the context of specific projects. Many utilities lack a dedicated NSS data analysis or MEL unit. This lack of specialized expertise can mean that analyses remain superficial, insights are overlooked, performance tracking is inadequate, and overall procedures do not comply with standardized data system guiding principles.

14 While MEL frameworks and units are vital for sharing knowledge and continuous improvement, utilities and municipalities in SSA tend to primarily implement M&E frameworks, with very few having dedicated M&E units. This may limit their capacity for learning and adaptation, innovation, and long-term success. Furthermore, these frameworks often cannot be implemented effectively due to data quality issues, irregular data collection, and the reluctance of private-sector emptiers to share data.

15 The WASH sector within the SSA region has yet to establish comprehensive guiding principles for data systems. These leaves utilities and municipalities without clear standards or frameworks for data management. As a result, these institutions lack consistent guidelines and best practices for their data collection, analysis, and operationalization efforts. In the absence of sector-wide guidance, utilities are struggling to implement robust data systems, further exacerbating inefficiencies and reducing the effectiveness of their operations.

6.2 FUTURE DIRECTIONS

As utilities and municipalities move toward digitalization, the application of artificial intelligence and machine learning techniques to support data analysis offers transformative potential for public NSS data systems. By automating complex data analysis tasks, artificial intelligence and machine learning can significantly enhance the efficiency and accuracy of data processing. These technologies can identify patterns and anomalies in vast datasets that would be difficult for humans to detect, providing deeper insights and more precise trend predictions.

As artificial intelligence and machine learning continue to advance and become more integrated into various sectors, it will be crucial to explore how they can be merged with NSS data systems to achieve unprecedented levels of efficiency, accuracy, and impact in the areas of service delivery and internal performance management.

6.3 CALL TO ACTION

Evidence from this report should encourage all stakeholders—utilities, municipalities, governments, regulators, donors, and development partners—to engage actively in helping to strengthen public NSS data systems in the SSA region. The effectiveness of NSS initiatives hinges on the generation of accurate, reliable, and timely data. Collaboration and investment are crucial in establishing standardized, reliable, and efficient NSS data-management systems and practices, which in turn will drive informed decision-making and enhance service delivery. By committing resources and expertise to developing and maintaining these systems, we can collectively ensure that the WASH sector operates with greater transparency, accountability, and effectiveness.

APPENDICES

APPENDIX 1: SUMMARIZED TABLE OUTLINING THE CHALLENGES FACED BY UTILITIES AND MUNCIPALITIES

Table 3: Summary of challenges faced by utilities and muncipalities along the sanitation data value pipeline

	Data Generation
Challenges	**Context**
Infancy of NSS Data Collection Methodologies and Systems	Many utilities and municipalities in SSA have established data collection methodologies and systems for sewered sanitation, but not for NSS. In addition, only a few WASH regulators are progressively developing regulatory mechanisms for NSS services, including inclusive sanitation KPIs; most are yet to create data collection guidelines, policies, and standards.
Lack of NSS Baseline Data	While essential, generation of comprehensive baseline data regarding sanitation facilities and FSM services has proven challenging due to the high associated costs and the limited technological capabilities in utilities and municipalities throughout SSA.
Inadequate Political will and Investment	An absence of political will, insufficient budget allocations, and weak oversight of NSS services all impede NSS data generation and subsequent achievement of service delivery objectives. Governments have yet to prioritize investment in effective data systems, resulting in limited financial support for such initiatives. Partner funding often goes to project-based and parallel systems, leaving service providers reliant on fragmented and outdated data.
Weak Data Capacities	Many utilities and municipalities lack the skills and expertise required to generate effective NSS data. Most personnel involved in data collection are not specialists, and often treat NSS data responsibilities as being of secondary importance. Typically, data officers are drawn from other departments, such as ICT. While some may receive in-house training, most learn on the job, which ultimately impacts the quality of the data.
Fragmented NSS Data Collection	Poor data-sharing practices and a lack of national coordination among sanitation stakeholders, including local authorities and WASH and health institutions, leads to fragmented data. For example, critical NSS data may exist in one sector (e.g., health), while other authorities working in other key sectors such as water, education, or environmental policy, remain unaware of it. This underscores the need to establish national coordination mechanisms.
Fragmented NSS Data Storage Systems	Utilities and municipalities struggle to integrate collected NSS data with centralized data-management systems such as cloud-based ERP tools because NSS data is often stored in separate systems like ArcGIS, Excel, or even paper files. Furthermore, in instances where data-collection systems like the LSS are in place, the comparatively long time required for service providers to gather data and input it into the system presents operational challenges.

Lack of Regulation and Clear Reporting Frameworks for Private-Sector Service Providers	Private operators play a significant role in providing NSS emptying and conveyance services, but many operate without regulation. This makes it difficult for them to interface with mandated water and sanitation utilities and municipalities. Therefore, it is crucial to establish a clear framework for regulating these private-sector service providers and ensuring sustainable reporting on their operations.
Poor data Quality from Private-Sector Service Providers	Utilities and municipalities depend on private service providers such as manual pit emptiers and exhauster trucks for data on sludge volumes and sources. However, data quality is often low, as these providers typically collect and store operational data using paper-based files. This makes it challenging for them to submit data consistently.
Inadequate Compliance Monitoring	Compliance monitoring of utilities and municipalities is weakened by inadequate funding for regulatory agencies, inadequate human resources and institutional capacities, political interference, and the lack of inclusive national sanitation management information systems. The main challenge for regulators is obtaining reliable local data for accurate SDG reporting and identifying investment gaps.

	Data Analysis
Lack of Automated Data Validation Tools	Most utilities and municipalities do not have tools or systems with embedded controls to automatically validate NSS data at the time it is entered. This increases the risk of poor data quality due to potential errors and duplication, significantly increasing the time required for manual data cleaning and validation.
Project-Driven Analysis	When utilities and municipalities conduct NSS data analyses, these are often narrowly focused and tailored to the immediate requirements of donor-driven projects. This is due to these institutions' limited financial and institutional capacity to consistently collect, analyze, and manage NSS data in the process of addressing their ongoing operational needs, and in turn leads to gaps in long-term strategic planning and service delivery.
Insufficient Skilled Personnel	There is a lack of staff with adequate skills to perform critical functions such as NSS data validation, cleaning, analysis, and visualization using software like Excel and GIS. This directly impacts the quality and integrity of the insights generated, hindering effective decision-making. Additionally, the absence of dedicated units for NSS data analysis means that these tasks are often assigned to officers who lack the necessary expertise.
Absence of Interoperable Data Systems	The lack of integrated and interoperable NSS data systems within utilities and municipalities results in siloed data management, making it difficult to engage in a comprehensive and holistic approach to analysis and obtain real-time insights. This fragmentation undermines efforts to improve service delivery in a coordinated way.

Underutilization of GIS Capabilities	Many utilities and municipalities fail to leverage the analytical and visualization capabilities of GIS for NSS data for several reasons including limited skills, lack of integration of NSS data into GIS platforms, and high cost of procurement. This means they miss out on valuable opportunities to conduct more effective spatial analysis, which is critical for planning and decision-making in NSS service provision.
Inaccurate GIS Mapping	The ability of utilities and municipalities to maintain accurate GIS maps for NSS data visualization is hampered by inconsistent data collection practices and a shortage of skilled personnel trained in geospatial data collection. This leads to outdated or inaccurate maps that cannot reliably support strategic planning and decision-making.
Financial Constraints	Financial limitations prevent many utilities and municipalities from acquiring advanced and interoperable tools for NSS data analysis. Even those who have invested in GIS or data-management systems struggle with the recurring costs associated with upgrades and maintenance, which can become unsustainable and strain institutional financial resources over time.
Absence of NSS Data System Guiding Principles	The absence of established guiding principles for WASH sector data systems leaves utilities and municipalities without clear guidance on acceptable data-management practices. This undermines efforts to ensure data quality, as utilities and municipalities are often left to determine their practices independently, which can result in inefficiencies and errors.

	Data Operationalization
Fragmentation of NSS Data	The lack of integration and the fragmented nature of NSS data often result in decision-making and planning functions being carried out in isolation. Without a cohesive data set that can be updated on a regular basis, and with analyses conducted in silos—sometimes using outdated information—decisions on service delivery and performance management are made without a comprehensive view of the overall situation.
Limited Funding for implementation of Data Insights	Utilities and municipalities often face financial constraints that limit their ability to implement plans based on insights derived from data analysis. Lack of funding prevents critical NSS projects from moving forward by hampering efforts to upgrade infrastructure, expand services to underserved areas, or effectively address identified issues. Consequently, service delivery institutions are forced to become heavily reliant on donor funding.
Political Interference	Politicians may prioritize their own agendas over data-driven investment in areas where resources would have the most impact. For example, they may interfere with resource allocations, spread misinformation, or discourage communities from adopting essential NSS services. This can lead to delays, reduced effectiveness, or even the complete abandonment of crucial projects, undermining service delivery and reducing resource-use efficiency.
Limited Operationalization of NSS Data	Utilities and municipalities frequently fail to integrate NSS data into their normal operations, instead focusing on project-based data collection and analysis. This challenge is compounded by the absence of a strong culture of evidence-based decision-making within many utilities and municipalities. This in turn limits these institutions' capacity to make well-rounded and informed decisions.

Inconsistent Data Quality	The lack of reliable, high-quality data in utilities and municipalities makes it difficult to track progress accurately, identify service gaps, assess the impact of interventions, and derive the meaningful insights necessary for enhancing service delivery and managing internal performance. This undermines MEL efforts both at the local level and within the broader WASH sector.
Limited MEL Frameworks and Dedicated MEL Units	Without a strong MEL framework, utilities and municipalities face challenges in setting clear performance indicators, tracking progress, promoting continuous learning and improvement, and ensuring accountability. Additionally, the absence of dedicated MEL units in many utilities and municipalities results in a lack of specialized teams able to consistently manage the tasks of data collection, analysis, and reporting. This ultimately hinders the overall effectiveness of service delivery.

APPENDIX 2: LIST OF SAMPLED STAKEHOLDERS

West Africa

1. Office of Drainage Services, Lagos State Ministry of the Environment and Water Resources: Nigeria.
2. Lagos State Water Regulatory Commission: Nigeria.
3. Ekiti State Water and Sanitation Regulatory Agency: Nigeria.
4. Lagos State Wastewater Management Office: Nigeria.
5. Environmental Health Council of Nigeria: Nigeria.

East Africa

6. Ministry of Water and Energy: Ethiopia.
7. Ministry of Water, Sanitation, and Irrigation: Kenya.
8. Water Services Regulatory Board: Kenya.
9. Water and Sanitation Providers Association: Kenya.
10. Kisumu Water and Sanitation Company: Kenya.
11. Malindi Water and Sewerage Company: Kenya.
12. Nakuru Water and Sanitation Services Company: Kenya.
13. Rwanda Utilities Regulatory Agency: Rwanda.
14. Water and Sanitation Corporation: Rwanda.
15. Association of Emptiers in Rwanda: Rwanda.
16. Energy and Water Utilities Regulatory Authority: Tanzania.
17. Water Utilities Regulation Department: Uganda.
18. Kampala Capital City Authority: Uganda.
19. National Water and Sewerage Corporation: Uganda.
20. Ministry of Health: Uganda.

Southern Africa

21. Lilongwe City Council: Malawi.
22. Lilongwe Water Board: Malawi.
23. Department of Water and Sanitation: South Africa.
24. Southern Water Supply and Sanitation Company: Zambia.
25. Lusaka Water Supply and Sanitation Company: Zambia.
26. Western Water Supply and Sanitation Company: Zambia.
27. Ministry of Health: Zambia.
28. Eastern and Southern Africa Water and Sanitation (ESAWAS)

Central Africa

28. U.S. Agency for International Development: Democratic Republic of Congo.

Enhancing public data systems to drive informed decision-making, optimize performance management, and improve non-sewered sanitation service delivery in Sub-Saharan Africa.

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