

Monitoring safely managed on-site sanitation (SMOSS)

Synthesis of lessons from phase 1 pilots and recommendations for phase 2 pilots

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Summary

Significant progress has been made in monitoring safely managed sanitation. Data available on safely managed sanitation increased from 84 countries to 120 countries between 2015 to 2020, an increase of 48% to 81% of the global population. However, there remains a major gap in the availability of data on **safely managed on-site sanitation (SMOSS)**, both on containment, treatment and disposal of excreta in situ and the emptying and treatment of excreta off-site.

On-site sanitation (pit latrines, cesspools, septic tank systems and other on-site containments) was used by 43% of the global population in 2020 and their use is increasing more rapidly than sewer connections [1]. Due to a lack of national monitoring data, only three of the eight SDG regions had estimates for excreta safely disposed in situ and no region had estimates for excreta emptied and treated off site.[i] Nationally representative data shapes awareness of countries' needs and informs policy, implementation and research efforts to extend and improve services [2].

The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) has brought together national governments and international partners to pilot new methods and tools to monitor on-site sanitation from 2019-2024. The objective is to produce a recommended set of harmonized indicators and methods that national authorities can use to assess the extent to which excreta from on-site sanitation systems are safely managed. This report synthesizes the methods and lessons of the first round of pilots from six countries: Bangladesh, Ecuador, Indonesia, Kenya, Serbia, Zambia. The synthesis includes a summary of core and expanded indicators to monitor SMOSS; methods and tools for collecting this data; and lessons and examples from the six pilots.

This synthesis of lessons aims to address an evident need for clarification and consistent language to define or assess the different safe and unsafe practices to benchmark and monitor progress over time and enable comparison of national data between countries. However, given the diversity of on-site sanitation facilities and management, the varied context of monitoring and that many monitoring tools are still in their infancy, there is not one standard approach to monitoring SMOSS. This synthesis can inform how countries can develop SMOSS monitoring approaches that take into account global norms and standards for consistent data, yet are also adapted to national sanitation contexts, priorities, and monitoring systems. Countries may

KEY MESSAGES

- *Core set of harmonized indicators for global monitoring, expanded set of indicators for national and local monitoring. All countries should be able to report on global indicators, but choice of expanded indicators will be country specific.*
- *National standards and indicators definitions for monitoring SMOSS are highly variable, and further clarity is needed on what to measure and monitor.*
- *National data sources on SMOSS are often incomplete and not fully representative of the population using on-site sanitation systems*
- *Effective monitoring of SMOSS requires piggy backing on existing data collection systems and integrating data from multiple sources including households, local government, and service providers to address all steps on the service chain.*
- *Roles and responsibilities for collecting, aggregating, and reporting data on SMOSS need to be clarified. Regulatory coverage needs to be expanded beyond formal urban systems to include informal rural sanitation systems.*
- *Establishing and expanding systems for routine monitoring of SMOSS will require investment in national data collection systems and capacity building and training at all levels.*

[i] National estimates are only possible when information on excreta management is available for at least 50% of the population using the dominant type of improved sanitation facility and 30% for regional and global estimates. JMP 2017

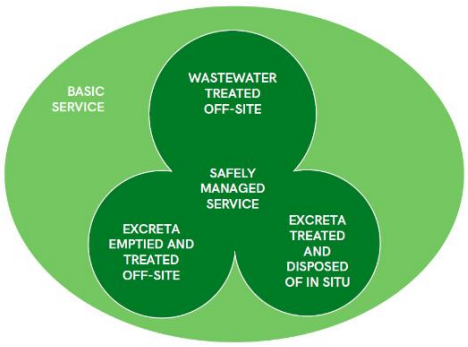
define their own national indicators to have the data needed to inform national and local planning and implementation, while at the same time producing statistics that can be used for SDG reporting.

Summary of core indicators and expanded indicators

SDG target 6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

Achieving safely managed sanitation requires that all excreta (wastewater, fecal sludge) are safely managed across all steps of the sanitation service chain: containment, conveyance, treatment and disposal. While previous monitoring of sanitation focused on household access to improved toilets, the assessment of safely managed sanitation requires consideration of household facilities and behaviors (e.g. emptying, disposal, reuse), as well as formal or informal service provision at community or larger scales. Monitoring safely managed sanitation is complex as there are a variety of options and criteria for assessing safe management at each step of the chain, ultimately resulting in three pathways by which excreta can be considered safely managed:

i. stored, treated and disposed of in situ,
ii. stored temporarily and then emptied, transported and treated off-site, or
iii. transported through a sewer with wastewater and then treated off-site.



The objective of safely managed sanitation is to protect human and environmental health, predominately through reducing discharge of and exposure to untreated waste in the environment. There are multiple pathways of exposure or release of fecal waste to the environment, many of which are context or system specific [3]. The JMP global monitoring of water, sanitation and hygiene requires consistent assessment across countries, with comparable indicators that can be drawn from national data. Only a select few criteria meet these requirements for inclusion in the definition of the SDG indicator 6.2.1a on the use of safely managed sanitation services. These are called the **core indicators** which all countries should be able to report on during the SDG period and are shown in Table 1.

It is recognized that the core indicators used for global monitoring do not capture all aspects of safety identified in the WHO guidelines on Sanitation and Health [3]. There are potentially many **expanded indicators**, that capture additional details of safely managed sanitation that countries may decide to monitor depending on their national sanitation policies, context, and resources. This could include additional aspects of safety identified in the WHO guidelines on Sanitation and Health [3] or indicators to better understand aspects of gender or inequalities in accessing safely managed services. This list of expanded indicators in Table 1 is not intended to be comprehensive but rather provides illustrative examples of the types of expanded indicators currently being considered for national and sub-national monitoring at different steps of the service chain.

Table 1. Summary core indicators used for global monitoring and expanded indicators for local monitoring

	Core indicators [4]	Example optional expanded local indicators
Toilet facility	Use of improved facilities	- Use: all members using facility, child stool disposal, cleanliness - Access: Location, accessibility all times and to all, privacy, safety
	Not shared with other households	- Use: all members using facility, number households sharing, restrictions, payment - Safety: Cleanliness, privacy, lockable doors, proximity, lighting, gender separated - Quality: water access, tiling, handwashing
Containment	Containment[ii] is not overflowing or discharging waste to the surface environment	- Design standards: sealed on the surface, walls and base material or permeability, chambers, dimensions, outlet type. - Functionality: damage, blockage leaks, sludge depth. - Groundwater risk: proximity to wells, depth of groundwater, soil characteristics, density (volume/area requirements for infiltration)
Disposal in-situ	Contained, not emptied	- Function: Years operation, size, sludge depth, - Risks: Groundwater risk, flood risk
	Contained, emptied, buried in-situ	- Location: on/off premises, distance from house - Safety: covered, how buried, buried in rainy season, groundwater risk, proximity to waterways / residents - Reuse: contents used after less than 2 years storage
Emptying	If containment ever emptied	- Frequency of emptying: regular/scheduled desludging - Method: manual, mechanical (type of equipment) - Safety to workers: PPE/protection, not entering pit - Safety to user/public: no spillage, not flushed out to drain - Accessibility: location of containment, presence of lid/manhole, street access
Transport	Excreta delivered to treatment facility	- Method of transport: manual (cart), motorized - Safety to workers: PPE/protection during transport - Safety to user/public: no spillage, covered transport, vehicles not used for water supply
Treatment	Designed to provide at least secondary treatment for both solid and liquid phase	- Design standards: meets national standards for fecal sludge treatment facilities; treatment adequately level for the risk of exposure to the effluent - Function: Systems function, not overloaded/ reasonable capacity, not damaged, leaking, overflowing or bypassed
Reuse	Not included in core indicators for SDG 6.2	- Safety: duration stored, meets national or global reuse quality standards, treatment adequate for intended reuse - Use: type of use, type of application

Methods and tools for monitoring SMOSS

Monitoring safely managed sanitation requires representative information about household sanitation systems and their management at an individual household scale, as well as information about services that are shared at a communal or city scale. To capture information from different groups and at different scales requires a mixed methods approach, as household questionnaires alone cannot accurately inform the transport and treatment steps. Table 2 summarizes the different methods applied in the pilots and what parts of the service chain they inform. The methods included in this section are an example of the different approaches that can be applied, and countries should determine what methods best suit their governance

[ii] Containment is defined as a permeable or impermeable container for storing excreta close to the toilet or latrine. Examples of containments include latrines pits, cesspools, septic tanks, and holding tanks.

and regulation of sanitation and their existing approaches to national monitoring. In developing or expanding SMOSS monitoring it is therefore important that the stakeholders are identified and engaged in the process and must also consider the enabling environment, including policies, regulations and responsibilities for provision of sanitation services and monitoring in general.

Table 2. Sources of data to assess SMOSS

Household survey	• Integrated into existing multi-topic household survey or dedicated WASH survey • Can collect data on access, containment, emptying and disposal in situ but less reliable for the rest of the service chain (transport, treatment). • Able to be disaggregated to assess inequalities
Household sanitary inspection	• Conducted for a sample of households, these interviews and visual inspections aim to confirm the type and safety of sanitation facilities and containment. • Could include additional technical assessment by inspection inside the containment.
Administrative data	• Administrative data from service authorities or sub-national agencies could include routine reporting on any step of the service chain, such as the population covered by emptying services or the treatment plant type and capacity per administrative unit. • Regulatory data from service providers could include data on the number and type of facilities emptied or treated per year for a specific area or service provider. • Other sub-national or secondary data such as from associations, WASH program data collection, etc. may not be adequate for national reporting but could inform assumptions or help to validate service provider data.
Service provider or local government surveys	• Conducted with a nationally representative sample of service providers, authorities, regulators and other key stakeholders to capture details on service provision, specific data from log-books or local records, or regulatory aspects. Particularly valuable for informing emptying, transport, treatment and reuse steps. • National representative surveys could be implemented through associations of municipalities or local government, wastewater authorities or service providers, depending on responsibility and formalization of sanitation services
Service chain spot checks / inspections	• Inspections conducted of infrastructure or services at the communal or municipal level to validate type of service, function, use and safety. • Random spot checks or audits can be used to assess compliance with service delivery standards or validate service provider or administrative data.

Analysis of SMOSS

Analysis of SMOSS data requires systematic assessment of on- and off-site excreta flows and Figure 1 shows how the three pathways to safely managed sanitation can be achieved considering the core indicators at each step of the sanitation service chain. The JMP estimates include assumptions for analysis for some indicators when there is a lack of available data. The data from pilots or expanded questions could inform the appropriateness of these assumptions for the country context. The analysis of data from the SMOSS pilot countries, especially Ecuador and Serbia, will likely inform approaches to the integration of administrative data with household surveys as there are limited examples of this to date.

At the time of this report none of the pilots had generated nationally representative estimates for safely managed services but are expected to collect representative data for different steps on the chain. The analysis of the nationally representative pilot data from Bangladesh and Serbia are available (Figure 2 and Figure 19), which calculated SMOSS until delivery to a designated site but did not assess the treatment step.

Figure 1. Excreta flow diagram showing core indicators used for global monitoring of safely managed sanitation (adapted from [3] [5])

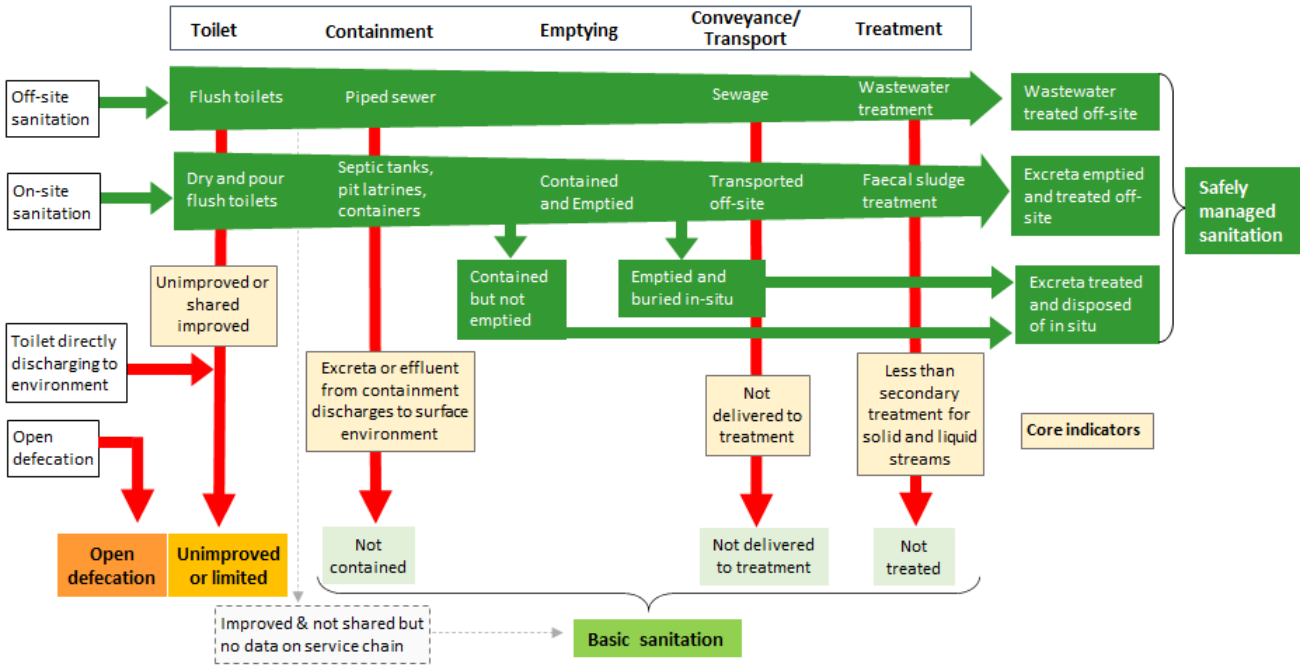
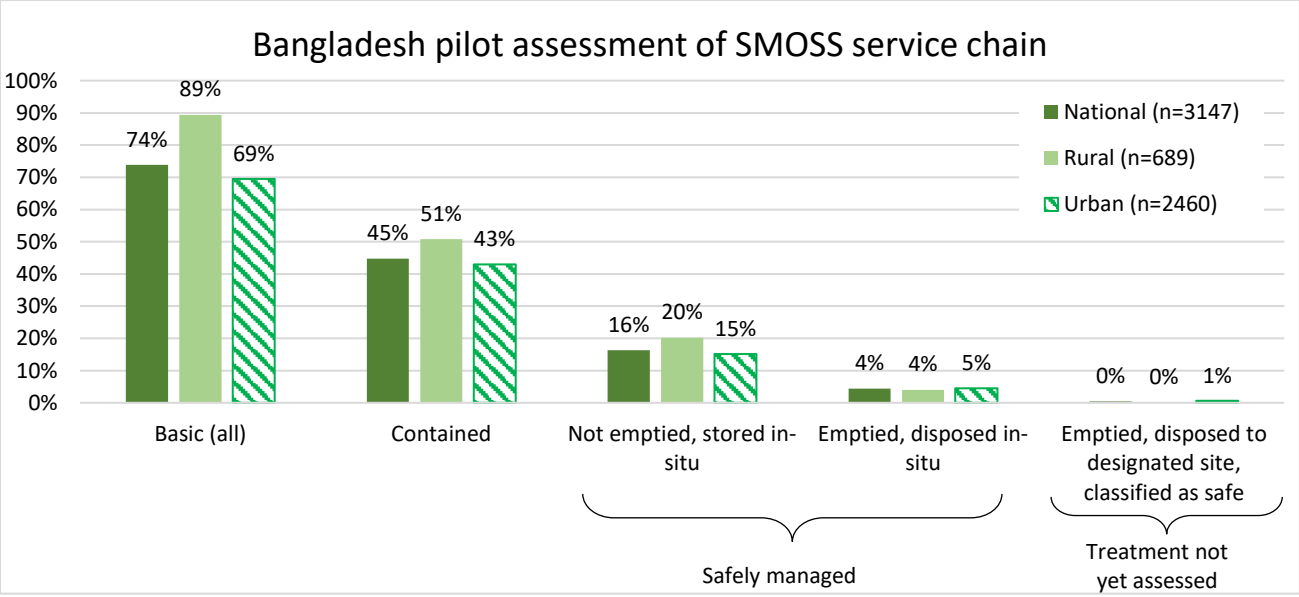


Figure 2. Example findings - Analysis of result from Bangladesh pilot



Synthesis of lessons from the phase 1 pilots

A key finding from the pilots was the increase in national stakeholder understanding and awareness about safely managed services and the importance of monitoring SMOSS, reinforced through the pilots' focus on stakeholder engagement at all stages of monitoring. Pilots also collected new and detailed data about SMOSS which was valuable to better understand the status of on-site systems at a national scale, yet most pilots suggested that for ongoing monitoring the number of indicators could be reduced. There are a multitude of questions and indicators being used at national and sub-national levels and it is evident that increased harmonization would simplify analysis and produce more consistent and useful data. This report outlines the core indicators which are the minimum required for global monitoring, as well as providing examples of expanded indicators that countries can adapt to suit the context and national priorities.

Household questionnaires remain the most common source of SMOSS data, however effective monitoring of SMOSS requires integrating data from multiple sources including households, service providers and local government to address all steps on the service chain. Administrative data for on-site sanitation are rare and national data sources on SMOSS are often incomplete and not fully representative of the population using on-site sanitation systems. Strengthening administrative data and data from service providers is influenced by the regulation and accountability of the sector, which is often weak for on-site sanitation services.

Integration with existing monitoring methods is the best way to ensure continuous and consistent monitoring of SMOSS and two pilots tested integration of new questions into existing national surveys, however most pilots are still identifying the best means to scale up data collection. Roles and responsibilities for collecting, aggregating, and reporting data on SMOSS need to be clarified and regulatory coverage may need to be expanded to include rural areas and informal systems. Increased regulation and accountability for sanitation, especially on-site services, are important for increased administrative and service provider data collection and availability. Establishing and expanding systems for routine monitoring of SMOSS will require investment in national data collection systems and capacity building and training at all levels.

Areas where future pilots could focus on include:

- Non-household data collection on transport, treatment and disposal for both urban and rural areas.
- Service chain sanitation inspections or spot checks are yet to be tested and existing WHO survey questions could be built from and piloted
- Administrative data are critical to provide national estimates of emptying, transport and disposal and should be a focus of future pilots, including the practices and services in rural areas.
- Methods for integrating of data from different sources. Such as linking emptying data from household surveys with emptying or treatment data from administrative sources or service provider surveys.
- While household sanitary inspections were piloted, further assessments could review: what sample size and frequency of data collection would be necessary for national estimates, further refinement of methods and whether non-technical enumerators can provide reliable assessments.
- Methods to collect data and assess inequalities along the service chain are needed to better understand access and progressive reduction in inequalities.
- Guidance on key questions for household surveys and pilots are recommended that could be further tested and refined in phase 2 pilots, as well as consolidation of existing materials for training enumerators.

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Need for improved monitoring of safely managed on-site sanitation (SMOSS)

Definition of safely managed sanitation

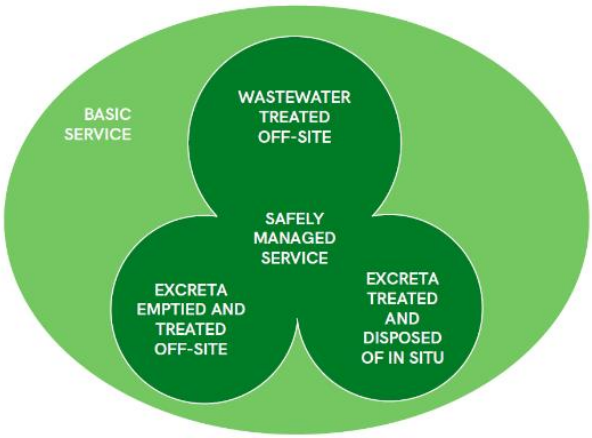
SDG 6: Ensure availability and sustainable management of water and sanitation for all.

Target 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

The World Health Organization (WHO) and United Nations Children's Fund (UNICEF), through the Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene, track progress towards the SDG targets 6.1 and 6.2. Sanitation is monitored against the "service ladder" (Figure 3) can be applied to all countries with different levels and types of sanitation.[iii] Open defecation and safely managed services are reported on for SDG target 6.2a, while the ladder also assess incremental progress of the intermediate rungs (basic, limited, unimproved). To be considered safely managed sanitation requires that people use improved sanitation facilities that are not shared with other households (equivalent to the basic service level), and that the excreta produced should be managed through one of the three pathways shown on the right of Figure 3. This reflects concerns relating to the poor management of fecal sludge in many parts of the world and the recognition that a large proportion of wastewater collected by sewer networks is not treated at all or receives insufficient treatment to protect public health [5].

Figure 3. JMP sanitation service ladder (left) and pathways to safely managed services (right) [6]

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or removed and treated off-site
BASIC	Use of improved facilities that are not shared with other households
LIMITED	Use of improved facilities that are shared with other households
UNIMPROVED	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
OPEN DEFECATION	Disposal of human feces in fields, forests, bushes, open bodies of water, beaches or other open places, or with solid waste



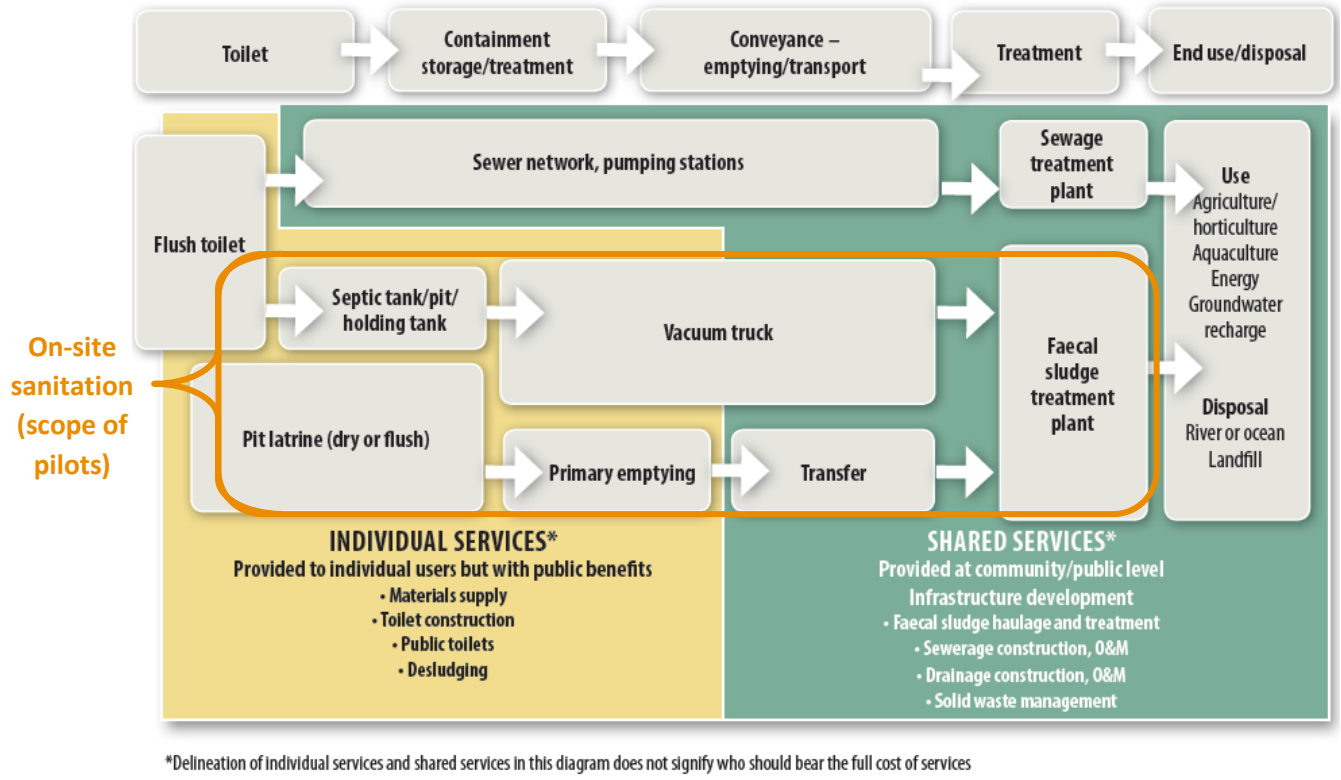
***Note**: Note: Improved facilities include: flush/pour flush toilets connected to piped sewer systems, septic tanks or pit latrines; pit latrines with slabs (including ventilated pit latrines); and composting toilets.*

Monitoring SDG6.2 differs from previous monitoring efforts as it requires consideration of how excreta are managed after the toilet, not just access to sanitation. Assessment is therefore needed forf each step of the service chain which may include some elements located on-site (pit latrines, septic tanks and other

[iii] Note this document considers only sanitation and not the hygiene aspects of target 6.2

containments) and some located off-site (desludging services, wastewater and fecal sludge treatment plants) and considers both solid and liquid fractions (see section 1.3 for details). The sanitation service chain consists of the toilet (or user interface), containment and on-site treatment, emptying and transport, off-site treatment, end use and disposal. As demonstrated in Figure 4, the initial steps of the service chain are considered characteristics of the sanitation facility used by households. However, the later steps of the service chain are shared services provided at community or public level and cannot typically be assessed at the household. This creates a need for new methods and approaches to monitoring safely managed sanitation.

Figure 4. Categorization of sanitation services [3]



*Delineation of individual services and shared services in this diagram does not signify who should bear the full cost of services

The latest progress report for SDG target 6.2, published in 2021, had estimates for safely managed sanitation services for 120 countries (81% of the global population), [1] increasing from 84 countries (48%) in the baseline assessment in 2017 [6]. Globally, the use of sewer connections and improved on-site sanitation facilities is approximately equal, but while most countries have data on treatment of wastewater from sewers very few have data on management of excreta from on-site sanitation (Table 3). This presents a major limitation in monitoring sanitation, particularly as the use of on-site sanitation is growing faster than sewers, even in urban areas, and is the dominant type in low-income countries and in peri-urban and rural areas which are home to the world's poorest people [1]. Unsafe containment, emptying and disposal of fecal sludge presents a growing risk to public health and the environment and threatens progress on other SDG targets related to ending poverty and improving health, nutrition and economic productivity. Furthermore, there are limited data to identify and address inequalities in safely managed services or time-series data to determine rates of progress [7]. Timely and accurate data on the status of SMOSS can increase awareness of countries' needs and gaps, and inform policy, implementation and research efforts to extend and improve services [3].

Table 3. Data availability for different types of sanitation [1]

	Safe management	Regional estimate (estimates if data available for >30% of the relevant population)	Data coverage
Off-site	Wastewater piped and treated	Global (34% of the world population) All SDG regions except sub-Saharan Africa	91% of the global population with sewer connections
On-site sanitation (Scope of pilots)	Safely disposed in-situ	Global (20% of the world population). Only three SDG regions (Central and Southern Asia, Eastern and South-Eastern Asia, and sub-Saharan Africa)	69% of the rural population with on-site sanitation and 59% of the urban population
	Emptied and treated off-site	No regions. Insufficient data for the global population estimate	1% global population. Only seven countries (all high income) had data.

Note: Sourced from WHO and UNICEF 2021, Table 1. JMP regional estimates require data for >30% of the population in each region.

SMOSS pilot project

In response to this gap, with support from BMGF, the WHO/UNICEF JMP launched a project to develop harmonized methods and tools for the collection of comparable data on Safe Management of excreta from On-Site Sanitation (SMOSS) to support national and global monitoring of progress towards SDG targets 6.2 and 6.3. Following an expert group meeting in early 2020, data collection pilots were initiated in 6 countries (Bangladesh, Ecuador, Indonesia, Kenya, Serbia and Zambia). Project activities have been significantly delayed due to COVID-19 and although not all pilot countries have completed their planned activities, their approach, data collection tools and lessons to date are synthesized in this report to inform the second round of pilots commencing in late 2021.

The objectives of the pilots were to a) Develop tools to assess the nature and scale of the challenges associated with SMOSS, and b) Make recommendations for routine monitoring of SMOSS in future. The countries were encouraged to consider urban and rural areas and could choose what parts of SMOSS were included: On-site containment and storage, emptying, transport, off-site treatment and disposal. While most countries focused on household sanitation, some also considered health care facilities, schools and institutions. Cross cutting issues to be considered by all countries included whether the statistics were representative, combining data from different sources and inequalities in exposure.

Due to delays in monitoring from COVID-19 restrictions many countries pilot projects were delayed and at the time of writing only Bangladesh had completed all planned activities, however most others were well underway. This report includes examples where the tools are already being used and reflections from all countries on the process and lessons for developing a SMOSS monitoring approach for their country. Table 4 summarizes which data collection methods are suitable for informing different parts of the chain and which of these were included in the pilots, with Table 5 providing more details on the activities conducted by each pilot country. Annex Table A1 contains a summary of the scale and means of data collection and cost estimate that may inform other countries in planning pilots or monitoring.

Table 4. Data collection methods across the sanitation chain collected by the pilots

DATA COLLECTION METHOD	TOILET	CONTAINMENT	EMPTYING	TRANSPORT	TREATMENT
Household questionnaire	BGD, ECU, KEN, IDN, SRB, ZMB	BGD, ECU, KEN, IDN, SRB	BGD, ECU, KEN, IDN, SRB, ZMB	In-situ only BGD, ECU, KEN, SRB	
Household sanitary inspection	BGD, KEN, IDN, SRB	BGD, IDN, SRB			
Administrative data			ECU	ECU	ECU
Service provider and local government surveys			SRB	SRB	SRB
Service chain spot checks / inspections					
Service provider and government interviews and focus group discussions[iv]		BGD, SRB	BGD, KEN, SRB	BGD, KEN, SRB	BGD, KEN, SRB

Levels of reliability and use of source: Low  High

Table 5. Summary of pilot country key activities

Bangladesh (BGD)	• National household surveys conducted in five regions (n=3149) by UNICEF volunteers, including questionnaires and sanitary inspections for 10% of households. • Conducted focus group discussions with service providers (n=10) and key informant interviews with policy and decision makers (n=14).
Ecuador (ECU)	• Updated questions in online National survey of municipalities (SNIM survey) (n=221) to include expanded questions on emptying, disposal and treatment. • Included SMOSS questions in existing national household employment survey (ENEMDU). • Dedicated surveys of household, schools, and health care facilities in 10 municipalities.
Indonesia (IDN)	• Household sanitary inspection tool piloted in 55 households in one province by local health inspectors, intended to be incorporated into inspections for national monitoring of ODF. • Included JMP core questions (including SMOSS) in national water quality survey (n> 20,000) • Investigating potential use of pit emptying apps and on-site sanitation databases already in use in some cities to inform monitoring of SMOSS.
Kenya (KEN)	• Assessment of existing monitoring tools, data sources and stakeholder engagement. • Dedicated survey including observations of 600 households, 27-45 schools, 27-45 healthcare facilities and interviews with service providers and county officials.
Serbia (SRB)	• Developed a policy analysis tool to assess the responsibility, legal framework and institutional mechanisms for all steps of the sanitation service chain; • National online survey of local government units and service providers to assess emptying, transport and treatment service provision and enabling environment (e.g. regulatory mechanism, coordination, human resources, finances). (n=75, 50% response rate); • Key informant interviews to follow up survey responses with select respondents. • National dedicated questionnaire and inspection of households, rural schools and rural healthcare facilities (n=1560) conducted by public health institute staff.
Zambia (ZMB)	• National household and institutional survey (n=23,000) conducted in 10 provinces and implemented by environmental health inspectors and water inspectors.

[iv] Interviews and focus group discussions are useful for formative research but not suitable for large scale collection of representative data.

Box 1. Situating global monitoring within the national context

NATIONAL AND GLOBAL MONITORING OBJECTIVES

The overarching aim of the sanitation SDG is to achieve safe management of fecal waste across the entire sanitation service chain for all. The global targets and monitoring of these are designed to drive change and improvements by highlighting the current and projected status and comparing data between countries. It is intended that this is an aspirational target, and it is recognized that many countries may take time to achieve this target. Governments are expected to localize the global SDG targets related to WASH and set their own national targets for progressively reducing inequalities in services, taking into account national contexts, capacities and levels of development, and respecting national policies and priorities [8].

- National monitoring of sanitation is valuable to inform policy and practice, understand regional priorities and demand for improved services. Member states will own the monitoring and reporting of the SDGs and be the main beneficiaries of improved access to better-quality data [8]. Any monitoring initiative must therefore be sensitive to national needs.
- Global monitoring is based on a comparison of data between countries and over time and to track progress at the regional and global levels and requires harmonized monitoring approaches and the use of similar standards and definitions across countries [9].

There is scope for greater harmonization of monitoring and reporting across these levels to increase efficiency so that local and national stakeholders can make better use of global monitoring data, and vice versa [3]. All countries should be monitoring whether sanitation services are safely managing excreta and data systems should allow reporting both towards the 2030 SDG target and towards any national targets which may use different indicators [10].

Overview of this synthesis of lessons from phase 1 pilots

What is the purpose of this synthesis report?

Through the phase 1 pilots it became evident that there is a need for documentation clearly detailing the monitoring of SMOSS to inform selection of indicators, globally comparable definitions, methods for data collection and expanded optional indicators for SMOSS, share emerging data collection tools and methods and lessons learned from phase 1 to inform phase 2 pilots and future SMOSS monitoring. The report is divided into the four sections presented below (Figure 5).

Who is this synthesis report for?

This synthesis of lessons is primarily intended for those involved in monitoring sanitation at national, sub-national and program levels. This may include national or sub-national governments, external support agencies, and civil society organizations (CSOs) that work in water, sanitation and hygiene (WASH) services. The specific national agencies involved in monitoring sanitation are not always evident and stakeholder mapping and engagement is included as an initial step in developing monitoring approaches (see 2.1). External support agencies and CSOs working in WASH may have existing tools or knowledge about safely managed sanitation services, particularly for certain sub-sets of the population and collecting information about these methods and any existing secondary data is also a key preliminary activity (see 2.2).

What does the report cover?

The report first steps through the key components to national monitoring of SMOSS, including definition SMOSS and the core and possible expanded indicators (1). The methods that could be employed to collect data for different parts of the service chain are presented, including examples from pilots and the stakeholder engagement activities valuable for implementing and improving monitoring of SMOSS (2). The analysis of SMOSS details the key assumptions in analysis, combining different data sources and considerations for this analysis (3). Lastly, we present a synthesis of case studies, key lessons learn and identified gaps to be addressed by future pilots or research (4).

Figure 5. Key concepts of monitoring SMOSS covered in this synthesis

Monitoring SMOSS is still in development and this synthesis of lessons aims to support the development or improvement of national or WASH monitoring to improve the gaps in estimates of SMOSS. The approaches and indicators used by pilots are examples of monitoring methods and are not exhaustive or prescriptive; rather, they provide practical guidance based on the pilots, sector experiences and the best available information at the time of publication [9]. As noted above in

Box 1, this is not intended to set requirements or be prescriptive of national monitoring and instead guide countries to identify indicators and develop monitoring approaches that best suit their objectives and context. As monitoring of SMOSS increases, it is expected that the recommendations will continue to be updated as new findings, methods and lessons emerge from practice, research, and global efforts.

1 Definitions and indicators

1.1 Introduction

Global core and national expanded indicators

The objective of safely managed sanitation is to protect communities and children from pathogen exposure by managing excreta along the entire sanitation chain. This includes universal access and use of toilets that safely contain excreta and safe systems that protect users, sanitation workers and the community from exposure to untreated excreta [4]. When sanitation is not safely managed there can be multiple pathways of release or exposure to untreated excreta in the environment, many of which are context or system specific.

Global monitoring of SDG indicators requires consistent assessment approaches across countries, with comparable indicators and adequate existing national data. Only a select few criteria currently meet these requirements for inclusion in the definition of SDG global indicator 6.2.1a use of safely managed sanitation services. These are the **core indicators**, which all countries should be able to report on during the SDG period. In addition to these are many possible **expanded indicators**, that capture additional aspects of safety identified in the WHO guidelines on Sanitation and Health [3] which countries may decide to monitor depending on their national sanitation policies, context and resources. Expanded indicators can also be used to assess aspects of gender and inequality in access to safely managed services (for example Gender-responsive indicators for WASH [11]). The list is not intended to be comprehensive but rather provides illustrative examples of the types of expanded considerations for the different steps of the service chain.

Adapting SDG global targets and indicators to country context

For all steps and systems in the sanitation service chain there are numerous ways in which they can be labelled or assessed in national monitoring tools. At times these do not align with the SDG global indicator definitions used by the JMP for global monitoring of SDG 6.2. This could be due to local nomenclature, design standards or policies (e.g. definition of “hygienic latrine” in Bangladesh), or often a carryover from the MDG definitions which focused on access to facilities rather than the quality of services delivered. Maintaining national definitions is important for national reporting and policies but cross-country comparison requires a standard set of indicators. This could be simple re-classification or grouping of indicators and may require discussions between national and JMP monitoring teams about how to best define SMOSS indicators that meet both objectives. Understanding existing national definitions and targets can be informed from a review of standards, policy documents and existing monitoring tools (see sections 2.2 and 0).

Box 2. Adapting the SDG global targets to national context in Indonesia

INDONESIA NATIONAL DEFINITIONS OF SAFELY MANAGED SANITATION

The Indonesia government was one of the first countries to define national targets for progressing safely managed sanitation. These are included in their medium-term development plan (2020-2024) as well as in the recently introduced minimum service standards for sanitation. Within this they have defined what can be considered safely managed for the Indonesian context: either toilets connected to sewer and treatment or septic tanks that are regularly emptied. This is more stringent than the global definition of safely managed sanitation which also permits pit latrines, doesn’t consider frequency of emptying, and counts contained but not emptied tanks to be safely stored in-situ. The data collected must therefore inform estimates for both national and JMP definitions of safely managed sanitation services, with the Indonesian estimate likely to be much lower.

One aspect that remains unclear is whether pit latrines are considered within the septic tank definition, as these terms are often used interchangeably in Indonesia, and it was noted that the government preferred to limit the categories of containment to unimproved pit and septic tank due to difficulties reliably differentiating them. However, if pit latrines are included in the definition of "septic tank", the requirement that these are regularly emptied may not be applicable, particularly for rural or lower density areas. This is something the pilot team plans to investigate further and support discussions of the inclusion of different technologies, with an emphasis on equity issues, in the development of the SDG roadmap later this year.

1.2 Access to improved sanitation

Facility type

The JMP continues to track the population practicing open defecation and using unimproved and improved sanitation facilities. For the purposes of SDG monitoring, improved facilities shared with other households count as a limited service and those that are not shared count as at least a basic sanitation service.[v] In the JMP ladder safely managed sanitation is only assessed for households that have already met the criteria for a basic sanitation service but for national monitoring it is important to track the management of sludge from all on-site sanitation facilities, including those that are unimproved and those that are shared as these may represent a large portion of the population and could inform particular needs and gaps in access to safely managed services for these groups. It is recommended that household surveys include questions about containment, on-site treatment, emptying and disposal for all households using on-site sanitation facilities, even if unimproved or shared.

Table 6. Basic sanitation service ladder

At least basic	Use of improved facilities that are not shared with other households
Limited	Use of improved facilities that are shared with other households
Unimproved	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
Open defecation	Disposal of human feces in fields, forests, bushes, open bodies of water, beaches or other open places, or with solid waste

Note: Improved facilities include flush/pour flush toilets connected to piped sewer systems, septic tanks or pit latrines; pit latrines with slabs (including ventilated pit latrines), and composting toilets.

Consideration of containment in classification of facilities

As noted above, the classification of sanitation service levels starts with an assessment of the type of facility households use. As there remain challenges with the identification and classification of the types of sanitation facilities, particularly containments, this section aims to clarify the categories of "improved sanitation", and the subsequent section details the assessment of "containment". It is important for longitudinal analysis of global data that countries continue to use the same definition and label of "improved sanitation" to assess facilities against basic sanitation criteria (i.e. pit latrine with slab or platform, toilet discharges to septic tank

[v] The level of limited and assessment of shared toilet facilities and have been discussed in detail in existing literature, for example: Evans, B., Hueso, A., Johnston, R., Norman, G., Pérez, E., Slaymaker, T., & Trémolet, S. (2017). Limited services? The role of shared sanitation in the 2030 agenda for sustainable development. Journal of Water, Sanitation and Hygiene for Development (2017) 7 (3): 349–351. https://doi.org/10.2166/washdev.2017.023

or pit and not directly to drain). The assessment of containment (i.e. whether the pit or tank has an outlet to the drain or is overflowing) is not taken into account in assessing whether the system is "improved sanitation" (see box right). Changing the established definition of improved sanitation would limit the ability to compare with other data (past and future) and to track improvements over time.

An ongoing challenge in monitoring sanitation is the inconsistency of labels and definitions of sanitation facilities. For example, open pit latrine, pit latrine and traditional latrine have each been used to describe facilities of the same type and over 400 different sanitation codes were found to have been used in the DHS surveys [11]. While it is important for countries to be able to classify sanitation facilities based on their context and in terms that are understood locally, it is important that these different labels are mapped to a common set of definitions. A detailed definition of the features and function of the different sanitation categories is included below, along with some common alternative names and examples of challenges in defining facilities from the pilots.

Unimproved vs. Improved but not contained

Initial analysis by the Bangladesh pilot labelled septic tanks discharging to drain as "unimproved" as they didn't want to promote these as an acceptable sanitation solution. However, this would limit comparability of this data with previous national and global data.

Septic tanks should be considered improved facilities and if they discharge to drain the preferred terminology is "improved but not contained".

Another challenge is the difficulty assessing the type of sanitation facility as these systems are typically underground and household respondents, or untrained enumerators, may not know or be able to accurately assess the type of facility. Previous data and national standards could identify the main types of sanitation facilities in a country and when developing survey tools these could be assigned to the JMP categories based on the descriptions below. Training the enumerator to help households differentiate the types of sanitation facilities is necessary and additional questions or observations could also be used to improve the assessment or validate responses. These are detailed in section 2.4.

Table 7. Types of sanitation facilities

	Description [4]	**Types and other names**
IMPROVED **Flush/pour flush toilet to**	Flush toilet has a cistern or holding tank to tore water for flushing and has a water seal (which is a U-shaped pipe below the seat or squatting pan) to prevent the passage of flies and odors. A pour-flush toilet also has a water seal but has no cistern and water is poured by hand for flushing	Latrine, Cistern toilet,
└ Piped sewer	Flushes toilet connected to a system of sewer pipes, also called sewerage, which is designed to collect human excreta (feces and urine) and wastewater and remove them from the household environment.	Sewerage, sanitary sewer, separate sewer, combined sewer[vi]
└ Septic tanks	Flush toilet to a water-tight container, normally buried underground away from the dwelling, designed to separate liquids from solids which are then allowed to settle and decompose.	Tank, holding tank, aqua privy, biodigester
└ Pit latrines	Flush toilet to a covered pit which retains solids. The base and sides of latrine pits may be permeable to allow liquids to percolate into the soil. (Note that this pit latrine receives significant amounts of water, unlike the one below)	Cesspool/cesspit, wet pit, twin pit, soak pit, leach pit, offset pit
Pit latrine with slab	Dry sanitation system that collects excreta in a pit in the ground. The pit is covered by a squatting 'slab' or platform that is constructed from materials that are durable and easy to clean. The 'slab' has a small drop hole, or is fitted	Dry pit latrine, Ventilated improved pit (VIP), twin pit, fossa alterna

[vi] Only if conveyed in pipes or closed drains and discharging to a wastewater treatment plant

	Description [4]	Types and other names
	with a seat, allowing excreta to be deposited directly into the pit These may accept a small amount of water where that is used for anal cleansing but not for flushing.	
Composting toilet	Dry toilet into which carbon-rich material (vegetable wastes, straw, grass, sawdust, ash) is added to the excreta and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device, but a squatting slab or platform as described above.	Dry toilet, UDDT,
Container based	System where toilets collect excreta directly in sealable, removable containers (also called cartridges) which are regularly collected by commercial service providers and delivered to treatment	
Unimproved pit latrine	Pit latrine without slab or platform	
Other unimproved sanitation facility	Toilet without containment and that discharges directly to the surface environment	Hanging latrine, helicopter toilet, bucket, toilet direct to open drain (other waterway, ditch, land, sea, elsewhere)
Open defecation	Disposal of human feces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste	No facility, bush, field, ocean, river

Note: Flush or pour flush latrines to unknown place/not sure/don't know are considered improved, however flush toilets to elsewhere are considered unimproved and don't know type of sanitation at all or missing is considered unimproved

Box 3. Classification of decentralized sanitation systems

Classification of technologies used in decentralized sanitation

Decentralized sanitation technologies, or small-scale sewerage systems, can make use of a range of technologies from a septic tank used by a single household to an advanced treatment process that treats wastewater from hundreds of households. These larger systems may be grouped together with conventional urban wastewater treatment. In countries where decentralized systems are used, it will be necessary to define how these systems fit into the analysis of safely managed sanitation. For example, in India and Indonesia the use of "communal" sanitation systems (SPAL-T or SANIMAS in Indonesia) are part of government policy and targets.

Regardless of scale, tanks that contain excreta, and which may or may not have baffled chambers, can be classified as containment and primary treatment. However, the liquid effluent from such tanks or reactors needs additional treatment, equivalent to secondary treatment or better, to count for safely managed sanitation services. Such additional treatment can be simple subsurface infiltration following primary treatment (especially at smaller scales) or complex engineered systems at any scale.

Treatment technology	1 household	2-10 households	>10 households
Septic tank, anaerobic baffle reactor, biodigester	Containment/ Primary treatment	Containment/ Primary treatment	Containment/ Primary treatment
Settling tanks or ponds, mechanical dewatering			Primary treatment
Johkasou, subsurface infiltration following primary treatment	Secondary treatment		
Anaerobic filter, constructed wetland, ponds, following primary treatment	Secondary treatment	Secondary treatment	Secondary treatment
Activated sludge processes, sequence batch reactors, moving bed biofilm reactors, etc. **[12]**		Advanced treatment	Advanced treatment

1.3 Containment: On-site containment/storage/treatment

Defining containment

Containment is defined as a permeable or impermeable container for storing excreta close to the toilet or latrine. Examples of containments include wet or dry pit latrines, septic tanks, and holding tanks. They are considered to contain waste if they prevent the release or discharge of wastewater to the surface environment [1]. Some level of treatment may also occur in the container. This is only relevant to non-sewered sanitation facilities.

The key principle of this step is that all excreta from the toilet are retained within the containment technology and/or discharged to the environment in a manner that does not result in potential exposure [4]. It requires containment of the solid contents (fecal sludge consisting of excreta, hygiene or other waste products) and the liquid contents (effluent consisting of excreta, flushing and ablution water, and occasionally also greywater from kitchen, washing, bathing, etc.). Typical on-site containments provide only primary treatment and therefore pathogen removal from sludge and effluent is low and require further treatment before release to the environment [4]. Sludge can either be emptied for further treatment (section 0) or stored in-situ (see section 1.4).

Improved dry pit latrines receive relatively little liquid inputs and are designed to allow these liquids to infiltrate directly into the surrounding soil through the permeable sides and/ or floor of the pit [1]. Septic tanks and pit latrines connected to flush-toilets (cesspools) receive much larger volumes of liquid inputs, including blackwater and, in some cases, greywater. Wet pits (cesspools) have permeable walls or bottoms which allow liquid infiltration, however if the infiltration capacity of the ground is low (due to soil conditions and groundwater level) wet pits, like impermeable septic tanks, will require an outlet for their effluent which should discharge to an infiltration system (i.e. soak away pit or leach field) or discharge to a piped sewer for further treatment.[vii] The effluent should discharge to a soil infiltration field (soak pit or leach field) or to a piped sewer connected to wastewater treatment, however in many cases it is released directly to the environment; this is classified as not contained (see Figure 7 and Table 8). As septic tanks are impermeable the effluent is likely to be continuous, however permeable pit latrines may only have effluent discharge during certain periods where the soil infiltration capacity is reduced (e.g. during rainy season or following flooding).

Figure 6. Overflowing pit in Bangladesh and pit discharging to drain in Indonesia[viii]

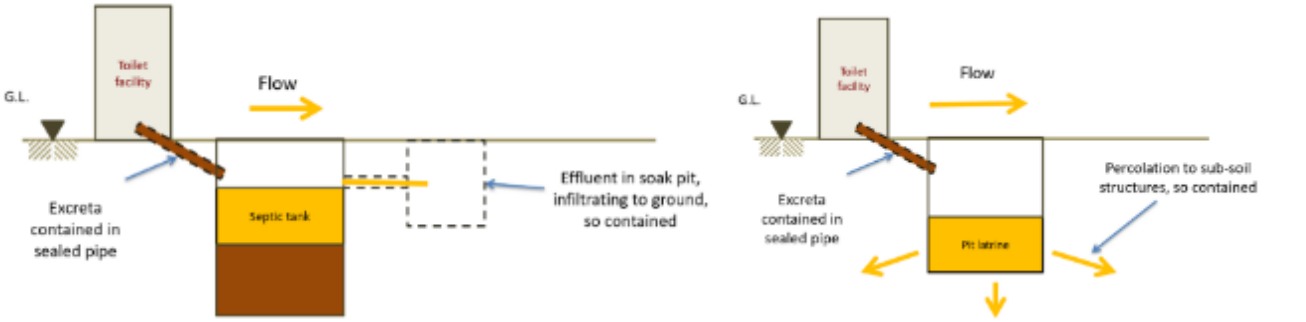
The assessment of containment must also consider whether any excreta is or could be released to the environment due to functionality issues or damages. These are detailed in the sanitary inspection (Annex Table A5) and could include overflowing (excreta or effluent visible outside containment), large cracks or holes, damaged or collapsed walls or flooding and wash-out of contents (which may be seasonal).

[vii] Note that the current JMP core questions (2018) only ask about outlets from septic tanks. It may also be necessary to ask whether pit latrines have effluent discharge to the environment, particularly in regions where high water tables and/or impermeable soils limit infiltration. Further analysis of data collected by the pilots may provide insights to the prevalence of this.

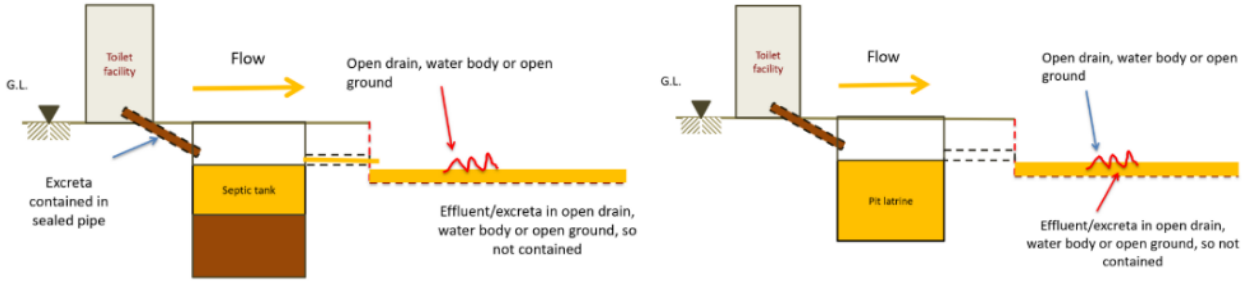
[viii] Bangladesh photo from Bangladesh Final Report, Indonesian photo by Andrianovi Kleden from Puskesmas Oepoi Kupang & Universitas Indonesia

Figure 7. Categorization of contained and uncontained septic tanks and pit latrines [4]

Contained: effluent discharges from septic tank to infiltration system or from pit latrine into soil



Uncontained: effluent discharges from septic tank or pit latrine to open drain, water body or ground



The core criteria used to assess containment for SDG monitoring is whether septic tanks and pit latrines are overflowing or discharging waste directly to the surface environment, encompassing both the effluent discharge and leaking or overflows to the environment. These are only two aspects of containment which present a direct risk of exposure to pathogens and Table 8 provides examples of other aspects that could be measured as expanded indicators to assess indirect exposure risks due to poor design, non-functionality or contamination of groundwater. There are various reasons these expanded indicators are not included in the JMP assessment at this stage, such as: a lack of existing data, difficulties having consistent measures applicable to the different contexts, or that assessments are very localized and difficult to apply at a national scale (e.g. groundwater source protection zones are typically very localized). The pilots have provided examples of how these could be included in local or national monitoring through households surveys, inspections or secondary data (see 0 and 2.4).

Table 8. Containment: Core and expanded indicators

Core	Expanded indicator examples
Containment[ix] is not overflowing or discharging waste to the surface environment	- Design standards: sealed cover, wall and base material or permeability, chambers, dimensions, outlet type - Functionality: damage, blockage, leaks, sludge depth - Groundwater risk: proximity to wells, depth of groundwater, soil characteristics, density (containments or population/area required for infiltration)

[ix] Containment is defined as a permeable or impermeable container for storing excreta close to the toilet or latrine. Examples of containments include latrines pits, cesspools, septic tanks, and holding tanks.

Assumptions on containment and pilot findings

From currently available data it is clear that many septic tanks globally are not effectively containing excreta, see Figure 8, and many have outlets discharging effluent to open drains. As many countries have not yet captured national data on the safe containment from septic tanks and pit latrines, in the absence of national data on containment in on-site systems, the JMP assumes that excreta are effectively contained in all latrines and half (50%) of septic tanks [13]. The majority of pilot studies captured this data through household surveys and inspections with the findings shown below.

Findings from pilots

Table 9. Pilot study findings on containment in on-site systems

Bangladesh	Pilot findings	- Type of containment: 28% septic tank, 35% pits (twin, single, unlined), 1% composting, 20% unsafe pit (TBC), 14% toilet direct to drain, 0.6% hanging, 2.6% no latrine - Outlet to open drainage system or open water bodies – 47% of septic tanks not contained (16% septic tanks with safe discharge, 14% with unsafe discharge) - Sludge accumulation: Pits (n=441) 26% almost full, 22% 2/3 full, 22% half full, 30% <half full. Septic tanks (n=206) 16% almost full, 22% 2/3 full, 24% half full, 37% <half full. - Unsafe pit latrine – 36% of all improved pit latrines which are unsafely contained (equivalent to 20% nationally) - Shared: 7% (improved latrine that are shared)
	JMP Country file data	2019 MICS survey data - Type of facility: 7% sewer, 23% septic tank, 17% wet improved pit, 37% dry improved pit, 8% unimproved pit, 3% flush to elsewhere, 2.5% hanging toilet, 1.5% no facility - Containment: No assessment - Shared: 24%
Ecuador	Pilot findings	- Not yet available
	JMP Country file data	2019 ENEMDU survey data - Type of facility: 63% sewer, 27% septic tank, 7% wet pit, 0.5% dry improved pit, 0.5% dry unimproved pit, 2% no facility - Contained: 93% septic tanks contained (defined as waste from septic tank/pit ends up somewhere open: river, stream, ditch, open field, etc.) - Shared: 6%
Indonesia	Pilot findings	Pilot (n=55, in one province only) - Type of containment: Septic tank 36%, pit latrine (improved/hygienically separated) 53%, pit latrine unimproved 10% - ST leaking or most likely leaking or non-functioning 20% total (55% of tanks) - Outlet/discharge to environment (not disaggregated between ST and PL): 64% leach to ground, 11% to drain/open channel, 9% pond/field/river/lake/ocean, 5% unknown, 5% no effluent, 5% advanced treatment (soakpit, wetland infiltration field, and up-flow filtration) - Compliance with national septic tank standard: 81% not, 7% complied, 11% NA - Sludge accumulation vs capacity – accumulation greater than capacity 53%, lower 13%, not able to be calculated 35%
	JMP Country file data	2020 Susenas survey data - Type: 1% sewer, 81% septic tank, 10% unimproved dry latrine, 8% no facility - Containment: No assessment - Shared: 3% shared
Kenya	Pilot findings	- Not yet available

	JMP Country file data	2019 Census - Type of facility: 10% sewer, 9% septic tank, 64% latrine, 9% unimproved pit, 1% bucket latrine, 7% no facility - Containment: No assessment - Shared: No data
Serbia	Pilot findings	- Type of toilet: Flush toilet connected to piped water 97.3%, Pour flush toilet (manual flush from the bucket) 0.6 %, Dry toilet with toilet slab 1.2%, Dry toilet without toilet slab 0.6%, Bucket /similar 0.1%, Open defecation 0.3% - Containment: Impermeable septic tank 35%, Permeable septic tank with unsealed bottom 49%, Impermeable twin pits 1.6%, Permeable twin pits 6.7%, Holding tank 1.0%, Permeable pit (no ring or brick) 1.4%, No containment 5.1%, Shared 2,2% - Uncontained: 11% of containments discharge to surface or water bodies. 11% of containments leak or overflowed in past year, 14% in urban areas and 10% in rural areas. Combined: 22% of all containments not contained based on core indicators. Serbia pilot assumed all permeable systems were uncontained and combined with discharge data 66% of all containments were assessed by Serbia's criteria as not contained.
	JMP Country file data	2019 MICS survey data - Type of facility: 37% septic tank, 58% sewer, 3% dry latrines, 1% flush to elsewhere - Containment: No assessment - Shared: 0%
Zambia	Pilot findings	Nationally representative survey (n=23,000) - Type of facility: o Urban areas - Not yet available o Rural areas – 78% had toilets, of which 93% pit latrines, 7% other types. Of the pit latrines 10% VIP, 90% ordinary. - Containment: No assessment
	JMP Country file data	2018 DHS survey - 7% sewer, 7% septic tank, 2% wet improved pit, 38% dry improved pit, 36% dry unimproved pit, 10% no facility - No estimate on containment - 39% shared

* To drain, other waterway, environment, etc.

Sources of containment data

Various sources could be used to assess the containment of on-site facilities, including household questionnaires, household sanitary inspections and in some countries' administrative records (see Figure 8). All pilots aimed to collect data on containment, with most including additional questions in household surveys and some implementing sanitary inspections.

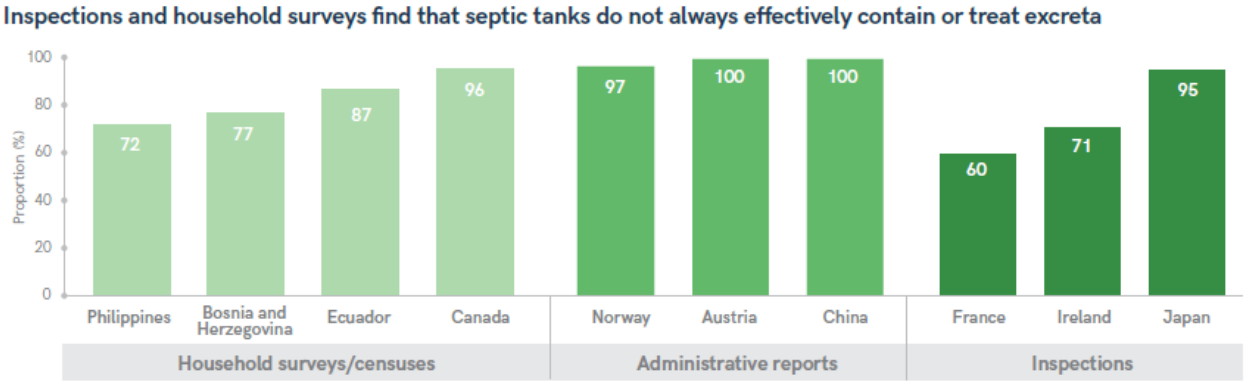
- **Household surveys** (see section 0): Questions about outlets are now becoming common in household questionnaires, while location or access to the latrine for emptying and potential risk to groundwater are also common. Questions on leak or overflow sometime refer to effluent discharge to the environment while at other times relate to functional issues causing overflow and care should be taken to confirm the appropriate wording for different discharge pathways. Household survey respondents and enumerators often lack the technical knowledge or training to accurately classify on-site sanitation technologies, and many existing survey questionnaires have limited response options [1].
- **Sanitary Inspections** (see section 2.4): These observational surveys assess the type of facility, whether it complies with standards, functions properly or presents a risk to human health. WHO sanitary

inspections focus on containment assessments and are available for seven types of facilities, although have not yet been widely implemented. In Japan, France and Ireland there are periodic inspections of on-site systems, with the assessments focusing on: minor and major system failures; effective protection against health and environmental risk; or compliance with relevant regulations for the three countries respectively.

- **Administrative records** (see section 2.6): National authorities may also compile administrative reports on the use of on-site sanitation technologies that meet national standards for safe containment. This data can be collected at the time of construction as part of building permits and inspections to assess what was built. More commonly available in high-income countries (HICs), some administrative reports also include data on whether facilities discharge 'straight to the environment' without treatment (e.g. Norway). Databases with information on the type, volume, location of and access to containments are also being developed as part of regular emptying programs in some Indonesian and Bangladesh cities however, are not yet collected at a national scale.

These sources can provide different types of information with varied reliability and coverage. Administrative data can provide detailed information on compliance with design standards at the time of construction, but it is typically only in HICs that these exist at a national level that can be readily integrated into existing reporting. However, these often lack detail on whether facilities continue to contain excreta and function. Household surveys can provide basic information on containment types and reported discharges to the environment or functionality issues. Relying on self-reporting and households' classification of containment is less reliable than direct observation but may be good enough to allow large scale data collection. Inspections are the preferred option but require technical training and to occur at scale they may be higher cost that other methods. Simplified inspection that could be integrated within household survey and carried out by enumerators with minimal additional training may be a good compromise (see section 2.4).

Figure 8. Different sources for data on the proportion of the population using contained septic tanks [13]



1.4 Excreta stored, treated and disposed of in situ

Defining storage, treatment and disposal in situ

There are two conditions in which systems can be classified providing treatment and disposal in situ, for SDG monitoring:

i. **Emptied and disposed of in situ:** Excreta from contained facilities (septic tanks and latrines) that are emptied and disposed of in-situ (i.e. buried in a covered pit locally)

ii. **Not emptied and disposed of in situ:** Contained facilities that have never been emptied (or never filled) and facilities covered and left undisturbed when full (i.e. abandoned and installed second pit)

The core indicators used in the JMP estimates do not assess the safety of in situ disposal nor its location and considers that all types of improved contained systems (septic tank systems, flush- or dry pit latrines) can be classified as treated and disposed of in situ. A sanitation facility that is contained and never emptied is considered stored in situ.

There are a number of expanded indicators which could be monitored to determine how excreta that have been buried on-site are actually disposed, considering exposure to public or contamination of the environment (Table 10). Some countries, such as Indonesia, requires that facilities comply with any nationally specified emptying criteria as detailed below, therefore for their national assessments not all emptied containments are considered safely disposed in situ. Defining what constitute in situ vs. off site was assessed by some pilots to differentiate between sludge being disposed on the owner's property (assuming with their consent) and sludge being disposed in a hole or trench off-site yet not at a treatment plant (see right).

Defining in-situ

In JMP estimates in situ refers to burial of excreta on premises or locally in the community, in comparison to off-site which is removal to another location (i.e. treatment site).

Bangladesh classified on-site as <30m and off-site as >30m from the household which they considered to be unsafe, as the disposal >30m was typically informal disposal to the environment and not considered safely buried. For the JMP the distinction between on-premises and off-premises is arbitrary as it may vary, particularly between rural and urban contexts, and it is the conditions of disposal rather than location that inform estimates.

Table 10. Disposal in situ: Core and expanded indicators

Core indicators	Expanded indicators
- Contained, not emptied	- Function: Years operation, size, sludge depth, - Risks: Groundwater risk, flood risk
- Contained, emptied and buried in-situ	- Location: on/off premises, distance from house - Safety: covered, how buried, buried in rainy season, groundwater risk, proximity to waterways / residents - Reuse: contents used after less than 2 years storage

Findings from pilots

The Bangladesh pilot analyzed the proportion of containments that were emptied and disposed in-situ or not emptied and stored in-situ. Data were not disaggregated by containment type but was available for both contained and uncontained systems although there was not a large difference between the findings. From

the Bangladesh data, emptied and buried on-site disposal in a covered pit within the compound was much more common for small towns (20%) than low income urban households (1%).

Assumptions

JMP classifies all improved sanitation facilities that have not yet been emptied as having been "treated and disposed of in situ" (and therefore counting as a safely managed sanitation service), regardless of the age, size, number of users or potential emptying practices. As mentioned under the containment section, in the absence of primary data, only 50% of septic tanks are considered contained, therefore only 50% of not-yet-emptied tanks could be safely stored in-situ. At present this is the most common means to achieve safely managed sanitation for on-site sanitation in both urban and rural areas [1].

Table 11. Findings on excreta stored, treated and disposed in situ

	Facility		Emptying and disposal by % of facility type			
			Not emptied or abandoned when full	Emptied and buried on-site	Emptied and discharge to designated site	Emptied, removed and discharged unsafely
Bangladesh	2019 MICS data (JMP data summary)	Septic tank (23% national population)	73%	16%	5%	8%
		Latrine (55% national population)	53%	39%	1%	8%
	Pilot data	Contained latrines (n=1513)[x]	59%[xi]	17%	4%	20%
Serbia	2019 MICS data (JMP data summary)	Septic tank (37% national population)	27%	18%	39%	16%
		Latrine (3% national population)	31%	23%	11%	35%
	Pilot data	Contained latrines (61% national households based on JMP core indicators)	36%	1%	9%	54%
		Contained (Serbia assessment: impermeable tanks/pits, 30%)[xii]	8%	1%	16%	75%

Sources of in situ disposal data

The main source of data is household questionnaires since disposal in situ within the premise is not typically regulated by any authority. However, there are many components that make up this indicator that could be informed or verified by different sources.

- Not emptied – as per the emptying indicator below, aside from household surveys this data could come from administrative or survey data on emptying practices.

[x] Bangladesh pilot: septic tanks and pit latrines that are contained (i.e. septic tanks don't discharge to to drain)

[xi] Bangladesh pilot data: of that with contained latrines (n=1513), 49% had never required emptying and 1% required emptying but didn't empty, 9% dug a new pit or switched to a new pit

[xii] Serbia pilot: Pilot considers only non-permeable septic tanks and pit latrines as contained, JMP consider discharge or overflow to environment but not whether pits are impermeable. For both JMP and Serbia estimate, only excreta emptied by Public Utility Companies are considered safely emptied and transported since other providers are unable to discharge to treatment facilities.

- Covered when full – will most likely come from a household questionnaire which could include further specifics such as covered and built a new pit or covered and use alternating pit. Sanitary inspections could be used to validate the household responses, particularly regarding whether covered or not.
- Emptied and disposed in-situ – again most likely to come from household questionnaires. While emptying service providers may inform disposal in-situ, this practice may be more common by private or informal service providers in peri-urban or rural areas, who have not typically been included in administrative data or surveys. Service chain inspections or spot checks of emptying service provider practices could inform this assessment.

1.5 Emptying and disposal

Defining emptying

Emptying is assessed by the proportion of people using on-site sanitation storage facilities (septic tanks or latrines) which have ever been emptied.

Fecal sludge accumulates in all containments and is not adequately treated for safe handling or disposal. Septic tanks are designed to be periodically emptied to function properly and reduce solids being discharged to the soil infiltration system or piped sewer. When pit latrines fill with sludge, households may choose to empty them or abandon them (covered) and dig a new pit, which is less likely in urban areas where space is limited [13].

For the current estimates the JMP does not consider the methods or equipment used to empty containments and only compiles information on whether on-site sanitation facilities have ever been emptied. Systems that are contained but never emptied may be considered treated and disposed of in-situ, see section 1.4. Expanded indicators allow countries to investigate emptying practices in more detail, including the frequency of emptying, methods of emptying and safety to the workers and public. Countries can decide what expanded criteria best apply to their context and policies to assess safe emptying with some examples provided in Figure 9. It is useful to recognize that emptying frequencies vary depending on the containment type, size and use, while methods also depend on containment, sludge consistency and vehicle access. For example, in Lao PDR and Ecuador 89% of facilities have never been emptied whereas in other regions containments fill quickly and emptying is common, such as Nigeria where only 10% on-site facilities have never been emptied [14].

Table 12. Emptying: Core and expanded indicators

Core	Expanded
If ever emptied	- Frequency of emptying: regular/scheduled desludging - Method of emptying: manual, mechanical (type of equipment) - Who emptied: self emptied, which family member, external formal or informal enterprise, request name if needed to match to logbook data. - Safety to emptiers: PPE/protection, not entering pit - Safety to user/public: no spillage, not flushed out to drain - Feasibility to empty: location of containment, presence of lid/manhole, street access

While indicators about methods or who emptied are not needed for the assessment of emptying, they may be useful to collect to support the analysis of administrative or survey data on transport and disposal. For example, there may be administrative data on the disposal practices of government and private emptying

providers. Alternatively, some countries may wish to develop local assumptions of transport or disposal practices based on previous studies or regulations, such as whether certain emptying methods (e.g. cart vs truck) will result in safe disposal and treatment. There are no global assumptions regarding safety of different types of emptying or transport as this can vary significantly between and within countries and is important for countries to define based on their context and priorities.

Figure 9. Country specific criteria on emptying [14]

Emptying frequency

Indonesia considers never emptied septic tanks and pits unlikely to be safe for their context, based on data that most containments are never emptied and many discharge or leak to the environment. This resulted in the national target for safely managed sanitation including only septic tanks that have been regularly emptied (at least once over past 5 years). This is based on septic tank design standards which require regular emptying to allow solids retention as designed.

The Indonesian pilot household inspection assessed:

a) The age of containments: any less than 5 years can be considered safe even if not emptied
b) When last emptied: Categories for indicating when containment was last emptied. Considered unsafe if never emptied, emptied more than the design frequency or unknown previous emptying.

The Bangladesh pilot also considered pit filling rates although did not use these in their estimates of safely emptied. International NGO SNV also considers "timely emptying" in the urban and rural monitoring program [11].

Safety of emptying

The safety for workers & users is another common consideration for assessing emptying practices. Health and safety of emptying could consider the workers (protective wear and hazards when emptying) and exposure of the public to excreta during emptying or transport.

The Bangladesh household survey and focus group discussions collected data on use of safety equipment by workers (53% wore masks, 39% gloves, 27% boots, 15% body cover), whether they entered the pit to empty (11% of emptying cases) and if there was any spillage.

The WHO draft service provider surveys include questions relating to special clothing or equipment [11]. A recent report presented case studies that assessed the challenges for both formal and informal sanitation workers through interviews and data [15].

Findings from pilots

The below table demonstrates the variety of data sources that can be used to inform emptying practices.

Table 13. Findings on emptying of on-site sanitation

	Source	Ever emptied	Method	Who emptied	Other assessments
Bangladesh [xiii]	Household survey	38% emptied (13% ST, 17% offset pits, 7% unlined pits)	Of those emptied 21% mechanical, 77% manual, 2% No response	6% self emptied, 92% sweepers or sanitation worker, 4% other (WASH committee, government, private)	Of the cleaning workers: 53% used masks, 39% used gloves, 27% used boots 5% used body covers, 15% used chemicals like kerosene, phenol,

[xiii] Bangladesh data based on households with contained facilities only

	Source	Ever emptied	Method	Who emptied	Other assessments
					bleaching powder, quick lime, ash
Ecuador	SNIM municipality data	NA	Municipal emptying: 49% mechanical, 9% manual 42% combined manual and mechanical. 75.5% of municipalities have a suction vehicle	Availability of municipal emptying service: 24% yes, 41% no, 35% no answer Availability of private emptying service: 9% yes, 56% no, 35% no response	Staff with equipment: 23%yes, 1% no Considering private: - 6% authorized by municipality, 3% not - 5% know the place of final disposal, 4% not - 2% regulations exist for the private sector, 7% not
Serbia	Service provider survey (n=73)	442 emptying on average per year	57% Vacuum trucks 5.4% Vacutugs 11% Small motorized pumps 4% Hand pumps 9% Hand tools (shovels, spades, buckets, rope) 10% Other equipment	77% of public utility companies (PUC) that participated in survey provide emptying services. 20% of PUC's reported existence of private emptying service providers	Possibility of spillage 78% no possibility 14% possibility of spillage during removal 8% no response Provision of services – 38% to entire territory, 8% to this and other territories, 49% only in part of the territory. Keep records of service: 30% no records, 15% no response, 55% keep records.
	Household survey and inspection (n=1059 households)	60.5%	95.2% Motorized 4.5% Manually 0.3% Do not know	21% Public Utility Company 38% Private service provider 24.8% Other entities/individuals: 15% Self-emptied 0.5% Do not know	PPE: Boots 81% Gloves 82% Face mask 34% Body cover 45% Eye goggles 14% Helmet 17% Protective coat 14%
Zambia	Household survey (SMOSS Pilot Data, 2021)	Urban areas: 2% ever emptied,	To be collected in second phase	Urban areas: 29% Community based enterprises, 15% Water supply and sanitation company, 10% licensed vacuum tanker, 46% other	

Sources of data

Household surveys can typically provide population-based data on whether a containment was emptied and some details about who or how it was emptied. However often respondents in shared residential properties (i.e. apartment buildings), rental properties or recent inhabitant may not have knowledge about prior emptying practices, therefore the data may have gaps for these segments of the population. Data may also come from administrative records, such as data on the number of containments emptied through regulated

service providers or from interviews with service providers about their typical emptying practices (see Ecuador and Serbia results in Table 13). Spot checks or observation of emptying practices are also possible and may be useful for reliably assessing health and safety of emptying; however, none of the pilot countries currently conduct regular audits of service provider compliance with standards for safe emptying. Bangladesh conducted FGDs with emptying providers in urban areas to understand emptying practices, formalization and safety existing networks of private emptying. The participants were identified through networks of existing private sector however were unable to identify rural participants despite the household survey data indicating 90% of households in rural areas reportedly using a sweeper or sanitation worker rather than self-emptying.

1.6 Transport / conveyance

Definition of transport

This section focuses on the transport of excreta removed from containments and its conveyance to treatment or approved disposal site.[xiv] This can include transport of fecal sludge and whether it is delivered to a treatment plant or disposal site. At this conveyance stage, the assessment does not consider the level or type of treatment and discharge sites could include treatment plants (all types), piped sewer networks connected to treatment, or designated sites for fecal sludge treatment and disposal (i.e. landfill, drying beds, constructed wetlands, trenches). Discharge to open drains, water body or open ground should not be counted as safely managed sanitation [7].

While the core indicator does not assess the safety of this transport, possible expanded indicators can assess the type of transport and the risk of exposure to the sanitation workers or public during transport. While there is not any particular type of transport classified as unsafe, assessing the type of transport, similar to assessing the means of emptying, can be used to align the household survey findings with data from interviews or administrative data on whether there is evidence that particular transport types are more likely to discharge to a treatment plant.

Designated disposal site

In many rural areas, particularly in low- income countries, we expect there are few faecal sludge treatment sites that meet JMP criteria of secondary treatment of solid and liquid streams. In less dense areas, with low rates of emptying, low-cost treatment (e.g. sludge drying beds, constructed wetlands or composting) or safe disposal methods (e.g. land disposal, trenching or designated landfill) could pose low levels of exposure risk.

A recent assessment of predominately rural sanitation services in the Global Sanitation Fund considered different types of land burial, providing examples of shallow and deep trenching practices and the option of communal trenches or pits for safe disposal [10].

Whether these alternatives could be considered safely disposed or treated requires further review and consultation.

[xiv] The conveyance of effluent from on-site systems flushed to sewer is expected to receive the same type and level of treatment as wastewater.

Table 14. Transport: Core and expanded indicators

Core	Expanded
Excreta delivered to treatment facility	- Method of transport: manual (cart), motorized, - Safety to workers: PPE/protection during transport - Safety to user/public: no spillage, covered transport, vehicles not used for water supply

Findings from pilots

Table 15. Findings on transport of excreta from on-site sanitation

	Transport method	Disposal of transported contents	Other
Bangladesh data from household survey. Proportion of those that were contained and ever emptied (38% nationally) [xv]	Of emptied containments: 78% manual carried/push car/van, 17% used motorized vehicle, 3% used vacuum tanker, 2% No response *(Only manual carts used in rural areas)*	**Disposal of treated contents:** 11% transported it to designated disposal site 42% buried in pit within compound, 12% disposed in uncovered pit/open ground/water 30% throw/discharge to open environment 6% don't know	**Disposal point:** 4% fecal waste disposal/treatment point 46% Buried <30m from premise 8% buried >30m, safe 32% into field, bush, water 1% unsafely stored for composting 8% don't know
Serbia service provider survey	Public utility companies own on average one vehicle for fecal sludge emptying and transport, typically a vacuum truck with average capacity of about 5 m3.	Serbia note that only public service providers can deliver sludge to treatment, therefore all private emptying is assumed to not be delivered to treatment, other than if buried into a covered pit on-site. **Local government survey:** Disposal of PUC providers 29% transport to WWTP, 37% to public sewer, 8% sanitary landfill, 7% wild landfill, 4% watercourse, 13% other **Household survey:** 54% unknown disposal, 2% wastewater treatment, 15% crop/field, 8% sanitary landfill, 9% non-sanitary landfill, 8% public sewer, 2% water course, 1% buried on-site, 1% open pit	**Possibility of spillage:** 14% possible spillage of fecal matter during removal 78% No possibility 8% no response.
Zambia pilot household survey Proportion of those that had emptied	Private owned & Commercial utility companies own vehicles for fecal vacuum emptying, transported, treated offsite.	Urban: Of the 2% that had ever emptied, excreta was disposed to: 14% treatment plant 40% buried in covered pit 4% drainage 19% other 23% don't know	Rural: Number that have previous emptied not assessed. If were to empty, household would: 68% bury in a covered pit, 21% abandon toilet once full, 4% other (dig another new pit)
Ecuador ENEMDU 2019 household survey		92% Remain in tank 7% some open place 0.6% another not open place	

[xv] Source Bangladesh SMOSS report Table 3.5: calculated from percentage of household with contained facilities that had ever been emptied (n=607). Entire sample was n=3149

Assumptions

In some countries, a significant proportion of systems are recorded as emptied to 'other/don't know where', particularly in urban areas. These are also considered unsafe and highlight the problem of unaccounted-for fecal waste [14].

Sources of data

While useful information on emptying of on-site containers can be collected in household surveys, household members generally do not know what happens to excreta once it is removed off-site, except when it is disposed in situ or nearby. For this reason, the JMP prefers to use data from administrative sources or regulators to estimate the proportion of excreta delivered to off-site treatment plants and receiving treatment [14]. Administration records and log books (if available for nationally representative samples) could include data from the treatment plant or emptying service provider on the proportion of households receiving desludging services, quantity of sludge delivered to treatment compared with quantity emptied, treatment plant inflow records or discharge to sewers, emptying service provider records. However, while countries often have data on the operation of treatment plants, few maintain centralized records of desludging services that would allow calculation of how much of the removed excreta is actually delivered for treatment [14]. When administrative data exists, it is often in different units (i.e. number of trucks, volume or mass of waste) or from undefined catchment areas that make it difficult to align it with household survey data or determine the equivalent population served (see section 3.2). In many areas where emptying services are not regulated, or where informal or private services occur alongside regulated ones, the data may only cover a portion of the emptying activities. WHO has developed draft questions for piloting in service-provider surveys (see Annex Table A7) that could be incorporated into inspections or spot checks of emptying, transport or treatment services [3].

1.7 Off-site treatment and disposal

Defining off-site treatment and disposal

Excreta from on-site sanitation facilities may be transported to wastewater treatment plants or to specially designed fecal sludge treatment plants. Excreta delivered to wastewater treatment plants providing at least secondary treatment are classified as safely managed. Excreta delivered to fecal sludge treatment plants are classified as safely managed if both the liquid and solid fractions are treated. Example of the treatment processes considered for safe management of excreta from on-site sanitation are shown in Table 17.

The core indicator for treatment in SDG 6.2 does not include an assessment of performance or compliance with effluent standards, however this is included in the household portion of SDG indicator 6.3.1. Similarly, the assessment whether the treatment plant has adequate capacity for the actual or intended inflows is not assessed but this could be an expanded indicator.

Reuse is currently not included as a core indicator in the JMP assessment (or for SDG indicator 6.3.1) however, could be monitored with expanded indicators if a national priority or interest.

Table 16. Treatment: Core and expanded indicators

	Core	Expanded
Treatment	Designed to provide at least secondary treatment for both solid and liquid phase	- Design standards: meets national standards for fecal sludge treatment facilities; treatment adequately level for the risk of exposure to the effluent - Function: Systems function, not overloaded/ reasonable capacity, not damaged, leaking, overflowing or bypassed. - Compliance: compliance of liquid effluent and residual solids with relevant standards
Reuse	Not included in core indicators	- Safety: duration stored, quality analysis, - Use: type of use, type of application,

Table 17. Off-site treatment options for excreta from on-site sanitation

Treatment of solid and liquid fraction	Solid fraction - Co-composting - Incineration - Lime stabilization - Ammonia treatment		Liquid fraction - As per treatment for excreta from piped sewers
Dewatering and/or stabilization of solid fraction and treatment of liquid fraction	Combined - Anaerobic reactors - Chemical conditioning - Mechanical dewatering - Safe burial or storage (e.g. deep-row entrenchment)	Solid fraction only - Drying beds	Liquid fraction - As per treatment for excreta from piped sewers
Primary/ limited treatment Solid-liquid fraction separation	- Thickening/settling tanks or ponds		

Findings from pilots

Table 18. Findings from pilots on off-site treatment of excreta from on-site sanitation

Serbia - Service provider survey	One third of participating local self-government units have a wastewater treatment plant, out of which 50 receive the fecal sludge from on-site sanitation systems which covers approximately 14% of the population.
Ecuador – SNIM survey 2019	Of the 221 municipalities, 43% indicate that their Wastewater Treatment Plant (WWTP) has the capacity to receive excreta from on-site sanitation facilities, 22% do not have capacity and 35% did not respond the question.

Assumptions for off-site treatment

In the absence of information on off-site treatment of fecal sludge, in countries where sewer connections are more common than on-site sanitation facilities, the JMP assumes fecal sludge receives the same level of treatment as sewered wastewater; but in countries where on-site sanitation is more prevalent, no estimates are made unless data are available on fecal sludge treatment [1].

Sources of data

Household survey respondents can't reliably indicate if fecal sludge is treated once it leaves the property; additional information is needed from administrative sources about the amount of fecal sludge that is collected and delivered to plants designed to treat fecal wastes. While such information may be available at the scale of individual municipalities, it is typically not aggregated at the national scale [1]. Globally, only seven countries had national level data on the off-site treatment of fecal sludge from emptied pit latrines and septic tanks [1]. A challenge in the scaling up and analysis of municipal data is the units of treatment are often in volumes which is not simple to derive household or population estimates as the volume disposed to fecal sludge treatment is not a direct function of the number of users but also depends on the containment size and emptying practices (partial or full emptying, adding water, etc.) [16].

2 Data sources and methods for monitoring SMOSS

2.1 Introduction

Monitoring safely managed sanitation requires information about household sanitation systems and their management at an individual scale as well as services that are shared at a communal or city scale. To capture information from different groups and at different scales requires a mixed methods approach recognizing that traditional household questionnaires cannot reliably inform safe transport and treatment steps. Table 19 summarizes the different methods applied in the pilot and which methods are best suited for informing each part of the service chain.

The methods included in this section are an example of the different approaches that can be applied, and countries should determine what methods best suit their governance and regulation of sanitation and their existing approaches to national monitoring. In developing or expanding SMOSS monitoring it is therefore important that the stakeholders are identified and engaged in the process and must also consider the enabling environment, including policies, regulations and responsibilities for provision of sanitation services.

This section provides examples of the different methods and how they have been applied in the pilot countries to monitoring different aspects of SMOSS. The details including questions and sampling can be found in the Annexes.

Table 19. Potential sources of data for different steps of the service chain

Service chain / Data collection method	Facility type	Containment	Emptying	Transport	Treatment
Household questionnaire				In-situ only	
Household sanitary inspection					
Administrative and regulatory data					
Service provider and local government surveys					
Service chain spot checks / inspections					

Levels of reliability and use of source — Low — High

2.2 Stakeholder engagement and assessment of enabling environment

> *"Participation of relevant stakeholders with a responsibility in sanitation is of great importance in all phases, from defining of methodological tools to data analysis and planning of future steps."*
>
> Serbia pilot

Stakeholder engagement

In all pilot countries, stakeholder engagement was an important part of monitoring SMOSS to both understand who is responsible for the management and monitoring all sanitation services and to engage stakeholders in the process to ensure ongoing support and validation of the definitions, methods and findings. Responsibility for SMOSS is often unclear or fragmented for different parts of the service chain, and unclear lines of reporting between local and national government. Understanding these roles is necessary for the immediate data collection (who to survey, who might have data), as well as identifying roles and responsibilities for ongoing SMOSS monitoring. Where the responsibility was unclear some of the pilots conducted stakeholder mapping alongside reviews of regulations to identify which actors were responsible for each step of the service chain and of monitoring and regulation. In many places responsibility is different for off-site and on-site systems, for different steps in the service chain or for urban and rural areas. For example, in Indonesia the Ministry of Health is responsible for implementation of a behavior change program focused on eliminating open defecation and improving hygiene practices (known as STBM) and focuses more on rural areas; while the Ministry of Public Works and Housing supports sanitation infrastructure beyond triggering process (e.g. from the containment) and is more active in urban areas.

Stakeholders were also engaged in the process of developing or improving SMOSS monitoring systems at all steps of the monitoring cycle: definition of locally relevant indicators that consider local priorities or targets, the selection of methods and sources of data, validation of findings, and support for proposed approaches for ongoing SMOSS monitoring. Engagement is needed with both the stakeholders involved in delivering and regulating sanitation, including national or sub-national departments of Water, Sanitation, Health, Environment, and Infrastructure, as well as those responsible for monitoring, such as the National Statistical Office. Effective stakeholder engagement and clarity of responsibilities for monitoring was evident in the Indonesia and Ecuador pilots where the team had close engagement with ministries which allowed SMOSS questions to be integrated to existing surveys and clarity of the roles for ongoing SMOSS monitoring. Most countries conducted inception workshops to highlight the gaps and challenges in monitoring SMOSS to date and seek inputs for priorities for the pilots and indicators. Many countries reported a challenge of engaging the National Statistical Office and some reported it was uncommon for technical stakeholders to be engaged in the setting of questions for household surveys and censuses and difficult for additional sanitation questions to be included. Activities to engage stakeholders were important throughout the data collection and analysis and all pilots plan to conduct validation workshops to review the findings and agree on methods and responsibilities for future monitoring.

KEY ENGAGEMENT STEPS

- *Stakeholder mapping for all steps in service chain, its regulation and monitoring*
- *Engagement of actors in all parts of the monitoring cycle*
- *Inception and validation workshops*

Assessment of enabling environment to identify key regulations and responsibilities

Similar to the stakeholder identification, the identification of relevant policies, regulations and standards can be difficult as on-site sanitation services may be delivered or regulated by different departments to off-site wastewater, which are often more clearly defined. Regulations, such as effluent discharges, are often

ambiguous whether they also apply to on-site systems and fecal sludge treatment. While assessment of the enabling environment can be extensive and guidance already exists, [3] [18] to specifically inform SMOSS monitoring it is useful to understand:

- Regulations on the responsibility for implementation, management and monitoring of each step in the sanitation service chain to identify who is, or should, be responsible for collecting data on SMOSS and who would use this data for planning or policies.
- Standards and regulations that may inform indicators against which sanitation systems are monitored. For example, the Indonesia pilot compared sanitation facilities against national septic tank standards whereas the analysis in Serbia identified there was no national septic tank standard as local governments were responsible to define their own standards (see Box 4). The WHO Guidelines on Sanitation and Health detail the sanitation aspects that may be covered by legislation and regulation (WHO 2018, Table 4.1) and the different regulatory mechanisms options for each step of the service chain (WHO 2018, Figure 4.4) [4].
- Policies or planning documents may indicate national or local targets for sanitation, against which monitoring should report on. The Indonesian indicators aligned indicators with the targets in the national development plan (see Box 2) and the Serbia government prioritizes monitoring of wastewater discharge as part of its commitment to the EU urban wastewater directorate.

Box 4. Serbia assessment of the enabling environment

SERBIA POLICY ANALYSIS TOOL

The Serbia team developed a policy analysis tool to conduct a qualitative assessment of the enabling environment for on-site sanitation at the outset of their SMOSS pilot. It aimed to assess the strengths and weaknesses of legislations and institutional arrangements against which to monitor sanitation and to identify institutions which are or could be responsible for monitoring SMOSS. Through desk reviews the tool collects and analyses national and local policies, laws and standards; institutional setup and coordination; monitoring and surveillance mechanisms; planning and financing for all steps of the service chain. The assessment ranks whether each aspect is addressed, from 0 (not), 0.5, 1 (sufficiently addressed). Some of the gaps identified in the Serbian policy framework relevant to monitoring SMOSS were:

- There is no national authority responsible for OSS and it is the responsibility of local government units. Local government units (LGU) each established public utility companies to manage water and sanitation services, however for sanitation there is no guidance for their local legal decisions and acts for management, design standards or monitoring of OSS, and some don't mention OSS at all. Given there are 158 local government units, understanding the individual regulations and developing monitoring to suit was challenging.
- No national standard for septic tanks since the LGU is responsible. While it is implicitly included by being an auxiliary object and therefore should be detailed in all housing project approvals and compared to a standard, this was uncommon as was inspection in field once built.
- Dispersed sources of pollution such as from septic tanks pit latrines are not defined as a specific priority in the Water management strategy and sludge management from treatment plants is not regulated (fecal sludge is typically co-treated with wastewater in Serbia).

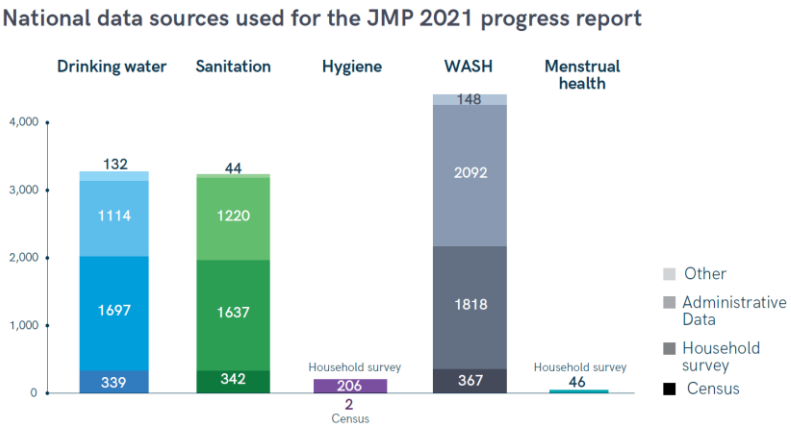
The figure below shows the results of the desktop scoring for governance and regulation across the service chain.

	Governance and regulation			
	Addressed in the national regulations and standards (make notes: sufficiently addressed - 1; partial -0.5; and No - 0)	Costing and financing of national (and local?) implementation plans addressing components of sanitation chain(make notes: sufficiently addressed - 1; partial -0.5; and No - 0)	Service provider/s roles clearly defined (make notes: sufficiently addressed - 1; partial -0.5; and No - 0)	Monitoring and surveillance (make notes: sufficiently addressed - 1; partial -0.5; and No - 0)
Planning	0.5	1	1	NA
Sanitation/ excreta disposal/point of use	0.5	1	1	1
Containment	1	1	1	0.5
Emptying	1	1	1	0.5
Transport of excreta and wastewater to treatment	0.5	1	1	0.5
Treatment plants that receive fecal sludge from on-site sanitation	1	1	1	1
Treatment of fecal sludge from on-site facility	0.5	1	0.5	0
End use/disposal	0.5	NA	NA	0

Assessment of existing data and monitoring

As detailed in the Introduction there remain large gaps in the global assessment of SMOSS and when developing or expanding monitoring it is important to map exactly what these gaps are for each country. Understanding the existing baseline data, or the lack thereof, can also be used to increase awareness of the need for improved monitoring. In Ecuador the analysis of the existing data and identified gaps resulted in increased awareness from the involved governmental institutions, principally the National Institute for Statistics and Census (INEC) and the Water Regulation and Control Agency (ARCA).

Figure 10. Number of data sources used in JMP 2021 report



Sources of data: Monitoring data could include national household surveys (e.g. census, MICS, DHS) and dedicated water supply & sanitation surveys, administrative reports and sector information management systems (e.g. national monitoring open defecation) or smaller scale data collection by CSOs, research institutes or development partners linked to sub-national programs or projects. For the recent JMP sanitation estimate, over 4000 data sources were consulted of which approximately half were household surveys and censuses, and half were from administrative sources.

Some useful consideration in the assessment of existing data sources include:

- **Does it cover all steps in service chain?** For both on-site and off-site sanitation and consideration of different service types, such as emptying by private or informal providers.

- **Is it nationally representative?** While censuses collect data from all households, other surveys or data sets can also be nationally representative if they follow an appropriate sample design. Some data may be available for urban or rural only, sub-national areas or partial data sets from small projects or ad-hoc studies. Where led or approved by a national statistical organization or Ministry these may be representative, although to date few countries have nationally representative data on on-site sanitation. Even if not sufficient for national estimates these existing studies may be valuable to understand the sanitation context, such as the prevalence of on- vs off-site and its variability in different regions or population groups. Examples of use of sub-national data include the review of SFDs in Kenya which focus on urban areas and Ecuador is drawing on a recent online WASH in Schools monitoring tool for its survey design.
- **Does it align with national targets and global definitions?** While guidance exists on standard questions for assessing sanitation (JMP, MICS, other), if monitoring systems are old or not regularly reviewed and updated, the questions and answer categories may not relate to current national or global definitions. This was identified in the latest Kenya census that included questions and categories on sanitation facilities from the previous MDG monitoring which do not align with current national targets or JMP categories.

Box 5. Data acceptance

ACCEPTANCE OF DATA FOR JMP ESTIMATES

The JMP country files (https://washdata.org/data) includes extracts from national data sources however in some cases data are excluded from use in calculation of indicators reported by the JMP. Some reasons that can cause a dataset to be excluded include [18]:

- Communication from national authorities that the data are not considered reliable or appropriate for use
- The classification of the data is based on few generic categories which are not aligned with JMP categories
- The "other" category is very large
- Data were available for the national population but not for the urban and rural ones (unless analysis for that country was done only at national level)
- Data were not representative of the national, urban or rural populations
- Data were representative of less than 80% of the national, urban or rural populations
- Sums of categories which should be mutually exclusive and exhaustive are far from 100%
- Data are markedly different from multiple other data points from a similar timeframe

For any of these reasons, a dataset may be excluded from calculation of any of the indicators reported by the JMP. In some cases a dataset can be used for one or more but not all indicators, because of variable data availability and quality. For example, a household survey might yield reliable data on "improved sanitation" but unreliable data distinguishing sewer connections from on-site sanitation systems, because of ambiguous question wording or inadequate training of survey teams.

Source: JMP METHODOLOGY: 2017 UPDATE & SDG BASELINES [18]

Below are examples from assessments of existing data sources and monitoring mechanisms from the Indonesia and Kenya pilots. Further details on how countries integrated improved SMOSS monitoring into existing data collection methods is described in section 4.3.

Figure 11. Assessment of SMOSS in existing data and potential data sources, Indonesia

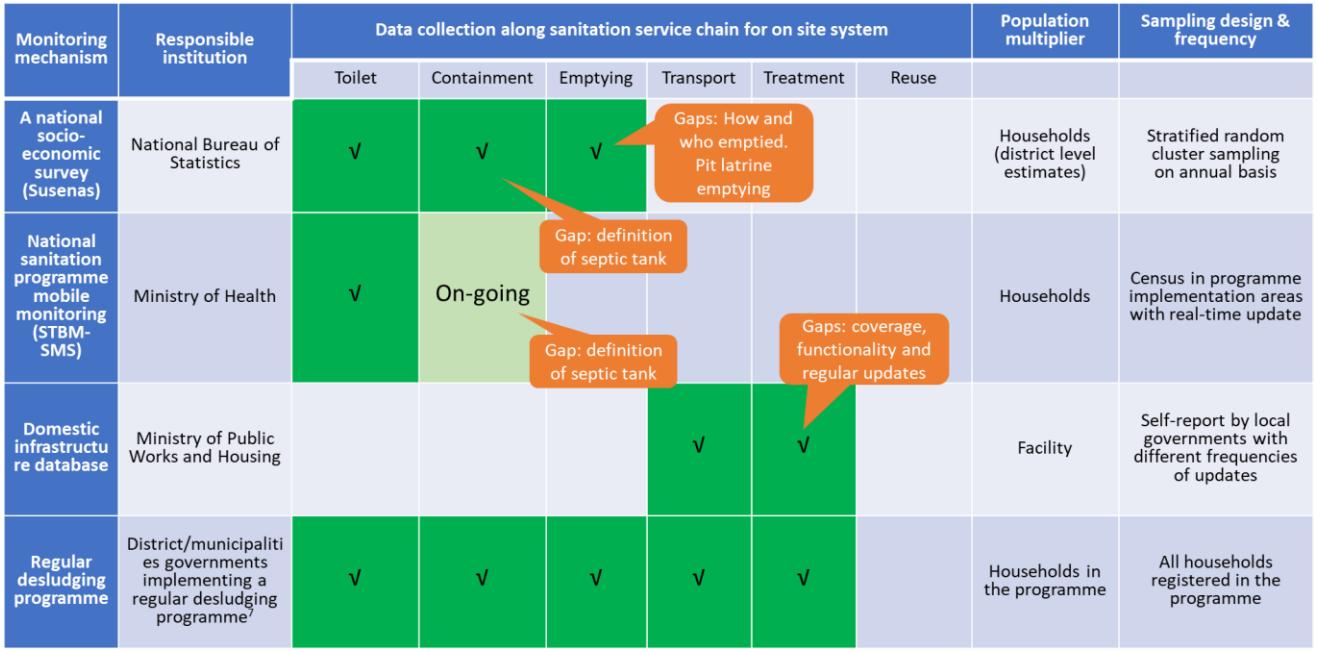


Table 20. SMOSS indicators included in national household surveys, Kenya

Survey (Last Updated)	SMOSS Indicators?	Description
PMA2020 Phase 1 (2017)	Containment type, FSM type	Performance, Monitoring and Accountability from 2014-17 was a nationally representative HH and Health Facility Survey that included a detailed WASH module including FSM. Although still active, PMA has not collected FSM indicators since 2018 (i.e. in Phase 2).
MICS (2014)	Basic WASH only	UNICEF Multiple Indicator Cluster Surveys, i.e. set of household questionnaire modules; no known survey data available since MICS5 from 2013-14
DHS (2014)	Basic WASH only	USAID Demographic and Health Survey implemented by the Kenya MoH; no known survey data available since MICS5 from 2013-14
SMART (2020)	Containment type	Nutrition household-based survey conducted at the county level that includes WASH modules. Survey for Nairobi County available for 2020.
2019 Census	Basic access	Sanitation categories did not align with JMP categories nor national targets

There is also an opportunity to further investigate existing data to assess SMOSS. For example, in Indonesia UNICEF together with the JMP, universities and government, carried out in-depth analysis of existing nationally representative onsite sanitation data to assess trends in on-site sanitation and emptying [18]. This provides an example of how expert support in collaboration could lead evidence-informed advocacy by making the best use of existing data to highlight issues.

2.3 Household surveys

Since 2000 the JMP has used data collected through censuses and nationally representative household surveys to develop estimates [3]. Survey questionnaires are often based on those of international survey programs (e.g. MICS, DHS or a combination of modules) and ask questions about individual sanitation facilities, their use and function and related household social-economic information which provides data that can be disaggregated to assess inequalities (e.g. urban/rural, wealth quintiles).

Household questionnaires typically rely on self-reporting which is effective for easily understood questions however can be less reliable when questions become more technical or relate to services occurring outside their household. For this reason, household surveys are an effective means to capture data about access, the use and function of sanitation facilities, and can provide some information on the type of containment and emptying, yet are considered unreliable for assessing transport, disposal and treatment of excreta (see Table 19 above). Survey questions can be found in Annex Table A3.

To improve estimates of safely managed sanitation most pilot countries conducted or supported household surveys, either through:

1. Integrating additional questions to existing national monitoring (e.g. IDN, ECU)
2. Conducting a dedicated survey for the pilot to test indicators and questions and in some cases inform a national estimate of SMOSS (e.g. BGD, ECU, KEN, SRB, ZMB).

Integration with existing monitoring: Integrating SMOSS monitoring into existing national surveys is advantageous as existing surveys typically have trained staff, approved sampling and quality assurance methods, analysis and reporting processes and ongoing budget. While Ecuador and Indonesia were the only pilots which integrated additional or improved SMOSS questions into existing national surveys, many other countries aim to do this in the future (see Table 28).

In Indonesia questions were integrated in the national water quality survey (2021) which was conducted for over 20,000 households and had previously made suggestions for additional sanitation questions for the national socio-economic survey in 2018. Ecuador integrated three new SMOSS questions and modified the responses to the toilet facility question in the national employment survey (ENEMDU 2019) which is conducted every three months and although not focused on WASH, includes a household section in which sanitation questions could be incorporated.

Various reasons were given why the integration was possible: sanitation priority of national ministries, clear responsibilities for monitoring and regular monitoring already in place, pilot teams had prior engagement with agencies responsible for monitoring. The key challenges were the limited number of questions that could be included, the low capacity of enumerators regarding technical sanitation aspects or difficulty in providing direct training and the risk of questions being cut due to budget or other constraints (i.e. Covid 19).

Dedicated household surveys: Integration of pilot activities with existing national survey was not feasible for some pilots due to lack of suitable monitoring mechanisms or poor timing, while others preferred dedicated household surveys to test a larger range of questions prior to proposing a short-list for regular national monitoring. Dedicated household surveys can be designed to suit the research objectives and comparing the surveys conducted through the pilots, the main variations were:

- **Scale:** One of the key differences, particularly when considering the analysis of results, is the scale at which the surveys were conducted. Three were nationally representative (Bangladesh n=3,149, Zambia n=23,000,) while others focused in areas where on-site sanitation is prevalent and covering different contexts (Serbia n=1,560, likely also in Ecuador and Kenya). Estimates of representative samples required assumptions about variability of data, often which was unknown/based on literature. The sample size was also limited in budget. Details on sampling are provided in the Annex.
- **Priorities:** Following initial stakeholder engagement the pilots identified key priorities that influenced the survey scope. Including different socio-geographic and environmental contexts was important in Ecuador and Bangladesh, targeting sampling on low-income areas was a priority for Bangladesh and Kenya, and sampling was weighted in rural areas in Serbia and Ecuador given the higher use of on-site facilities.
- **Enumerators:** The background of enumerators, their experience and knowledge of sanitation and the extent of training received may influence the quality of data collection, particularly for assessment or explanation of technical sanitation aspects (type of facility, discharge of effluent or sludge). Surveys implementation design can improve quality even for unskilled enumerators if adequate training is given as well as guidance on providing additional details or clarification to complex questions. Some countries conducted duplicate questionnaires for quality assurance purposes, however, did not report on the findings which would allow assessment and comparison of enumerator accuracy. Local public/environmental health inspectors implemented the survey in Serbia (25 field teams) and Zambia (2500 data collectors), UNICEF volunteers conducted the survey in Bangladesh (65 enumerators) and FLACSO academic institution students in Ecuador. Specialist staff were involved in the enumerator training which was conducted either in person or remotely. All surveys were piloted before use and were conducted through handheld electronic devices, employing a range of survey programs (e.g. Kobo, ODK, Electronetc).

Figure 12. UNICEF Volunteers conducting household surveys in Bangladesh

2.4 Household sanitary inspections

Sanitary inspections are an observational technical and risk assessment of toilet facilities and containments that can capture more technical details than household questionnaires or validate what is self-reported by households. Given most household surveys do not involve direct observation of sanitation facilities and rely on household responses, the reliability of facility type classification depends heavily on whether enumerators have received any training or guidance on how to differentiate the main types of sanitation facilities found in a given country. Inspections can validate what is self-reported for facility type, along with other aspects of safe containment that may not be answered truthfully due to known non-compliance with regulations (e.g. effluent discharge to drain) or embarrassment (e.g. containment damaged or overflowing). Inspections can also be used to assess toilet access, hygiene, privacy, and handwashing facilities, but this report just focuses on their use in assessing containment.

The following section details the types of questions that could be included, the different means of collecting data and considerations for the skill or training required of enumerators. Table 21 summarizes how sanitary inspections could inform assessment of core and expanded indicators for SMOSS. Examples questions are provided in Annex table A5, which include the sanitary inspection checklist developed as part of WHO's Guidelines on Sanitation and Health [3]. As a minimum, we propose the following two key questions as minimum to assess the core containment indicator through a sanitary inspection:

i) Validation of containment based on the same categories as the household questionnaire, including whether it is a flush or dry toilet
ii) Observation whether there are any major structural or functionality issues that could discharge waste to the environment, including:
    a. There are large cracks or holes visible in the containment which could allow the contents to discharge directly to the surface environment
    b. Ponds of effluent are visible on the ground outside the containment
    c. Effluent is flowing from the containment to an open drain, water body or to open ground

Table 21. Topics included in sanitary inspections for SMOSS

Core	Expanded indicator examples
Containment types: - Validation of what was reported by household by visually inspecting the toilet (flush or not) and the containment (type or key features that indicate the type). Recognizing acceptance to view the toilet may be challenging and the time to view two locations, preference should be given to observing the containment rather than toilet. - Where containment types are difficult to differentiate, inspection could assess features that can be associated with certain containment types (e.g. shape, dimensions, material of cover and walls), rather than relying on the enumerator selecting a containment type. See the Indonesia inspection questions as an example (Table A5). Discharge of waste to environment: - For pour flush sanitation (i.e. not dry toilet) observe whether there is an outlet pipe, or other opening, from which effluent (liquid fraction) could discharge directly to	Containment types: - Features required for compliance with national standards such as vent pipes, manholes, etc. Function: - Internal inspections to assess the sludge depth to understand emptying requirements or the liquid content to understand if the containment is watertight. See box below. Groundwater risk: - Assess whether the containments leaks to the soil (type of containment, sealed walls and base), the likelihood of this interacting with groundwater (depth of tank, depth of groundwater and soil conditions), and the potential risk to water supplies (proximity to groundwater water supply, use of water supply for drinking).

Core	Expanded indicator examples
open drain, water body or to open ground. Given the discharge is not continuous the objective is to observe the infrastructure rather than the flow at the time of survey. - Inspection of functional or structural issues that may result in discharge of waste to the environment. This could be observations of major structural or functionality issues such as large cracks, holes, openings, damaged or collapsed walls. They could also be temporary issues such as overflowing, leaking or ponding of effluent which could be observed at the time of survey or asked whether they have previously occurred.	Setting and emptying access: - Location of the containment to understand accessibility for emptying including where it is situated with respect to the house, whether it can be easily opened to empty and street access for an emptying vehicle. - Density and land availability may inform likelihood and suitability of soil infiltration - Soil and groundwater conditions to inform infiltration capacity and groundwater risk - Flood risk

Figure 13. Sanitary inspection Indonesia (left), effluent to drain (center), sludge measure (right)[xvi]

Implementation of sanitary inspections:

Inspections can be implemented as part of a larger household questionnaire or conducted as a separate inspection only survey. Depending on the scope and objective of the household questionnaire, integrating inspections may mean fewer observation can be included and that the enumerator is not necessarily technically trained. However, integrating inspections will likely enable large sample sizes and minimum additional cost to the standard questionnaire. Separate inspections can go into more detail, such as measuring the containment size and internal inspections and be conducted by a technically skilled enumerator. Yet due to this they may be more costly and harder to achieve the same scale as the household survey.

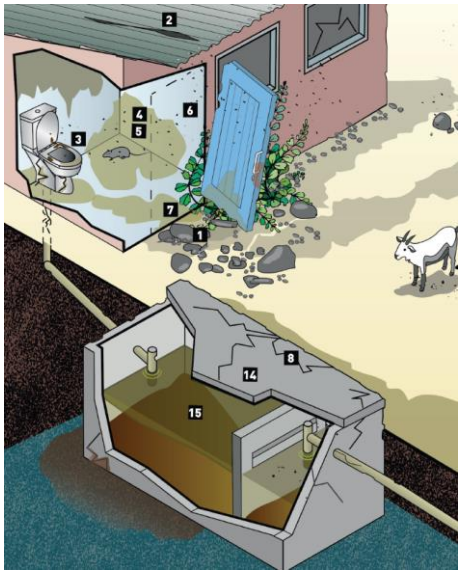


Figure 14. Image of inspection points for WHO sanitary inspections [3]

[xvi] Photo by Andrianovi Kleden from Puskesmas Oepoi Kupang & Universitas Indonesia

It is still being debated whether inspectors with technical backgrounds are needed or if providing technical training to standard enumerators is adequate. In the pilots, environmental health staff conducted the inspections in Indonesia and Serbia while trained UNICEF volunteers conducted them in Bangladesh. Indonesia and Ecuador are looking to develop videos to support the training while Bangladesh suggests government engineers could participate in local enumerator training and trouble shooting. Photos of different responses or diagrams of critical inspection points are used by the inspections in Indonesia and the WHO Inspection Checklists to support the enumerator with the assessment. Another outstanding question is what scale of inspections are useful to be nationally representative and requires further assessment.

A range of methods can be integrated into inspections including taking photos, measuring containment sizes or distance to critical points, or internal inspections (see below). The value of these expanded methods to inform SMOSS compared with the time and challenge of data collection and analysis requires further assessment. Some of these may be useful for initial formative research but not needed for ongoing monitoring.

Figure 15. Spot checks and tank inspection Bangladesh

Box 6. Sanitary inspection – opening the containment

Internal inspections in Bangladesh

The Bangladesh pilot opened containments as part of the inspection to confirm type of system, permeability of walls and base, sludge depth and containment height. Inspections were conducted within the household questionnaire by UNICEF volunteers.

Internal inspections were possible for two thirds of all inspections or 20% of all households surveyed (n=647). At times the containment couldn't be opened by one enumerator alone and they return to the household later with support.

It is unclear how the data on sludge depths will be used in the assessment of SMOSS or whether this was collected to improve understanding of filling.

Internal inspections in Indonesia

Indonesia included optional inspection of the inside of the containment using a septic checker. The aim was to measure the sludge and supernatant depths to understand need for emptying and likelihood that the containment was sealed, in consideration of surrounding groundwater conditions.

A high proportion of hosueholds did not permit opening containment (75%) due to it being considered too dirty, couldn't access, located under house or other reasons. Even from the 14 households that agreed, only 4 were accessible to inspect (7% all households assessed).

Indonesia intended to use these assessments to confirm containment type, groundwater contamination risk and whether they require emptying for the assessment of timely emptying.

2.5 Administrative data

Administrative data from routine reporting by municipality and local government service authorities are a valuable source of nationally representative data to inform what happens to the fecal sludge once it leaves the property. Administrative data forms an important part of JMP monitoring and 38% of national sources used for the JMP 2021 report for sanitation were administrative data sources [1]. For the JMP global monitoring these data have come from regional programs (EUROSTAT, IB-NET, other) or directly collected from reports by national authorities, statistical offices, ministries, and regulators. JMP estimates can also be informed by studies conducted by research institutes, or technical advice received during country consultations [7].

Administrative data are often more likely to capture data on wastewater treatment and sewer connections than fecal sludge management. Data that are available for emptying, transport and treatment is more often available at individual municipality scale that is typically not aggregated at the national scale [1]. Some datasets reviewed by the JMP are not representative of national, rural or urban populations, or may be representative of only a subset of these populations (e.g. the population using piped water supplies or sewer connections).

Regulatory data could also play an important role by compiling data from service providers such as pit construction services, desludging services or treatment plant operators. While it remains relatively underdeveloped for on-site sanitation and sludge treatment, as the scope of many wastewater service providers is now being expanded to include on-site systems and rural sanitation, such as in Zambia, regulatory data from sewerage services could soon be expanded to include on-site sanitation.

Municipalities and local government sometimes double as service providers but this is far from ideal from a governance perspective as we need to separate data on service coverage and service quality or compliance. Examples of the types of data that could be reported on:

Table 22. Administrative and regulatory data example indicators

Administrative data from LGU/service authorities	Regulatory data from service providers
• Population using on-site sanitation facilities, OSS building permits or inspections, • Population covered by fecal sludge collection services or treatment • Number and type of service providers per administrative unit • Number, capacity and type fecal sludge treatment facilities	• Number of people receiving emptying services per year • Types of facilities emptied • Methods of emptying and transport • Treatment capacity, type and function • Volume of sludge or number of tanks emptied/ received/ treated per year

One of the challenges of administrative data is the inconsistency in definitions, terminology or methods applied that makes comparison with JMP definitions difficult [19]. For example, data on the volume of sludge emptied or treated requires a conversion to apply to population served that is not as simple to estimate as sewage flows since emptying volume depends on containment size and emptying frequency which can vary significantly. Similarly, where the sewerage infrastructure clearly defines the relevant population for wastewater data, emptying services providers are not typically limited to defined areas and can cross administrative boundaries. While the pilot in Ecuador provides a valuable contribution, significant gaps remain in the methods to collect and use administrative data for SMOSS estimates.

Box 7. Example of integrating SMOSS questions in administrative data - Ecuador

ECUADOR NATIONAL SYSTEM FOR MUNICIPAL INFORMATION

The National System for Municipal Information (SNIM) is a digital platform collecting annual information on the management of municipalities at the national level. It is administered by the Association of Municipalities of Ecuador (AME), in coordination with Agency for Water Regulation and Control (ARCA) and the National Institute of Statistics and Censuses (INEC).

The pilot suggested the inclusion of 15 additional parameters related to on-site sanitation, which were included in the 2020 reporting. These included: Emptying services (public or private), Emptying equipment available (vacuum trucks), existence of administrative records of these services, final disposal, and municipal regulation. Given training was not possible the questions were very simply constructed (i.e. Is the municipality providing emptying services? Do you have trucks?).

The survey was distributed to all municipalities (221) by the AME. While submission was mandatory, there were a high percentage of non-responses for different SMOSS questions. 35% of municipalities do not answer the questions about whether the municipality provides the service of emptying from on-site sanitation facilities, or about the existence of private companies that carry out this activity, or if the wastewater treatment plants have capacity to receive fecal sludge. 91% of municipalities do not respond if there are regulations for private sector emptying.

Suggested reasons for the low response rate were:

- Knowledge of technician completing the survey about the new on-site questions was not adequate to fill out the information and it wasn't possible to conduct training or provide extra explanations given it was conducted by a third party and sanitation was only one component.
- It was the first-year reporting and municipalities may not have records of on-site sanitation data to draw on.
- The online survey design included a constraint that made it impossible to submit the form without answering all questions about on-site sanitation.

Although no amendments to the survey could be made prior to its implementation this year, it is hoped the analysis of this year's data will clarify some of the issues and the team is considering how to provide remote training, such as a video, to build awareness of the objective of data collection and information on collecting the data.

2.6 Local government or service provider surveys

In many countries there is a lack of routine administrative or regulatory data on on-site sanitation services which often results in gaps in the national assessment of emptying, transport, and treatment. Nationally representative surveys of local governments or service providers can capture either general responses or specific data on SMOSS at a scale that can be used to inform national estimates. This may be similar to what is reported in the above mentioned administrative or regulatory data but can also be specifically targeted to SMOSS. It can include both urban and rural areas and be disaggregated by administrative units that allow it to be aligned with household survey data.

The survey respondent will depend on how sanitation is managed (e.g. water and wastewater authority or municipality or local government department) and the ability to distribute the surveys to a nationally

representative sample of these. The local government and service provider surveys conducted through the Serbia pilot distributed the surveys through an association that supports local government units. It is evident that this approach requires some level of formalization of responsibility for sanitation and benefits from existing coordinating bodies that regularly collect data on different topics from these actors. In countries whether emptying services are predominately informal or if there is no common service provision approach between administrative units, the implementation of surveys may be difficult. However, in some countries like Bangladesh there are associations of private emptiers and national workshops for private emptiers which could provide contact lists for survey distribution. Similarly, there may be different responsibility between rural and urban areas that may require different approaches to data collection.

Serbia developed two online questionnaires to collect existing data from the local self-government units (LSU) and service providers, covering the management, human resources, monitoring, planning and finance of OSS emptying, transport and treatment and small-scale sewerage (<2000 PE). A summary of the questions included in Annex Table A8. The online questionnaires (using Google forms) were distributed to the 158 LGUs with the support of the Standing Conference of Towns and Municipalities, an NGO that is closely connected with LGU and support them in their work.

The completion of the questionnaires was voluntary and 50% responded which represented 80% of the population. As it was implemented through the NGO, it was not possible to receive feedback or provide follow up about the questions directly with LGUs. The submitted forms included many questions that weren't answered, particularly questions around discharge of waste and treatment, as it is expected that LGUs are aware of what unsafe or illegal practices are and are afraid to reply truthfully if they do not have adequate services. Given previous data has shown that only 10% of wastewater in Serbia is treated and that fecal sludge is discharged to sewers or wastewater treatment plants, the proportion of safe disposal and treatment is expected to be low.

2.7 Service chain spot checks / inspections

Similar to the sanitary inspections of household sanitation facilities, a visual inspection and technical assessment, or "spot check", of emptying, transport, treatment and reuse can provide reliable information to validate the findings from household surveys and responses from interviews and FGDs. The objective would be to assess the services against the core and specific expanded indicators through visual inspection, often accompanied with an interview or group discussion with the operator(s). Inspections require some level of technical knowledge and understanding of the intended or safe management of the system in order to assess whether it complies or not, therefore someone familiar with sanitation systems should conduct the assessments or have a detailed guide of what to assess. Inspections are particularly useful when the interview is not fully reliable, for example due to the operator not having an in-depth understanding of the potential risks (e.g. that transporting waste uncovered or regularly bypassing treatment steps may be common practice but not necessarily safe) or lack of trust in the validity of responses, particularly for unsafely managed systems or practices. The frequency of such inspections depends on the level of trust by environmental health staff in the service providers and the potential hazards arising from non-compliance [4].

While there were no examples of service chain inspections in the pilots, WHO has developed draft questions for piloting in service-provider surveys (see Annex Table A7) that could be incorporated into inspections or spot checks of emptying, transport or treatment services. Indonesia also reported that the Public Works

Authority conducts an assessment of treatment function and capacity, however the specific checklist or means of collecting the data is not known (it may be surveys rather than visual inspections).

2.8 Other methods of data collection

While the above methods are recommended to obtain nationally representative and reliable data, given the gaps in administrative data, particularly where on-site sanitation services are far from being formalized, other methods may be possible. While it is likely that these will mostly be used for formative research, if the methods could be applied to a nationally representative sample, they may be able to inform estimates.

Data from small studies: Sometimes data are available from small studies conducted by academic institutions or NGOs. An example is or that the minimum service standard assessment in Indonesia is relying on NGO data to inform emptying estimates.

Focus group discussions (FGDs): Bangladesh conducted FGDs with emptying service providers that, although wasn't the case for the pilot, could be conducted with representative sampling which may allow quantification of their responses relevant to the administrative area they serve. For example, the FGD discussion may find that 4 of 10 emptiers using a cart report discharging at the treatment plant, or 2 of 10 that manually empty bury excreta in-situ, which could then be applied to household data for that area or compared with other FGDs to understand national variations or assumptions. As some countries are making efforts to identify private or informal sanitation services providers as part of formalization, regulation or health and safety initiatives, comprehensive lists of service providers could allow representative sampling. Given regular data on emptying practices from informal service providers are unlikely to be available anytime soon, FGDs could be a useful tool to expand on administrative data from government or formalized service providers, even if they can't be used to develop nationally representative estimates for SDG reporting.

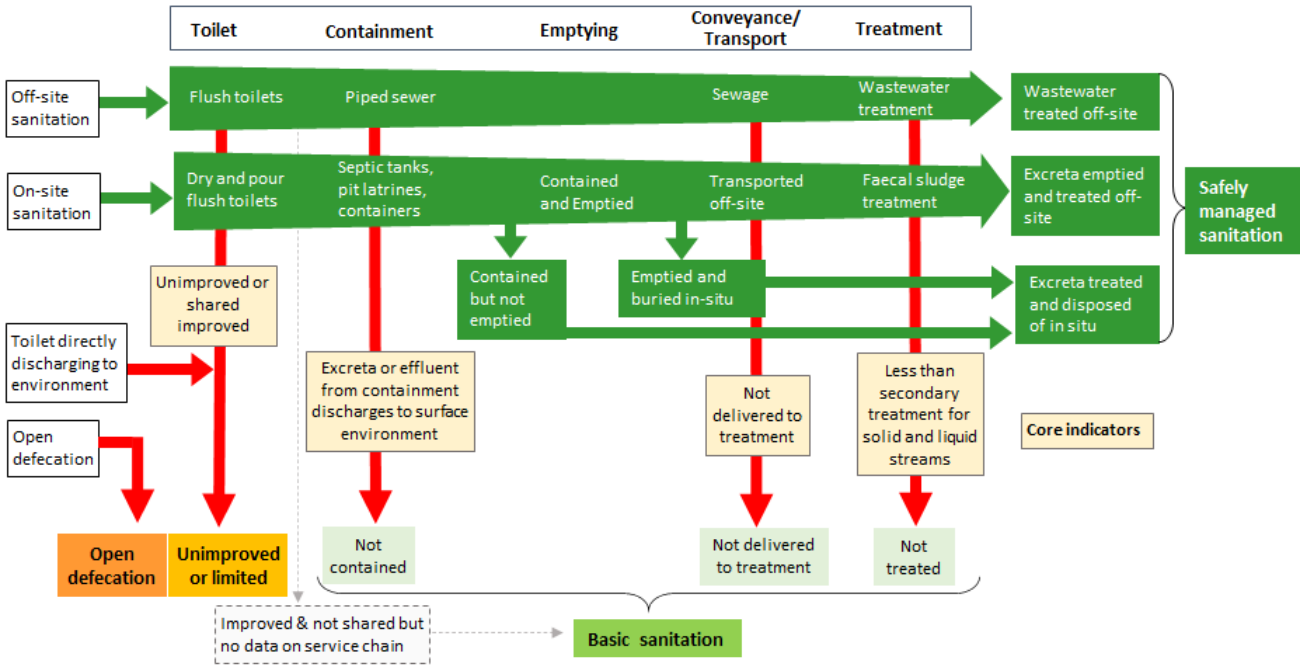
City scale databases: Various cities in Indonesia, Bangladesh and elsewhere are developing databases on containment and emptying practices or GIS applications to track emptying providers and disposal at treatment. While they are predominately developed to inform regular emptying service provision, they could be valuable sources of data for SMOSS. Although these data are typically limited to individual cities, if common approaches or databases were used globally, this could provide a valuable source of administrative data. The Indonesia pilot is currently working with the Ministry of Public Works and Housing to review existing FSM apps and databases to strengthen monitoring beyond household-level.

3 Analysis of SMOSS

3.1 Pathways to safely managed

As detailed in section 1 there are three means to achieve safely managed sanitation, two of which are relevant to management of excreta from on-site systems. Figure 16 is an adaption of the excreta flow diagram ([3] [5]) that demonstrates how these three pathways to safely managed sanitation can be achieved considering the core indicators used for global monitoring at each step of the sanitation service chain. The green arrows represent excreta that is safely managed, and the red arrows indicate where waste is unsafely managed. This diagram demonstrates the steps of analysis, including that the assessment of safely managed occurs only for the households that have achieved at least basic access (improved facility that is not shared[xvii]), as well as showing which indicators need to be monitored at each step of the chain to enable assessment to the three means of safely managed sanitation.

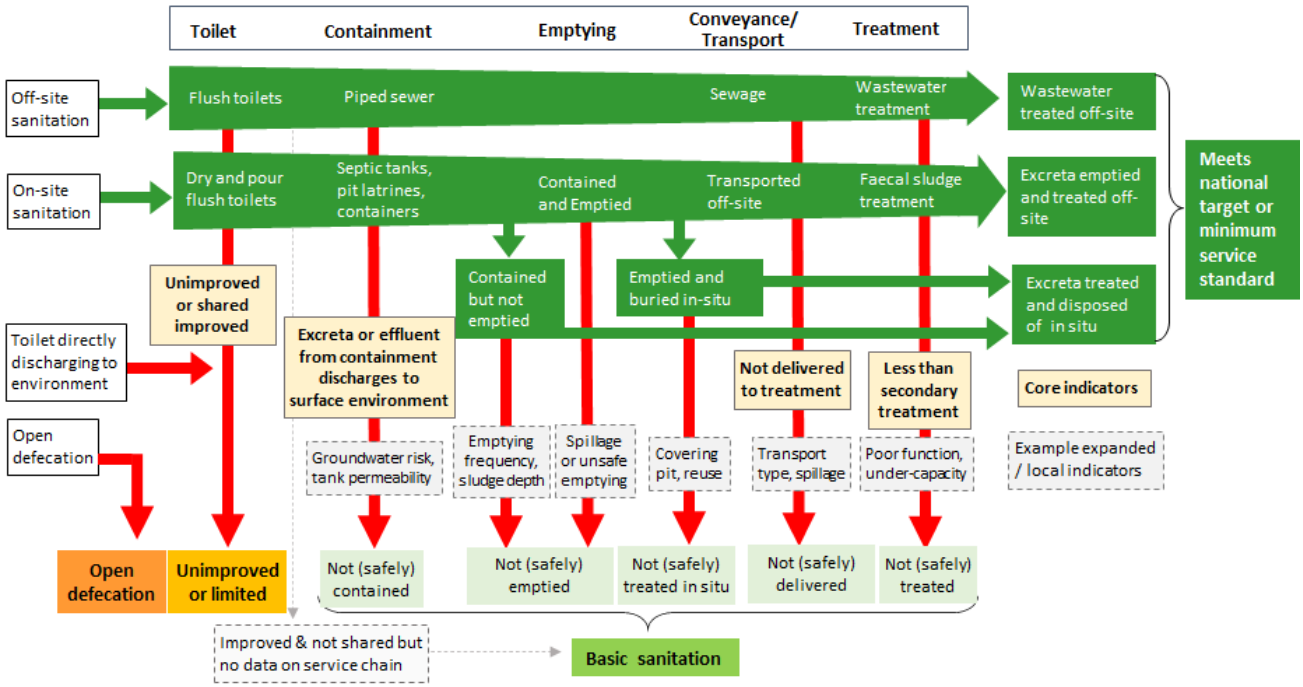
Figure 16. Excreta flow diagram showing core indicators used for global monitoring of safely managed sanitation (adapted from [3],[5])



For local monitoring, additional data may be collected that go beyond the core indicators used for global monitoring, as above, and enable monitoring of an expanded set of indicators, see Figure 17 below for examples.

[xvii] Although JMP estimates of safely managed services are restricted to households with improved sanitation facilities that are not shared with other households, national monitoring systems should consider the management of excreta from all facilities in order to have a more complete picture of the demand or lack of services. For this reason, pilots also asked SMOSS questions to households that used unimproved and shared latrines.

Figure 17. Example excreta flow diagram showing expanded indicators that may be considered for national and sub-national monitoring of safely managed sanitation



Analysis of these multiple steps for multiple systems is complex and requires a systematic approach to assess each step of the chain. The graphs below show the analysis of each step of the service chain based on JMP core indicators for the Bangladesh and Serbia pilot data. Both surveys were stated to be nationally representative surveys and results are presented for national, urban and rural data sets. The Serbia pilot weighted sampling based on use of onsite facilities, which were mostly in rural areas, while the Bangladesh survey included a greater focus on urban areas. Neither pilot included assessment of the level of treatment, therefore the total amount of safe cannot be calculated since the proportion of emptied and treated off-site remains unknown. The proportion of safely managed on-site sanitation based on storage in-situ or emptied and disposed in-situ could be calculated.

Figure 18. Analysis of results from Bangladesh pilot based on JMP core indicators

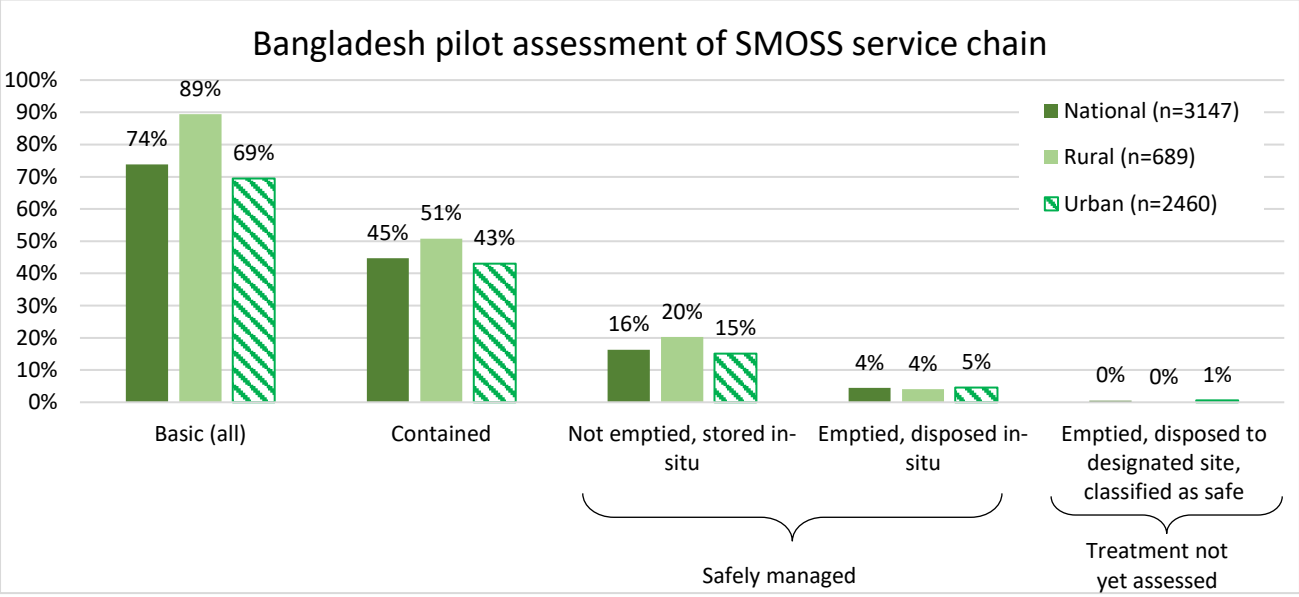
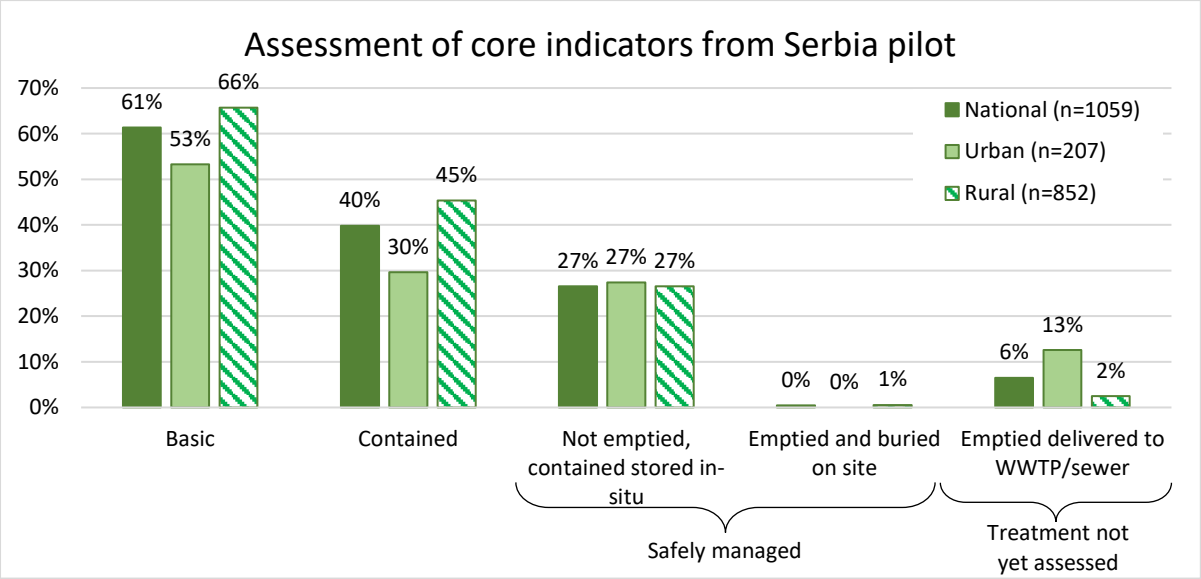
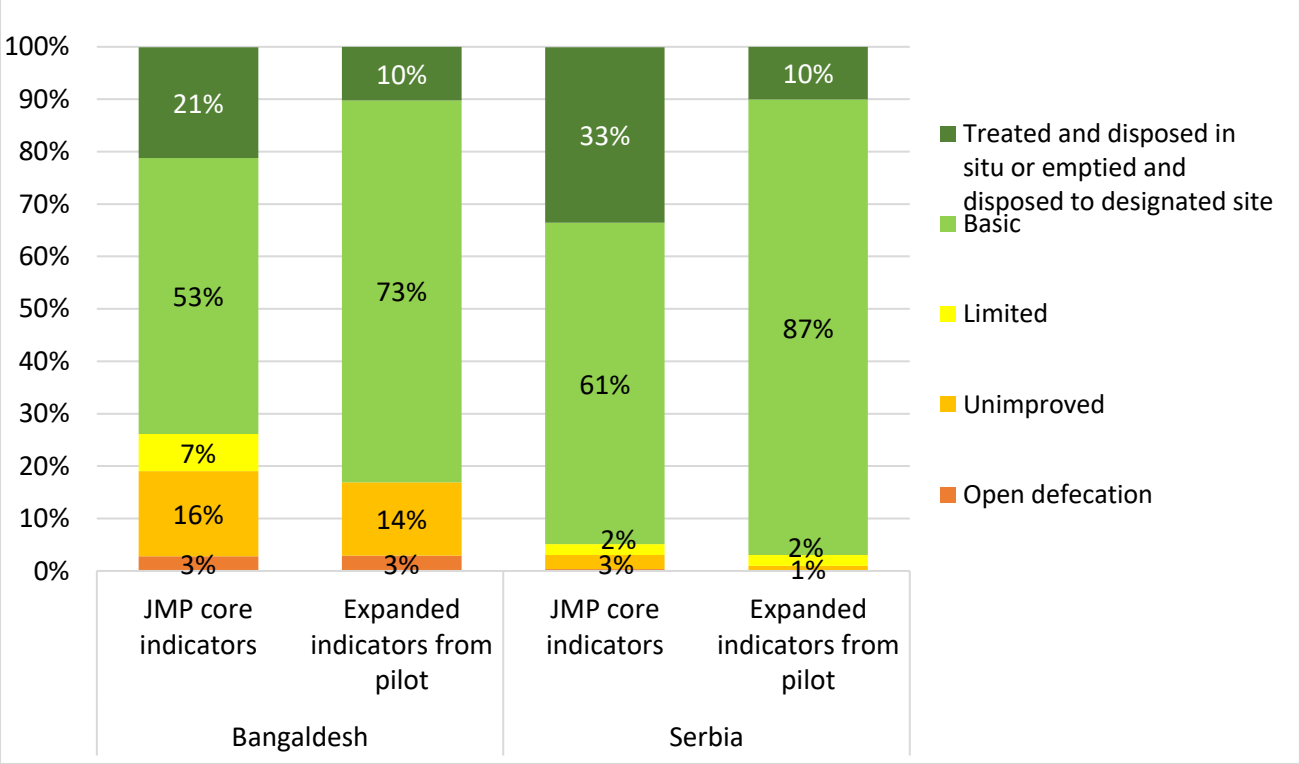


Figure 19. Analysis of results from Serbia pilot based on JMP core indicators



Both pilots included expanded indicators in their local assessment of containments which differ to the JMP core indicators. This results in different estimates for safely managed services (Figure 20). For the Bangladesh pilot, toilets discharging to drains were considered improved (JMP assesses these as unimproved), limited systems were not included and not emptied stored in-situ was not included as safe disposal options. For Serbia, all impermeable pits and tanks were considered not contained and therefore not safely managed, which differs from the JMP core indicators which includes unlined containments.

Figure 20. Comparison of JMP core indicators and expanded indicators used in pilots



For the JMP analysis some assumptions are made for different steps when there is no national data to inform the analysis. These assumptions can be tested once real data, such as from these pilots, are available and considered representative of rural, urban and national populations.

Table 23. Summary of key JMP core indicator assumptions in analysis

	Core indicators	Analysis and assumptions used for global monitoring [1]
Toilet facility	• Use of improved facilities	• Disaggregation of septic tanks and pit latrines essential. Further disaggregation of wet and dry pits desirable.
	• Not shared with other households	• Improved facilities shared with other households do not contribute to safely managed sanitation.
Containment	• Septic tank or pit latrine is not overflowing or discharging waste directly to the surface environment	• In the absence of containment data, assume that excreta are contained in 100% of pit latrines and 50% of septic tanks. (which require periodic emptying) are assumed contained • Only systems assessed as contained can contribute to safely managed sanitation.
Disposed in-situ	• Contained, not emptied	• Contained facilities that have never been emptied are considered stored/treated and dispose of in-situ.
	• Contained, emptied and disposed of in-situ	• Contained facilities that have been emptied and buried are considered disposed of in-situ
Emptying	• If containment ever emptied	In the absence of emptying data: • If onsite is dominant estimates are only made if data available on emptying. 'Don't know' considered never emptied. • If sewer connections dominant, in the absence of emptying data 50% of onsite considered safely managed.
Transport	• Emptied and removed offsite • Excreta delivered to treatment facility	• In the absence of transport data assume all excreta removed by service providers is delivered to treatment facility • Emptied to 'other/don't know where' are considered unsafe and highlight the problem of unaccounted-for faecal waste.
Treatment	• Designed to provide at least secondary treatment for both solid and liquid phase	When no data on treatment of fecal sludge: • If sewer connections are more common than on-site sanitation, faecal sludge assumed to receive the same level of treatment as sewered wastewater. • If on-site sanitation is more prevalent, no estimate is made unless data are available on fecal sludge treatment.

3.2 Data analysis

Analysis of household questionnaires

Data analysis for household questionnaires should follow standard practices and guidance for data processing and analysis used by the National Bureau of Statistics and international survey programs[xviii]. For example, the JMP has collaborated with the MICS to develop standardized syntax for analyzing WASH data and standard tables for calculating and reporting on the core WASH indicators used for global monitoring. The 2017 JMP methodology update provides a summary of methods used by the JMP to calculate estimates

[xviii] For example the MICS guidance on data processing https://mics.unicef.org/tools#analysis

from national data sources and the considerations for what data is accepted to make estimates was summarized in Box 5.

Some considerations for analysis of household data with regards to SMOSS:

- Accurate technology classifications are very important for analyzing household data as assumptions and pathways to safely managed vary depending on facility type (e.g. containment assumption varies for septic tank and pit latrine).
- Given that many household questionnaires and sanitary inspections fielded in the pilot countries included expansive questions on sanitation, it is important to clearly separate the core and nationally agreed expanded indicators in the assessment of safely managed services. Other questions will be useful to inform a broader analysis of the situation.
- Assumptions should be recorded and made clear when presenting results. In Indonesia the team even presented the probability that their assessment was accurate, including assessment of the likelihood of containment type and likelihood of functioning or leaking.

Analysis of other data sources

A challenge in the analysis of data for estimating SMOSS comes from the integrating or combining data from different sources. Data are often collected at different scales (household survey vs administrative), in different formats and may also present different findings (especially regarding emptying and disposal rates). While the integration of data was generally discussed in the JMP Methods Task Force [20], some specific considerations for analyzing non-household SMOSS data and integrating them with household data are presented below.

Sanitary inspection data: As inspections are not typically conducted on a nationally representative scale due to the time and cost involved, these data are most likely used to validate household responses or inform assumptions used in analysis. Some examples include:

- Validate household responses – where inspection and household response data are available for the same households, the inspection data can be used to validate the accuracy of household responses. Household self-reporting on various technical aspects of sanitation (e.g. the type of containment, whether there is an outlet to drain, proximity to wells) could be captured in parallel to an inspection of these systems and the variability in the responses analyzed to understand if there is a trend in what households report compared with inspections. For example, if in 30% of cases a household reported septic tank but the inspection classified it a wet pit, data from household surveys could be adjusted to reclassify 30% of septic tank responses as wet pits.
- Develop or confirm assumptions used in analysis – JMP estimates assume 50% of septic tanks and 100% of pit latrines that have not been emptied are contained. Inspection data could confirm or update these figures for the national conditions, or a sub-set relevant to the scale of the inspections. For example, inspections can be used to estimate the proportion of septic tanks and pit latrines which are leaking or overflowing waste to the surface environment and therefore classed as 'not contained'. Countries could also develop other assumptions related to expanded indicators. For example, if inspections assessed sludge depth or accumulation rates and containment volumes, they could develop a general assumption around a safe frequency of emptying.

Administrative data: Administrative data may be compiled from local governments or from service providers (via regulators) and usually refer to specific geographic areas or service areas. The methodological challenge is to integrate administrative datasets relating to geographic areas with household survey datasets relating to populations. It is important to consider how these datasets will be linked and analyzed upfront when

designing the different data collection methods to optimize possible integration. In developing the JMP methods the taskforce recognized there will be difficulties integrating and combining new data sources, especially when these cannot be linked to individual households and the facilities they use [20]. Some of the challenges and considerations include:

- **Integrating datasets** requires comparable indicators in both data sets to allow linking the data sets. For example, some household surveys asked the name of the provider who emptied their containment which could be linked to the logbooks for that provider and matched with data on the proportion of excreta collected which were delivered to and received treatment. While this is probably too fine detail for national analysis, alternatively the datasets could be linked by area served by different treatment plants or operators, requiring that the same administrative units are recorded in both data sets. Household surveys are typically designed to generate representative statistics for sub-national regions (admin 1) but rarely for districts (admin 2) or finer scales. The Ecuador team had prior experience in the integration of household and administrative water data and have a paper detailing these methods [21].
- **Defining service coverage** – A particular challenge for monitoring sanitation is scaling up data from individual treatment plants or emptying providers to estimate the population covered by services. For water supply or wastewater service provision the service area and frequency of service are relatively clearly defined by infrastructure boundaries and consistent daily services. For on-site sanitation, there is more uncertainty on which area is served as there can be multiple providers serving different or same areas of a city or crossing administrative boundaries to empty or deliver excreta (e.g. sludge emptied in rural areas may be delivered to urban treatment plants). Frequency of provision is also uncertain, as most containments do not need to be emptied every year and therefore the frequency of emptying needs to be considered in analyzing annual emptying or treatment data.
- **Aggregating data for rural, urban and total populations -** Nationally representative data may be generated from sector information management systems, or from nation-wide local government surveys such as those conducted by Serbia and Ecuador. However, data are often only be available for a small number of service providers and therefore represent only a sub-set of the population. Decisions need to be made whether or not data from a sub-set of local government units or service providers could be expected to apply more broadly. The JMP will generally only include datasets in its database when they represent at least 80% of the population of interest [7].
- **Alignment and reliability** of the data with JMP definitions and methods needs to be considered when assessing whether a secondary or administrative data source can be used in JMP estimates. A challenge with secondary data from different sources is potential inconsistency in definitions, terminology or methods applied that makes comparison with JMP definitions difficult [22]. The JMP suggests that if information from small studies or those conducted by academic institutions or NGOs is to be incorporated into estimates, the data should be verified with the national statistical office [20].
- **Validating or comparing between sources** may be an objective of analysis, particularly to clarify whether household self-reported responses on the service chain (e.g. emptying methods, location of disposal) align with administrative or secondary data.
    - One easy example of validation would when administrative data indicates a complete absence of service in an area, and therefore household survey estimates for that area can be adjusted (i.e. no safe FS treatment or no sewerage system in rural areas). Validating specific household responses may be possible for areas where survey data could align with detailed databases on containment and emptying such as those developed in some cities for scheduled emptying.
    - Validating must consider the dates when the two data sets were captured and make assumptions of how actual difference could be expected between these times.

- Validating requires an assumption of which data source is considered the more accurate to base updating inconsistent findings. In most cases household data are given priority regarding the type of sanitation facility used and emptying practices, while administrative data would be considered more reliable for assessment of off-site sanitation services (e.g. conveyance, treatment).
- An important consideration during communication of results from surveys is the notion of "official government sources of data". For example, it is not unusual for line ministries to prefer administrative data for indicator calculation and to view household surveys as a secondary source. On the other hand, National Statistical Offices may have reservations about the quality of administrative data. Since discrepancies between the two sources of data are common, it is important for National Statistics Offices and line ministries to agree about which data sources are considered most reliable to use as official statistics for each step on the sanitation chain. The National Statistical Office is the ultimate authority about which data sources should be considered and used for international reporting on the SDG indicators [23].

Box 8. Assessment of inequalities in SMOSS

INEQUALITIES RELATED TO SAFELY MANAGED SANITATION

Given the SDG goals include several targets that aim to progressively reduce inequalities related to WASH it is important to be able to monitor inequalities related to safely managed sanitation. The 2030 Agenda specifies that 'SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location or other characteristics. Governments are expected to determine the most relevant dimensions of inequality in WASH services and develop mechanisms to identify and monitor the situation of disadvantaged groups. 'Leave no one behind' implies that in addition to tracking overall rates of progress governments should also focus on closing the gaps in services between disadvantaged groups and the rest of the population [13].

Although assessment of inequalities is feasible for open defecation and access to basic services, so far assessments of inequalities in access to safely managed services have been limited to the urban and rural differences. While household questionnaires could be used to explore aspects such as unequal exposure to unsafe releases (e.g. household and cluster level analysis of unsafe containment and unsafe disposal in situ), or if integrated with administrative data could provide some information on inequalities related to emptying and treatment offsite, exploring other aspects would require new or additional types of data. Some areas that require consideration in analysis of inequalities in access to SMOSS are:

- Who is negatively impacted at different steps along the sanitation chain?
- Inability to access emptying and treatment services
- Inequalities in exposure to unsafe releases

4 Synthesis of lessons from pilots

4.1 Summary of each pilot

The table below summarizes the methods of data collection conducted by the pilots and the relevant steps of the service chain that this informs. The final column indicates the areas that may be built upon for national monitoring or may be useful to apply in other countries.

Table 24. Summary of pilot country key activities

Country	Toilet	Containment	Emptying	Transport	Treatment	Methods and tools	Promising methods for integrating into routine monitoring or Phase 2 pilots
Bangladesh						• Nationally representative household surveys (n=3149) including sanitary inspection(n=959) conducted by UNICEF volunteers.	• Integration of inspections in household survey • Intensive online support to enumerators.
Ecuador						• Additional emptying and treatment questions added to national online survey of municipalities (SNIM, n=221) • Included SMOSS questions in existing household survey. • Plan to conduct dedicated surveys of household, schools and health care facilities.	• Approach to including questions in different existing surveys and administrative data collection • Collaboration with bureau of statistics • Survey training videos
Indonesia						• Household sanitary inspections pilots ongoing, so far 500 households surveyed by local health inspectors. • Included inclusion of JMP core questions in national water quality survey (n= over 20,000)	• Inspection tools and means of implementation • Means to integrate questions into national surveys
Kenya	Plan to conduct across full service chain					• Policy analysis, assessment of existing monitoring tools and data and a stakeholder workshop. • Dedicated household survey including inspections • Focus group discussions with sanitation service providers and county government officials	• TBC – findings from dedicated survey
Serbia						• Policy analysis desktop tool • National online survey of local government units and public utility companies (n=75) to assess service provision, management and regulation of emptying, transport and treatment • Dedicated nationally representative questionnaire and inspections of households, rural schools and rural healthcare facilities (n=1560) by public health institute staff.	• National survey of local governments and service providers to assess emptying, transport. • Policy analysis tool • Sampling method for household survey
Zambia						• Nationally representative household and institutional survey (n=23,000) implemented by environmental health inspectors. • Develop OSS data base (hosting & retrieval).	• Engagement and training of health inspectors to implement survey • Coordination with regulatory monitoring

4.2 Synthesis of lessons from SMOSS definitions, indicators and data collection methods

Definitions, indicators, and national priorities for monitoring SMOSS

Pilots built understanding and awareness about safely managed services and the importance of monitoring SMOSS. Although at the time of writing not all pilots had finished data collection and analysis, considerable progress has already been made to increase national and international understanding of approaches and considerations for national SMOSS monitoring. At a national level, there was a varied level of initial awareness and consideration of SMOSS in national policies and monitoring, with many still focused on toilet access aligned with the MDG targets, and only a few which had already included safely managed targets in national policies. The pilots conducted national workshops which raised the awareness about SMOSS and the gaps in current monitoring to a broad stakeholder group. These workshops also identified national priorities, that even if not yet documented could be included in the data collection. For countries without current estimates of safely managed sanitation, the national scale data collection will provide an initial assessment of SMOSS (Kenya and Zambia), while findings from other countries will support prioritization of future monitoring efforts. Pilots collected data including and beyond the core questions, such as on behaviors, preferences and challenges in sanitation use and service provision, which informed their recommendations on steps to progress safely managed sanitation services, not just monitoring.

Choice of expanded indicators to inform country context specific monitoring yet all countries should be able to report on the core indicators for global monitoring. While the definitions and assumptions about the core indicators and assessment of safely managed on-site sanitation have previously been documented in JMP reports, these were not always clear for the pilots. This synthesis highlights that monitoring of SMOSS should achieve the parallel objectives of data that informs national and sub-national policy and practice as well as being able to report against the harmonized indicators used in global monitoring (see

Box 1). As national data needs may differ from the core indicators, expanded indicators are often included taking into account national contexts, capacities and levels of development, and respecting national policies and priorities [9]. These can include either the expanded questions proposed by JMP [4] or questions specific to national targets or priorities. Expanded indicators that are needed to monitor national sanitation targets or priorities as identified in the stakeholder workshops included: emptying frequency, more nuanced definitions of pit latrines, and questions to allow analysis of inequalities such as wealth or disability. Most pilots are still to define which minimum set of expanded indicators are critical for routine national monitoring and which might be collected on an ad hoc basis.

National indicators and definitions for monitoring SMOSS are highly variable, and there is a need to improve clarity on what to measure and monitor to report on the SDG global indicator. Assessments of existing monitoring tools identified that questions or response categories are not clearly harmonized with the global JMP indicators which results in inefficiencies in analysis and reporting and a disjoint between what may have been presented from national analysis and the data that the countries and JMP team agree on for their national SDG estimate. A greater harmonization of national monitoring and reporting with the JMP indicators and categories will improve the alignment of estimates so that local and national stakeholders can make better use of global monitoring data, and vice versa. Standard questions, as suggested by the JMP guidance, or those included MICS or other surveys that align with the JMP, could help harmonize this data. Various pilots noted that it was difficult to update indicators in national surveys as these were conducted

infrequently (i.e. every 3-5 years) or had limited engagement with technical ministries or opportunities for input. Below are examples of possible misalignment or discrepancies in indicator definitions and Annex Table A4 highlights the variability in household questions and response categories between pilots.

- Categorization of sanitation facilities in line with national definitions were sometimes more strict than global definitions. For example, some facilities were directly categorized as hygienic latrine or improved latrine considering cleanliness, superstructure and other categories not considered in JMP's improved definition. Alignment would be easier if the question was split into two, the first on facility type aligned with JMP categories, and another expanded question to assess against national criteria.
- Slight changes in wording can affect the interpretation of the question. Such as the survey conducted in Zambia which asked "*Has your pit latrine or septic tank ever been emptied?"* in the urban questionnaire but asked "*When the pit latrine is full how do you dispose of the excreta?"* in the rural questionnaire. This rural question is more of a hypothetical question and doesn't capture the current emptying practice. Again, analysis is simplified if it is split into two questions, the first as per the urban questionnaire and the second on how the excreta was disposed if the containment had ever been emptied. Questions about both septic tanks and pit latrines can be asked in both urban and rural areas.
- Translation challenges are also apparent in the more technical assessments, such as is required for containment. While there might be nuanced differences and intended assessment in use of the words around contents (e.g. excreta, sludge, effluent, wastewater) or about discharges from containment (outlet, effluent, overflow, leaking) the direct translation of these may not always be evident or commonly defined nationally. For example, the question in the ENEMDU survey "*Where does the waste from septic tank or pit end up? a) Some open place, b) Remain in the tank/pit, c) Another place but not open site*" may refer to the emptied sludge, the overflow or just the initial containment. Questions should be designed so that they clearly refer to either the liquid fraction (e.g. effluent lines, overflowing) or solid fraction (e.g. emptied sludge).

Lessons from monitoring across the service chain

The below table highlights some of the lessons from pilots on aligning definitions and monitoring across the service chain. An outstanding step for all countries is to recommend which core and expanded indicators should be included in routine national monitoring of SMOSS.

Table 25. Lessons on definitions and monitoring across the service chain

Containment	• Discharge of septic tanks to the environment was the priority indicator in assessing containments in Bangladesh, Indonesia and Serbia, and is a critical element for the global SDG indicator. Many so-called 'septic tanks' don't connect with leach fields or soak pits, and discharge effluent directly to the environment. • Expanded indicators which were prioritized in some countries included the proximity of on-site containments to groundwater resources, and accessibility for emptying. However, the final list of critical expanded indicators has not been specified. • Assessments of containment were incorporated directly into the indicators of facility type in Indonesia and Bangladesh, making analysis of core JMP indicators difficult since in most datasets the assessment of improved facilities does not consider containment. • In some cases the wording of questions on discharge to environment (containment), emptying and disposal on-site were unclear and these questions are better separated to increase clarity, particularly with translations risking to further modify meanings. • The Indonesia pilot highlighted that even with inspections it was not always feasible to assess containment types since many were located under the house or couldn't be

	opened and introduced a scale of likelihood that their assessment was correct (e.g. septic tank, most likely septic tank, somewhat likely septic tank). • There was a low acceptance rate of inspections inside containments (20% households Bangladesh, 7% in Indonesia) and opening was difficult for single enumerators.
Disposal in-situ	• Only Zambia assessed whether emptied excreta were disposed of in a "covered" pit, Serbia and Ecuador included various options but it's not clear if any can be considered a covered pit, while Bangladesh focused on disposal location (distance from house). • Bangladesh and Serbia asked a specific question to determine whether households built new pits or switched to an alternating pit to capture non-emptying management practices of full pits.
Emptying	• Pilots captured data on many expanded questions about emptying practices, which are not required for the global indicators, but were seen as an opportunity to better understand the practice and not all will be used for routine data collection. • Indonesian national targets and service standards require consideration of emptying frequency and age for the national definition of safely managed. The Indonesian inspection tool assessed different conditions (sludge depth, containment volume) which may inform national debates around this regular emptying objective. • Sludge depths were captured in Indonesia, Serbian and Bangladesh surveys however it is unclear how the data are used in analysis or the response rate to understand if this question is useful. • There were gaps in data collection on emptying in rural areas: rural surveys in Zambia did not assess if containments had been emptied; Bangladesh only conducted FGDs for urban emptying providers despite the similar demand in rural areas (28% of rural households vs 34% urban households reported having their containments emptied by sanitation workers); and the Indonesia indicator of emptying every 5 years may be unsuitable to rural pit emptying practices.
Transport and treatment	• Self-reporting from government or service providers in administrative surveys could result in inaccurate or absent responses due to taboos around reporting unsafe practices, or high non-response rates (Ecuador, Serbia). • Local government or municipality surveys questions did not include assessment of the level of treatment for liquid and solid streams or other questions around function. Further refinement of suitable questions for administrative surveys is needed to assess off-site treatment of both solid and liquid fractions. • Although data have been collected, pilots are yet to fully analyze the data or integrate them with household findings to inform estimates. • Spot check or confirmation of disposal and treatment has been suggested to overcome gaps in administrative data but has not yet been tested by any pilot. • It remains unclear whether the administrative data and surveys include the complete emptying, transport and treatment services, particularly those that are private, informal or in rural areas. • Household questionnaires included many indicators on transport, disposal and treatment, however these are considered low accuracy data sources for the community scale services.

Data gaps and methods for complete and representative monitoring of SMOSS

National data sources on SMOSS are often incomplete and not fully representative of the population using on-site sanitation systems. The assessment of existing monitoring (section 2.2) identified that existing data sources do not cover emptying, disposal or treatment and some only partially cover containment. Regarding household surveys, pilots reported that some national survey questions on sanitation have not been updated

for some time and do not align with current JMP indicators, and for Kenya the 2019 census also didn't align with the 2017 national sanitation targets. Major gaps exist with regards to non-household data and only Ecuador had nationally representative administrative data on emptying and treatment service provision, however treatment data typically refers to (sewered) wastewater treatment which may or may not have data about quantities of sludge treated.

Gaps in data on sanitation services are at times linked to gaps in formal service provision and regulation. As data and regulation play a central role in improving these services, particularly for the emptying, transport and disposal of sludge, developing standard national approaches could create new administrative data sources for SMOSS. In Indonesia, the pilot is supporting the Ministry of Public Works to assess how city databases on emptying and tracking of trucks can be compiled to inform national estimates. However emerging administrative FSM data are often not representative of all service delivery methods, such as informal or manual emptying providers, and typically do not include service provision in rural areas. Formalization or associations of private pit operators in rural areas is not common and, as was found by the Bangladesh pilot, makes collecting data from these groups difficult. At present household surveys have been the main source of data on rural FSM practices.

Effective monitoring of SMOSS requires integrating data from multiple sources including households, service providers and local government to address all steps on the service chain. From the gaps noted above SMOSS monitoring cannot rely on household surveys alone. As shown in Table 26 reliable answers from household surveys and inspections are limited to toilet facility, containment, and parts of the assessment of emptying or disposal practices. The pilots tested a range of data collection methods with a summary of lessons about these methods summarized below. Spot checks or inspections of the non-household elements of the service chain were not tested in any pilot, however the WHO guidelines for sanitation and health recommends these would be valuable to validate service provider reported data, such as that provided in administrative data or surveys. This is an area for further development as suggested in section 4.4 below.

Table 26. Summary of lessons from pilots on methods and data sources

Household surveys	• The Bangladesh and Serbia pilots considered their surveys too long as they included an extensive number of expanded indicators and many additional questions of general interest to the survey team or stakeholders. While the extensive list was useful for understanding the broader picture of sanitation, a condensed list of questions limited to those that specifically inform the analysis of SMOSS was suggested if these questions were to be routinely included in national surveys. Integrating into existing multi-topic surveys would allow mean the general questions useful for disaggregation are already included. • Enumerators were either staff from the public health department or volunteers (see Annex 1 Table A1) and had a range of previous education and knowledge about sanitation. Training by experts was necessary to help enumerators understand the differences between sanitation facilities and assess aspects of safe containment. Ensuring adequate training and capacity when the questions are integrated into mainstream surveys, often conducted by more social trained enumerators, was a concern (see section 4.3). • Priority to piggy back on multi-topic surveys as sustainable for ongoing monitoring and cost efficient. Challenge that these are often large questionnaires and it can be difficult to include many additional questions. The frequency is often only every 3-5 years • As noted above and shown in annex, question wording and response categories vary and harmonization with global standards would be useful. Related to this is the need for thorough pilots of survey tools to test the understanding and clarity of questions. It's also recommended to use fewer open-ended questions, or 'select all that apply' type questions, for easier and more accurate analysis.

Household sanitary inspection	• Need to streamline questions to have a small robust set that can be used by enumerators with little skilled background and suitable for a range contexts. For example the Indonesia pilot recommended that household sanitary inspections should be reduced in length, suggesting less than 15 minutes, focusing on the priority questions to inform the core indicators. The scope of these questions is still to be refined and further simplified if they are going to be conducted by health extension workers or integrated into multi-topic household surveys. Another outstanding question is whether inspections are required of both the toilet and the containment, or if the toilet may be too personal and risk low acceptance. • It is also yet to be determined whether the enumerator conducting the inspection requires specific technical skills, or whether typical enumerators with adequate training and clear methods (e.g. objective observation questions) or tools (e.g. inspection guides with photos or visual) is can provide sufficiently accurate responses. Simplification would increase the opportunity for sanitary inspections to be conducted by community health workers or integrated into existing multi-topic household surveys enabling large scale data collection. Future pilots could test this by making duplicate assessments with differently skilled enumerators. It was also noted that even the capacity of sanitarians or public health staff to understand and assess SMOSS should not be overestimated and they still require training. • Further guidance is needed on how to analyze and draw conclusions from the data, which is also linked to guidance on suitable sampling strategies. For example, in the future it would be valuable if the data could be analyzed to assess the difference in response rate between inspections and household questionnaire responses to better understand the accuracy of inspections over questionnaires. This information may eventually be produced by the Indonesian and Kenyan pilots. This may also inform the sample size suitable for inspections at scale or specific conditions in which inspections increase the accuracy. • A good sanitary inspection should also link to enabling remedial measures to fix failing toilets/containment, either for follow up by the household or local authority. Links between the monitoring and sanitation programs are important. In Indonesia for monitoring open defecation the sanitarians typically provide support to household to improve their sanitation, this could be expanded to support improvements in SMOSS.
Administrative data and local government surveys	• **Existing associations supporting local government units or municipalities** provided an efficient means for the distribution of surveys in Ecuador and Serbia. These associations were reputable and had direct connections with participants to manage the survey however both pilots noted that distribution through a third party meant they couldn't provide direct support or training to help completion of the surveys. Ecuador is considering whether links to videos could be used to improve the municipalities' understanding of the objective of reporting and explain the data required. • **Low survey response from local government** was a key challenge for both pilots, with 50% responding in Serbia and low response rates for some questions on emptying in Ecuador. Low survey response may have been due to it not being obligatory, respondents not having the available data, or, as was expected by both pilots, that questions were skipped or the survey not completed when practices were unsafe. For example, in Serbia there were many non-answered responses to the question of sludge discharge, which is expected to be due to very few treatment plants and it is common that sludge is dumped in rivers, yet as this is known to be "taboo" respondents did not answer the question. This also leads to the question of accuracy of self-reporting by governments particularly if there are perceived repercussions for unsafe practices. Recommendations to improve the response rate and accuracy of administrative data included: a) Build understanding of value of accurate reporting and b) validate responses with spot checks for a sample of locations.

- **Integrating data from different sources** to estimate safe management of sanitation along the sanitation chain requires that administrative or survey data can be paired with household scale data through a common data point, such as administrative unit. At the time of writing none of the pilots had aggregated data sets, however the Ecuador team has previous experience with integrating administrative data on water supply with household water data based on municipality and source of water.

4.3 Lessons and outstanding questions for scaling up and integrating SMOSS into routine monitoring

Methods should update or expand on existing data collection systems where possible.

The dedicated surveys conducted by the pilots were valuable to refine indicators and test methods prior to scale up, ultimately it is intended that monitoring of SMOSS is integrated into existing data collection systems. To enable systematic and consistent monitoring over time, integration of the methods developed by the pilots within existing data collection systems can benefit from ownership within a ministry, existing systems for reporting and data use, skilled staff for collecting and analyzing data and budget allocation. Integration into existing monitoring efforts was tested in Indonesia national households water quality survey and Ecuador's national employment households survey and administrative data collection through an annual national survey of municipalities, see Table 27Table 27. The ability of these pilots to directly integrate questions included the prior engagement and support of national data collection efforts by the pilot teams, clarity of data collection responsibilities for sanitation in both countries and the opportunity that surveys were occurring during the pilot. Infrequency of national surveys and the difficulty of integrating multiple or untested questions in national surveys was a barrier for other pilots, particularly as many surveys in 2020 and 2021 were reduced due to COVID-19 restrictions.

The tables below provide examples of how the pilots adapted existing data collection systems to monitor SMOSS, as well as their limitations and plans for national monitoring in the future.

Table 27. Examples of integration into existing national surveys

Country	Data collection system	Benefits	Limitations
Ecuador	ENEMDU (Employment survey 2016 and 2019)	- Survey conducted frequently (every 3 months) therefore able to include within pilot timeframe - Existing module on household allowed SMOSS questions to be added	- Disaggregation and analysis for inequalities less suitable due to employment focus of survey. - Surveys were cancelled or reduced in scope due to Covid which limited opportunities to include new SMOSS parameters in existing national surveys
	National System for Municipal Information (SNIM) 2019	- Annual data collection and able to integrate new questions	- No scope for providing training or support to survey respondents - Survey tool did not allow skipping of questions which led to low completion rate as it is expected some municipalities did not have the data to answer all sections.
Indonesia	National water quality survey	- National scale - Content is related	- Further training on assessing sanitation facilities and educating on what is safely managed sanitation

		- Able to add multiple questions more easily than Susenas	- Data management and addressing quality issues
	National socio-economic survey (Susenas)	- Nationally representative - Conduct regularly (annual basis) - Relatively good data quality as managed by BPS (national bureau of statistics) - Able to analyze the data with other relevant information such as wealth etc.	- Limited capacities of enumerators (non-WASH) - Limited additional question space due to a full list of existing questions - In general, relies on self-reporting
Kenya	Performance Monitoring and Accountability WASH Questionnaire – Pilot considered integrating but ultimately not suitable	- Multi-country, nationally representative survey, previously tested a set of questions to evaluate household FSM practices.	- Survey now shifted focus to a longitudinal study of family planning for a smaller sample and FSM questions no longer included.

Table 28. Plans for integration within existing data collection systems

Bangladesh	- A newly formed CWIS-FSM support cell within DPHE can develop national and local level SMOSS monitoring protocols and is best positioned to monitor and track progress of National SMOSS situation. - Suggest engineers should be part of the training and quality assurance if SMOSS questions are to be included in the upcoming national census.
Ecuador	- In place of inclusion in the ENEMDU survey the team hopes that WASH questions can instead be included in a national nutrition survey that is currently being updated and conducted annually as nutrition is currently a national priority. - Another round of SNIM surveys was conducted, the scope of SMOSS questions may have been reduced due to covid restrictions. The team plans to continue to update this tool and is considering developing training videos or other means to improve response rates. - Supporting the inclusion of SMOSS questions in a national WASH in schools survey, including providing training videos to support the enumerators
Indonesia	- Ministry of Health, through local sanitarians, implements routine household sanitary inspections as part of the national community-based sanitation and hygiene program (known as STBM). This is currently being updated and the pilot is supporting inclusion of SMOSS questions and alignment of definitions with national targets and JMP indicators. The pilot plans to provide support for survey training, such as short videos. - Following findings from water quality survey the team will recommend questions for inclusion in the national socio-economic survey.
Kenya	- Uncertain if questions could be included in national surveys as the future plans for these are unknown. - UNICEF is planning to expand monitoring beyond CLTS, yet this is only in rural areas. SMOSS Kenya team is working with the Real-Time Monitoring and Information System (RTMIS) in the meantime to ensure consistency of indicators and definitions. - There is opportunity to improve definitions within the national census to align containment types with JMP definitions - There are plans in Kenya national policies to create a national sanitation coordinating system for monitoring of WASH (known as NESCRA) that may be able to uptake management of SMOSS indicators
Serbia	- Plan to explore options with National Statistical Office to include SMOSS questions in national household or service provider surveys. - No national responsibility for sanitation to coordinate routine collection of local government sanitation data. Leveraging from the facilitation of the survey through the NGO, there is potential that a sanitation topic could be included in the NGO's annual conference where LGUs come together.

	- For schools and health care facilities, national public health institute staff conduct surveillance of sanitary conditions, which could be expanded to include OSS questions. Coverage of this survey is not 100% for each year as it depends on the capacity of IPH staff and financial resources.
Zambia	- National Water Supply and Sanitation Council (NWASCO) are supporting implementation of household surveys by two large Water and Sewerage Corporations (WSC) which include questions on sanitation access and containment. They also collect data on wastewater treatment plant performance which may include data on fecal sludge. Now that WSCs responsibilities include rural areas the survey could also be expanded in the future. - The developed tools on SMOSS to be integrate in the existing MoH- DHIS2 tool by the environmental health officers and other line Ministries and stakeholders - To develop action plans at national, provincial and district levels to monitor and routinely collect data on sanitation for all service areas (Rural, Urban & Institution).

Roles and responsibilities for collecting, aggregating, and reporting data on SMOSS need to be clarified and regulatory coverage may need to be expanded to include rural areas and informal systems.

The stakeholder mapping and assessment of regulations was an important first step in the pilots to assess the regulations and enabling environment to determine who is responsible for service provision, regulation and monitoring of SMOSS. A common challenge for SMOSS is that responsibility is often fragmented, either between parts of the service chain or between urban and rural areas. However, through stakeholder engagement and workshops most pilots were able to identify who was best suited to lead ongoing monitoring efforts, particularly if they were already conducting existing monitoring activities.

In Indonesia and Ecuador, the responsibilities for monitoring by different agencies were already defined, however required some clarification for covering the expanded aspects needed for SMOSS monitoring in both urban and rural areas. For example, the Indonesian Ministry of Health (MoH) is responsible for monitoring open defecation and toilet access, predominately in rural areas. However, they have agreed to expand their scope to also assess containment, which is a technology and the responsibility of the Department of Public Works (PU). While the importance of responsibility for sanitation in rural areas is expanding, such as the recently expanded scope of Zambia Water and Sewerage corporation, it is likely that much administrative data focuses on urban areas and particularly those with existing sewage systems and may not capture rural practices. In Ecuador while the municipal boundary includes rural areas, the data is focused on urban and peri-urban services. Other data, such as ARCA's systems for monitoring water supply in rural areas, could also be reviewed to better assess SMOSS. Associations supporting or coordinating private or informal pit emptying providers are also more common in urban areas and there remains a gap in methods to systematically collect data from rural emptying providers.

Limited incentives and budget are some reasons that stakeholders do not agree to lead monitoring efforts, even when they are identified as being responsible in legislation or most suitable to take this role. While the various actors in the Kenya stakeholder workshop agreed to the benefit of increased SMOSS monitoring, none were willing to lead. In Serbia there is a lack of legislation or a national body responsible for water and sanitation utility companies, without which data collection is likely to be ad-hoc. While responsibilities were clearly identified in Ecuador, including agreement with a Memorandum of Understanding (MOU) between actors, a change in government has meant these roles require renegotiation as priorities have changed. An incentive to increase data collection may be that such data are required to release certain government budgets, especially where specific budget lines, funding windows and expenditure codes for sanitation at central and local government levels have been established. Part of these budgets should be assigned to cover the costs of monitoring [4].

Establishing and expanding systems for routine monitoring of SMOSS will require investment in in national data collection systems and capacity building and training at all levels.

Linked to the responsibility is the capacity to collect, analyze and use data, as well as financing of building and implementing these systems, particularly if monitoring can't be integrated into existing systems. Integrating of SMOSS data collection into existing monitoring needs to consider the capacity of the enumerators to accurately collect sanitation data, particularly if inspections are included. This will inform the design of methods and tools, as well as what training, supervision or quality assurance measures may be needed. Adequate training of enumerators was a priority for all pilots and suggested that technical staff with sanitation knowledge are present in training or remote support is provided such as through training videos. WHO suggests that where non-specialist staff are involved in data collection it is important that environmental health staff assist with enumerator training, including some supervised fieldwork, to ensure that the basic concepts are understood and improve consistency [3]. The pilots benefited from predominately skilled enumerators with both Serbia's Public Health Institute staff and Bangladesh's UNICEF volunteer enumerators reported to have a strong background knowledge and training in sanitation. Capacity building and support will be required at all steps of the data collection, analysis and reporting with survey design, question refinement and data analysis all areas where support was needed in the pilots.

Finance a common concern for scaling up monitoring, particularly when the national responsibility for monitoring is not evident or agreed upon. Even in Ecuador with clear responsibility, budget cuts meant that not all sanitation questions could be included in the latest survey. The pilots noted that the pilot budget permitted detailed data collection, at different scales, yet this level of finance is likely greater than could be requested for ongoing monitoring and therefore the tools tested would need to be reduced for scale up. The frequency of data collection will also affect budget and some countries noted that they were not yet clear how often detailed SMOSS monitoring, such as inspections, would be needed. Where possible, integrating SMOSS into existing monitoring systems, would minimize the additional cost. These systems could be existing monitoring systems for open defecation, such as was implemented in Indonesia, or multi-topic country surveys as was implemented in Ecuador.

4.4 Recommendations for phase 2 pilots

A preliminary assessment of recommendations and gaps for phase 2 monitoring is shown below. This will be further developed during workshops with phase 1 pilots and an expert global panel.

Recommendations

- Phase 1 pilots were exploratory and focused more on understanding the challenges associated with monitoring SMOSS. Phase 2 pilots need to have a stronger focus on developing recommendations for integration of new questions and indicators within existing monitoring systems including technical feasibility, logistics and cost implications.
- Phase 1 pilots used a range of resources to inform questions. For improved harmonization and clarity of data a draft set of recommended questions and indicators informed by Phase 1 pilots should be developed to be further tested and refined by Phase 2 pilots.
- Phase 1 pilots focused more on in-depth assessment of specific aspects of sanitation chain. Phase 2 pilots need to have a stronger focus on combining data sources on different aspects of the sanitation chain and how to achieve representative data (i.e. rural or private emptying, transport and treatment services).

- Phase 1 pilots all recommended cutting back survey and inspection questions and length as most focused on understanding the situation and found the surveys too long for both the implementation and the respondents. Going forward pilot countries indicated they would identify a set of “necessary” questions that address core indicators and a minimum set of “nice to have” expanded indicators. One approach could be to collect a small set of necessary indicators at scale, and a larger set of indicators in smaller, possibly qualitative, assessments targeting specific populations or geographic areas.
- Designing the Phase 2 pilots to assess specific gaps may require specialist support such as designing a rigorous sampling strategy, more detailed data analysis and reviewing the outcomes of pilots, or experts that understand the language and context to support the alignment or testing of definitions and wording of questions. Guidance on sample design (scale and frequency)
- Given the importance of training enumerators to improve quality of surveys and inspections, it was recommended to consolidate training materials for core indicators and questions which can then be adapted to suit local contexts and terminology.

Gaps

- Transport, treatment and disposal remains a major gap in data and in methods for collecting data for both urban and rural areas.
- Service chain inspections and spot checks have not been tested and it would be useful to pilot the WHO Emptying and Treatment service provider survey, including testing of different approaches to identifying and sampling providers and collecting nationally representative data and how the data will be used.
- Administrative data remains the key method for national data on emptying, transport and treatment services however there remain few examples of its availability for on-site sanitation. Further efforts are needed to identify administrative data or conduct local government or service provider surveys and testing of measures to improve quality assurance and methods of analyzing and using the data to inform estimates. Further efforts are needed to ensure that all service methods (i.e. private services) and service provision in rural areas are captured in this data.
- Inspections would benefit from further research on their benefit over household self-reporting, including whether this varies with context or facility type. Further refinement of the minimum required set of inspection questions, the frequency and sample size of conducting inspections, and assessment on how different enumerator capacity or training can ensure quality data is collected.
- Although estimates for safely managed services are only assessed for households already with basic access, it is valuable to understand the extent to which containment and emptying and disposal practices differ between households with basic, limited and unimproved services. Further research and methods are also needed to identify how inequalities in access to safe service levels can be collected and analyzed.

Table 29. Knowledge gaps and next steps identified by pilot countries

	General gaps	Country specific gaps	Next steps
Bangladesh	- Structured observation / inspections for rest of service chain (emptying, transport, treatment)	- Emptying and treatment - Data from institutions (educational institutions, health care, public facilities and commercial places) - Insufficient administrative data on safely managed sanitation service chain	- Divide questions into mandatory (latrine super and sub structure), secondary (emptying, transportation and in-situ disposal) and tertiary (treatment, disposal and reuse) to clarify what questions are most needed
Ecuador	- Budget for ongoing surveys - Frequency and number of additional questions needed - Analysis of administrative data with household data	- Private sector emptying, when go in field it will be something to look further. - Further investigation/analysis of 2020 data to understand reasons for no responses to SNIM survey - Require support to improve question design and analysis to avoid conflicting responses	- Still to conduct household & institution surveys - Engaging with World Bank about integrating questions into nutrition survey - Review 2020 SNIM data and revise if issues remain
Indonesia	- What scale do inspection tools need to be implemented to be statistically representative at scale?	- How rural sanitation can be assessed relative to the defined SMS objectives at national level - Septic tank definition based on self reporting remains unclear and requires further efforts to assess containment. - Consider how to use inspection to address limitations of grouping all containment as septic tank - Capacity building efforts for sanitarians to be continued, including providing technical advice to improve containment after inspection.	- Integrate the on-site sanitation inspection tool into national sanitation programme monitoring with MoH - Review results from Water Quality Survey and refine questions to propose for national household survey - Review existing FSM apps with Public Works to explore opportunities to make the best of administrative data - Produce a training video for sanitarians - Develop a proof of concept for comprehensive safely managed sanitation data collection (i.e. combination of inspection tool data collection, local government data and administrative data) at provincial level to be scaled up
Kenya	- Reliable data from emptying and transport segments of value chain - Quality and analysis of administrative data	- Determining the frequency of data collection, noting changes may be fast with current rate of urbanization towards informal settlements and slippage associated with CLTS campaigns - Decentralization of services is transferring responsibility	- Conduct data collection in partnership with Sanivation (Kenya-based organization) - Analyze and validate data with key stakeholders - Identify the most promising pathways for uptake of SMOSS indicators into a routine monitoring system

	General gaps	Country specific gaps	Next steps
		from national to county level government, resulting in gaps in authority to enforce standards	
Serbia	- Recommendations for routine monitoring of SMOSS: What frequency of data collection is needed, noting that changes in sanitation are not fast? Annual probably excessive. - Treatment plant assessment - Pilot agreed checklist in selected areas and refine accordingly - Human resource and technical capacities for undertaking a routine monitoring system of SMOSS	- Need strengthened legislation and a national body responsible for W&S public utility companies - Routine monitoring of on-site sanitation practices does not exist and there is not a legal basis or responsibility for it. A first step will be to amend legislation with a clear definition of roles and responsibilities for monitoring of SMOSS. To be discussed at the national sanitation workshop September 2021.	- Compile developed methodological tool into a national methodology for on-site sanitation surveillance - Select and agree on a list of indicators from developed tools that fits to the framework and scope of setting up future monitoring system - Discussions with national statistics to include questions in census and questions for service providers in public utility company surveys - Liaise with the network of local self-government units led by the Standing Conference of Towns and Municipalities for raising awareness on the need for establishing local registers on SMOSS
Zambia	- Consolidate the national data collection tools into one which is easily accessible	- Methods to assess rest of service chain (emptying, transport, treatment) including in rural areas - Review current legislation and integrate - Regulation and standards for faecal sludge management including its handling and reuse);	- Harmonize the developed tool into a national data collection tool for on-site sanitation surveillance - Agree on a list of indicators from the developed tools and produce a framework for national determination of OSS - Discussions with national statistics to include questions on sanitation in future national census

References

[1] WHO and UNICEF, "Progress on household drinking water, sanitation and hygiene 2000-2020: Five years into the SDGs," World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), Geneva, 2021.

[2] J. Bartram, R. Luyendijk, R. Hossain, M. Fisher, B. Gordon, T. Wardlaw and C. Brocklehurst, "Global Monitoring of Water Supply and Sanitation: History, methods and future challenges," *IJERPH ,* vol. 11, pp. 8137-8165, 2014.

[3] WHO, "Guidelines on sanitation and health," World Health Organization, Geneva, 2018.

[4] UNICEF and WHO , "Core questions on drinking water, sanitation and hygiene for household surveys: 2018 update.," United Nations Children's Fund and World Health Organization, New York, 2018.

[5] R. J. R. M. F. C. C. &. S. T. Bain, "Establishing sustainable development goal baselines for household drinking water, sanitation and hygiene services," *Water,* vol. 10, no. 2, p. 1711, 2018.

[6] WHO and UNICEF, "Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines," World Health Organization and the United Nations Children's Fund, Geneva, 2017.

[7] UNICEF and WHO, "State of the World's Sanitation: An urgent call to transform sanitation for better health, environments, economies and societies.," United Nations Children's Fund and the World Health Organization, New York, 2020.

[8] UN Water, "Monitoring water and sanitation in the 2030 agenda," UN Water, Geneva, 2020.

[9] UNICEF, "Guidance for Monitoring Menstrual Health and Hygiene," United Nations Children's Fund, New York, 2020.

[10] The Sanitation and Hygiene Fund, "Safely Managed Sanitation Services in the Global Sanitation Fund," The Sanitation and Hygiene Fund, Geneva, 2020.

[11] I. Gunther and G. Fink, "Water, Sanitation and Children's Health: Evidence from 172 DHS Surveys," The World Bank, Washington DC, 2010.

[12] M. Klinger, L. Ulrich, C. Ramprasad, A. Wolf, N. Reynaud, A. Narayan, P. Siemsen, C. Lüthi and L. Philip, "echnology, Implementation and Operation of Small-Scale Sanitation in India – Performance Analysis and Policy Recommendations," Eawag-Sandec, Zurich, 2020.

[13] UNICEF and WHO, "Progress on household drinking water, sanitation and hygiene 2000–2017," United Nations Children's Fund and World Health Organization, New York, 2019.

[14] World Bank; ILO; WaterAid; WHO, "Health, Safety and Dignity of Sanitation Workers : An Initial Assessment," World Bank, Washington DC, 2019.

[15] L. Strande, M. Englund, N. Andriessen, J. P. Carbajal and A. Scheidegger, "Estimating quantities and qualities (Q&Q) of faecal sludge at community to city-wide scales," in *Methods for faecal sludge analysis*, London, IWA Publishing, 2021, pp. 115-144.

[16] I. S. R. M. A. W. Z. &. S. M. Ross, "Fecal sludge management: diagnostics for service delivery in urban areas-tools and guidelines," World Bank Group, Washington, 2016.

[17] WHO & UNICEF, "JMP Methodology - 2017 update and SDG baselines," World Health Organization (WHO) and United Nations Children's Fund (UNICEF), Geneva, 2018.

[18] T. A. L. M. M. F. B. R. M. Z. S. T. M. A. G. A. I. A. R. H. W. J. Odagiri M, "Safely Managed On-Site Sanitation: A National Assessment of Sanitation Services and Potential Fecal Exposure in Indonesia," *Int J Environ Res Public Health,* vol. 18, no. 15, p. 8204, 2021.

[19] WHO and UNICEF, "Task Force Report on Methods," World Health Organization and United Nations Children's Fund, Geneva, 2015.

[20] E. B. B. I. H. P. H. C. Peal A, "Fecal sludge management (FSM): analytical tools for assessing FSM in cities," *J Water Sanit Hyg Dev.,* vol. 4, no. 3, pp. 371-383, 2014.

[21] L. P. M. V. K. B. R. P. J. C. &. J. F. Moreno, "Integrating water-quality analysis in national household surveys: water and sanitation sector learnings of Ecuador," *npj Clean Water,* vol. 3, no. 1, pp. 1-11, 2020.

[22] UN Habitat and WHO, 2021, "- . For example, the effectiveness of inspections rather than relying on household surveys alone for assessing containment has not been validated, nor has there been comparison between quality of data obtained from FGDs, interviews, log books or administr," United Nations Human Settlements Programme and World Health Organization, Geneva, 2021.

[23] UNESCO-UIS, "SDG 4 Data Digest SDG 4 Data Digest - Using household survey data to monitoring SDG 4," UNESCO-UIS, Montreal, 2020.

[24] I. Ross, R. Scott and R. Joseph, "Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas - Case study in Dhaka, Bangladesh," World Bank, Washington, 2016.

[25] WHO, "WHO guidelines for the safe use of wasterwater excreta and greywater," World Health Organization, Geneva, 2006.

Annexes

Summary of tables and figures

A1. Key Definitions[19]

CLTS: Community led total sanitation

Container: Technology used to store excreta, e.g. septic tanks, cesspools, latrine pits

Containment: The ability of a container to effectively isolate excreta from the (surface) environment

Container-based sanitation: A sanitation service in which excreta are captured in sealable containers that are then transported to treatment facilities.

Conveyance: Conveyance describes the transport of products from either the toilet or containment step to the treatment step of the sanitation service chain. For example, where sewer-based technologies transport wastewater from toilets to wastewater treatment plants.

Effluent: Effluent is the general term for a liquid that leaves a technology, typically after blackwater or fecal sludge has undergone solids separation or some other type of treatment.

End use/disposal

In this document refers to the methods by which products are ultimately returned to the environment as reduced-risk materials and/or used in resource recovery. If there is an end use for the output they can be applied or used, otherwise they should be disposed of in ways that are least harmful to the public and the environment.

Excreta: Urine and feces.

Exposure: Contact of a chemical, physical or biological agent with the outer boundary of an organism (e.g. through inhalation, ingestion or dermal [skin] contact).

Fecal sludge: Solid and liquid wastes removed from on-site storage containers, also called septage when removed from septic tanks

Feces: (Semisolid) excrement that is not mixed with urine or water.

Greywater: Greywater is the total volume of water generated from the household, but not from toilets.

Improved sanitation facilities are those designed to hygienically separate human excreta from human contact. These include wet sanitation technologies, such as flush and pour-flush toilets connecting to sewers, septic tanks or pit latrines, and dry sanitation technologies, such as dry pit latrines with slabs and composting toilets

Leachate: The liquid fraction that is separated from the solid component by gravity filtration through media (e.g., liquid that drains from drying beds).

Manual emptying: In this document refers to the emptying of fecal sludge from on-site sanitation technologies, where humans are required to manually lift the sludge. Manual emptying can be used with either manual or motorized transport.

Manual transport: In this document refers to the human-powered transport of fecal sludge emptied from on-site sanitation technologies. Manual transport can be used with manual or motorized emptying.

Motorized emptying: In this document refers to the use of motorized equipment for the emptying of fecal sludge from on-site sanitation technologies. Humans are required to operate the equipment and maneuver the hose, but the fecal sludge is not manually lifted. Motorized emptying is most commonly followed by motorized transport, but it is also used with manual transport.

Motorized transport: In this document refers to the use of motorized equipment for the transport of fecal sludge from on-site sanitation technologies. Humans are required to operate the equipment, but the fecal sludge is not manually transported. Motorized transport can be used with either motorized or manual emptying.

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 a sewer technology for transport.

On-site sanitation: A sanitation technology or system in which excreta (referred to as fecal sludge) are collected and stored and emptied from or treated on the plot where they are generated.

Open drain: Open channel used to carry greywater, surface water or stormwater.

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[19] Drawn from WHO (2018) Guidelines on Sanitation and Health, WHO, Geneva. Available at www.who.int/water_sanitation_health/sanitation-waste/sanitation/sanitation-guidelines/en

Outlet A pipe or hole through which wastewater is discharged or a gas may vent.

Overflow: An outlet for excess wastewater.

Sanitary inspection: A sanitary inspection is an on-site inspection and evaluation, by qualified individuals, of all conditions, devices, and practices in the sanitation system that pose an actual or potential danger to the health and well-being of the various exposure groups. It is a fact-finding activity that should identify system deficiencies - not only potential sources of hazardous events, but also inadequacies and lack of integrity in the system or that could lead to hazardous events.

Sanitation service chain: All components and processes comprising a sanitation system, from toilet capture and containment through emptying, transport, treatment (in-situ or off-site) and final disposal or end use.

Sanitation system: A context specific series of sanitation technologies (and services) for the management of fecal sludge and/or wastewater through the stages of containment, emptying, transport, treatment and end use/disposal.

Sanitation technologies: The specific infrastructure, methods, or services designed to support the process of managing fecal sludge and/or wastewater through the stages of containment, emptying, transport, treatment, and end use/disposal.

Sanitation workers: In this document refers to all people – employed or otherwise – responsible for cleaning, maintaining, operating or emptying a sanitation technology at any step of the sanitation chain.

Sewage: Wastewater that is transported through the sewer.

Sewer: An underground pipe that transports blackwater, greywater and, in some cases, stormwater (combined sewer) from individual households and other users to treatment plants, using gravity or pumps when necessary.

Sewerage: The physical sewer infrastructure for conveyance and treatment of sewage.

Shared toilet: A single toilet shared between two or more households.

Soak pit: A pit or chamber that allows effluent to soak into the surrounding ground.

Toilet: The user interface with the sanitation system, where excreta are captured; can incorporate any type of toilet seat or latrine slab, pedestal, pan or urinal. There are several types of toilet, for example pour- and cistern-flush toilets, dry toilets and urine-diverting toilets.

Treatment: Process/es that changes the physical, chemical and biological characteristic or composition of fecal sludge or wastewater so that it is converted into a product that is safe for end use or disposal. Treatment level defined as [1]:

- **Primary treatment** is a mechanical, physical or chemical process involving settlement of suspended solids or any other process in which the BOD of the incoming water is reduced by at least 20% before discharge, and the total suspended solids of the incoming water are reduced by at least 50%.
- **Secondary treatment** is a process that follows primary treatment of water and generally involves biological or other treatment with a secondary settlement or other process that results in a biochemical oxygen demand (BOD) removal of at least 70% and a chemical oxygen demand (COD) removal of at least 75%.
- **Tertiary treatment** is a process that follows secondary treatment and removes nitrogen, phosphorous or any other pollutant, such as microbiological pollution or color, that affects the quality or a specific use of water.

User interface: User Interface describes the type of toilet, pedestal, pan, or urinal with which the user comes in contact; it is the way by which the user accesses the sanitation system.

Wastewater: Used water from any combination of domestic (households and services) industrial, stormwater and any sewer inflow/infiltration.

Water body: Any substantial accumulation of water, both natural and manmade (i.e. surface water).

A2. Scoping pilot projects

Scale and cost of pilots

Below is a synthesis of the scope, implemention method and cost of phase 1 pilot activities.

Table A1. Scale of pilots and data collection methods

Country	Methods	Who/how conducted	Cost estimate
Bangladesh	National workshops – inception and validation	Pilot team with national stakeholders	Concept note (Feb 2020) $140k including: Workshops x2 - $30k; Data collection x2 – $40k; Support to country workplans x2 $70k = $140k Actual budget (May 2021) $121k
	Nationally representative household survey (n=3149) including inspections for 30% of households (n=959)	65 enumerators/UNICEF volunteers and 9 supervisors Smartphones with Electron software	
	FGDs with service providers (n=10) and KII with government and national stakeholders (n=14)	Pilot team in person	
Ecuador	Added on-site sanitation questions to National System for Municipal Information (SNIM) survey	Managed by the association of Municipalities. Distributed to all municipalities, 221 responded in 2019	Concept Feb 2020 $90k including: Desk review, national workshop and TOR $17k, Data collection $55k, Sharing and validation $18k
	Tested inclusion of SMOSS questions in existing ENEMDU household survey.	Part of existing national survey, n= 16,954 for 2019 survey.	
	Plan to conduct surveys of household, schools and health care facilities in 10 municipalities.	Contracted data collection organization sample size and enumerators to be confirmed	
Indonesia	Household sanitary inspection pilot (n=55)	Inspections conducted by sanitarians (local environmental health officers	Concept Feb 2020 $90k. Including: Data collection 30k, Workshop 20k, Support to country workplans 40k)
	Inclusion of FSM questions in national water quality survey (n= over 20,000)	WQ survey conducted by MoH, informs Susenas	
Kenya	Plan to conduct a survey of Households, schools and healthcare facilities including inspections. In addition will conduct FGDs and KII with service providers and county officials	Contracted Sanergy to implement data collection. Dedicated household survey (n=600) and 27-45 school and health care facility surveys. Key informant interviews with sanitation service providers, treatment providers and county officials	Concept Feb 2020 - $100k including: Inception desk review and workshop $13k; Data collection $55k; Sharing and validation $16k
Serbia	Policy analysis tool KII with LGU in 4 districts		Concept note Feb 2020: total budget $90k including: Workshops x2 - $30k; Data collection x2 – $30k; Support to country workplans x2 $30k
	Two questionnaires for local self-government units and service providers on FSM services	Sent to LGUs through national NGO that supports LGUs. 75 answered (represented 80% population)	
	Questionnaires for households and institutions (rural school and HCF)	Questionnaire/ inspection conducted by 25 field teams from public health institutes (IPHs). 1560 samples, including 15 from each schools and HCF and 30 from hh in each district. Sampling weighted in rural areas based on	

Country	Methods	Who/how conducted	Cost estimate
		greater use of on-site sanitation (84% in rural areas vs 16% in urban).	
Zambia	Household survey (n=23,000) in 10 provinces including institutional, rural and urban questionnaires. Used KoBo digital data collection	Virtual training of 2500 data collectors, in 50 districts of 10 provinces, environmental health inspectors and some water inspectors from NAWSCO	Budget $71k (Detailed budget breakdown by activity in ZMW in May 2021 progress update)

Sample size calculations

Example of sample size calculation from Serbia

Number of on-site sanitation facilities for sanitary inspection

To obtain statistically significant findings at national scale, the number of on-site sanitation facilities to be inspected (N_{SMOSS}) is calculated to be representative of households, schools, and health care facilities in the country, with a confidence level of at least 95% and level of precision (or margin of error) of 5%. Obtained data at national scale will not be used for representing regional or municipal situation with respect to SMOSS situation. These formulas yield a representative number in this assessment according to Kasiulevičius et al. (2006).

$N_{SMOSS} = z^2 * p (1-p) / c^2$

With z = z-score (number of standard deviations for a given confidence level; z equals 1.96 for a 95% confidence level); p = estimated proportion of the attribute that is present in the population (arbitrary set at 0.5); and c = confidence interval, expressed as decimal (0.05 = ±5).

Furthermore, the obtained N_{SMOSS} is corrected for the size of population of interest (number of HCFs reported), as per the following:

Final $N_{SMOSS\ (corrected)} = N_{SMOSS} / (1 + (N_{SMOSS} - 1 / population\ size))$

In order to calculate the number of on-site sanitation facilities to be inspected, the following data were taken into consideration:

- For households – the proportion of households not connected to public sewer system (p_h) was obtained from the 2019 MICS survey[20]. The average proportion of households that are currently not connected to public sewerage system is 41.8% on the national / state level. The variations of this proportion by urban-rural areas, across regions, districts, and municipalities, were taken into consideration for the primary and secondary stratification of the household samples.

[20] Republički zavod za statistiku, UNICEF, 2019. Istraživanje višestrukih pokazatelja položaja žena i dece u Srbiji i Istraživanje višestrukih pokazatelja položaja žena i dece u romskim naseljima u Srbiji, 2019, Izveštaj o nalazima istraživanja. Beograd, Srbija: Republički zavod za statistiku i UNICEF.

- For households – the number of households in the Republic of Serbia was obtained from the 2011 Census of Population Households and Dwellings in the Republic of Serbia[21]. The total number of households in the country eligible for the study (i.e. not connected to the public sewer system) is 982859. The number of households by regions, districts, and municipalities was taken into consideration for the primary and secondary stratification of the samples.
- For schools and healthcare facilities – the proportion of facilities not connected to public sewer system (p_s and p_z) was obtained from the 2019 MICS survey. The average proportion of facilities that are currently not connected to public sewerage system was considered to equal 72.5% in rural areas.
- For schools – population size of schools in rural areas in the Republic of Serbia was obtained from the 2020 inventory of rural schools, property of the Institute of Public Health "dr Milan Jovanović Batut". The total number of schools in rural areas in the country eligible for the study (i.e. not connected to the public sewer system) was 1407. The number of rural schools by regions, districts, and municipalities was taken into consideration for the primary and secondary stratification for the final selection.
- For health care facilities – population size of health care facilities in rural areas in the Republic of Serbia was obtained from the 2018 inventory of health care facilities, property of the Institute of Public Health "dr Milan Jovanović Batut".The total number of health care facilities in rural areas in the country eligible for the study (i.e. not connected to the public sewer system) was 1312. The number of rural health care facilities by regions, districts, and municipalities was taken into consideration for the primary and secondary stratification for the final selection.

Based on all these criteria, the calculated number small on-site sanitation facilities to be visited at households, schools, and health care facilities is:

- For households – the exact number of small on-site sanitation facilities is 1054, which is rounded to 1055;
- For schools – the exact number of small on-site sanitation facilities is 252, which is rounded to 255;
- For health care facilities – the exact number of small on-site sanitation facilities was 249, which is rounded to 250.

Finally, the total number of small on-site sanitation facilities belonging to households, schools, and health care facilities for the study is 1560.

Primary stratification

According to the 2011 Census of Population Households and Dwellings in the Republic of Serbia, the country is divided into five statistical regions, each containing a certain number of districts. For the purpose of this assessment, four Broad Areas were created:

- Broad Area BA1 – Vojvodina, comprising 7 districts,
- Broad Area BA2 – Belgrade, comprising 17 city municipalities,
- Broad Area BA3 – West Serbia and Šumadija, comprising 9 districts, and

[21]2011 Census of Population, Households and Dwellings in the Republic of Serbia. Population. Household according to the number of members. Data by settlements. Belgrade, 2013. Available at: www.popis2011.stat.rs

- Broad Area BA4 – South and East Serbia, including Kosovsko-mitrovački district and enclaves, comprising 10 districts.

Primary stratification of households by four Broad Areas was performed according to the total number of households, and the number of eligible households in urban and in rural areas separately. As mentioned above, the number of households which are eligible for the survey, meaning that they are not connected to public sewer system was obtained from the 2011 Census of Population, Households and Dwellings in the Republic of Serbia and from the 2019 MICS survey.

Table A 2. Primary stratification of households by Broad Area

Broad Area (BA)	Number of eligible households in urban areas	Selected households in urban areas	Number of eligible households in rural areas	Selected households in rural areas	Total number of eligible households	Selected households total
BA1: Vojvodina	55969	60	222616	239	278586	299
BA2: Belgrade	66934	71	81274	87	148208	158
BA3: West Serbia and Šumadija	42787	46	276994	297	319781	343
BA4: South and East Serbia, Kosovo and enclaves	36780	40	199504	214	236284	254
Total	202470	217	780388	838	982859	1055

Secondary stratification

Secondary stratification of the small on-site sanitation facilities used by households, schools, and health care facilities was performed according to their reported number for each district of the Broad Area. As mentioned above, these data were obtained from the 2019 MICS survey, or collected by the Institute of Public Health "Dr Milan Jovanović Batut".

The selection of small on-site sanitation facilities at households, schools, and health care facilities

After primary and secondary stratification, filed teams from all four Broad Areas will be provided with the lists of urban and rural settlements in their districts, as well as the lists of eligible schools and health care facilities in their districts. Field teams will randomly select the households, schools, and health care facilities, whose septic tanks and pit latrines will be inspected during the surveillance. The exclusion criteria for the selection of household are:

- connection to a public sewer system
- respondents from household under age 18
- refusal to participate
- on-site sanitation facility at household, school or HCF is under construction and/or reconstruction at the time of survey

The total number of inspected small on-site sanitation facilities belonging to households, schools, and health care facilities must be equal to the calculated number of all three entities. Should any small on-site sanitation facility at household, school, or health care facility be unavailable at the time of the study, the field team will replace it with another one randomly.

Proposed algorithm for the sampling of households

The selection of individual households to be surveyed will be done by random sampling method. In summary, field teams from each district will be given a list of settlements in the district (available from Census), as well as the number of households to be visited (calculated from secondary stratification). For example, assuming that district A has 140 settlements (census data), and the number of households to be visited is 50. Dividing 140 with 50 gives a step interval of 2.8, or approximately 3. Team members will use a random number generator to get the order of the first settlement to be selected (from 1 to 140), for example number 33. Starting from the settlement that is on the 33rd place of the list, the team will use the step interval of 3 to choose the subsequent villages: 36, 39, 42, … etc., until they get 50 villages selected. In the selected settlements team members will try to find a household who is willing to participate. If it turns out that the village is connected to the public sewer, the team will leave the village and replace it with the subsequent one from the list, using the step interval as described above. On the other hand, if a household refuses to participate, field teams will continue searching for qualifying household in the same village randomly – the so called “random walk” procedure. This technique is unbiased because the starting point and the path of travel along the village are determined randomly by the field teams. However, the probability of bias toward cooperative, available households is always present. Field teams will therefore be encouraged to make effort to convince reluctant households to be interviewed, because their unwillingness to participate may be related to poor socio-economic conditions in the first place (and possibly poor sanitation).

A3 Household survey questions

Table A3. Example questions from JMP and Pilots

JMP Core questions for household survey 2018[22]	From other sources
TOILET FACILITY AND ACCESS	
JMP S1. What kind of toilet facility do members of your household usually use? (if not possible to determine, ask permission to observe the facility)	BGD - What is the latrine/toilet containment? ECU[23] -Type of toilet service? SRB - What is the type of toilet which the household members are using? (Observe – user interface) AND Where is fecal sludge drained and contained from the toilet? (Observe – containment) ZMB- What type of toilet facility do members of your household usually use?
JMP S2 .Do you share this facility with others who are not members of your household?	JMP XS6. Do you share this facility only with members of other households that you know or is the facility open to the use of the general public? BGD - Do you share this latrine with other people/individual/households who are not member of this households? SRB - Do you share this toilet with other people/individual/households, who are not members of this household?
JMP S3. Where is the toilet facility located?	WHO Ws14/SRB. Where is your toilet facility located? (Observe)
JMP XS1. How many households in total use this toilet facility, including your own household?	BGD /SRB - How many people, including children, use this latrine?
JMP XS2. Do all household members usually use the sanitation facility?	
JMP XS3. Is everyone in the household able to access and use the toilet at all times of the day and night?	SRB - Is there at least one member in your household that doesn't usually use this toilet for defecation? AND If any or all members in the household do not use this toilet, what are the reasons for this?
JMP XS4. What was the (main) reason that household members were unable to use the toilet at all times of the day or night?	
JMP XS5. The last time [name of child] passed stools, what was done to dispose of the stools?	SRB - The last time passed stool by children <5y, what was done to dispose of the stools?
JMP XS7. Does the design of your toilet prevent other people seeing and hearing what you are doing when you use it?	ZMB - Does your toilet facility have a smooth cleanable floor, lid on the hole and super structure providing privacy
JMP XS8. Do you or other household members face any risks when using the toilet?	
CONTAINMENT	
JMP XS10. Where does your septic tank discharge to?	WHO WS5. What type of outlet arrangement does your sanitation facility have? (Outlet broken, outlet to xx, no outlet) IDN - Where does the wastewater discharge from this containment? SRB - Where/how is fecal effluent drained from septic tank/pit latrine? (observe)

[22] UNICEF and WHO (20180. Core questions on drinking water, sanitation and hygiene for household surveys: 2018 update. New York: United Nations Children's Fund (UNICEF) and World Health Organization. Available at: https://washdata.org/report/jmp-2018-core-questions-household-surveys. Also available for schools and health care facilities

[23] ECU from EMENDU 2019 survey questions.

JMP Core questions for household survey 2018[22]	From other sources
JMP XS9. Does your sanitation facility [answer to S1] leak or overflow wastes at any time of year?	BGD /SRB - Did the pit/tank leak, overflow or flood at any time in last one year so that pit/tank contents came out? (Reported)
JMP XS15. How do you dispose of household water used for cooking, laundry and bathing?	
	SRB - Do you have permission for the construction of septic tank?
	SRB - What is the capacity of the containment facility? (in cubic meters)
	SRB - Approximately how full is your latrine pit/septic tank at the moment?
	SRB – What is the distance to nearest drinking water source? (observe) SRB - Is that drinking water source uphill or downhill from the containment facility?
	IDN - How do you construct the containment? IDN -What is the material used for the containment walls? AND Bottom/base?
EMPTYING	
JMP S4. Has your (pit latrine or septic tank) ever been emptied?	BGD - How many times has your pit filled up/septic tank overflowed till date? When was the last time, your latrine pit/septic tank required emptying? When the pit/septic tank last needed emptying", what did you do? SRB - When the pit/septic tank last needed emptying, what did you do? ZAM (urban only)- Has your pit latrine or septic tank ever been emptied? ECU – Has it ever been emptied?
	WHO Ws12. Before it was emptied, did you stop people from using this pit or tank to prevent it from filling up any more? WHO Ws13. What was the length of time between the date you stopped it from filling up and the date that it was emptied?
JMP XS11. How many years ago was your pit latrine/septic tank built?	BGD /SRB - When was the latrine installed? SRB- When was a containment facility built/installed?
JMP XS12. How many years ago was your pit latrine/septic tank last emptied?	WHO WS6. When was the last time your containment was emptied? BGD - When was the last time, your latrine pit/septic tank required emptying? SRB - When was the last time your latrine pit/septic tank filled up? ZAM (urban) - How long ago (months) was your pit latrine /septic tank emptied?
JMP XS13. The last time your pit latrine/septic tank [answer to S1] was emptied, who emptied it? (only to hh reporting emptying by service provider in S5.)	BGD/SRB - Who did the emptying? BGD- Who provided the emptying/digging equipment mentioned in question number 3.9? SRB - How did you contact the service provider who emptied your pit/septic tank? ZAM (Urban) -The last time your pit or septic tank was emptied, who emptied it?
	SRB - Was the pit/septic tank easily accessible for the emptiers?
	SRB - How was emptying performed predominantly last time? BGD - How was the emptying/digging equipment for the fecal contents emptied/removed? ZAM (rural) How do you process the excreta when Septic tank is full?
	BGD /SRB - To empty the pit/septic tank, did someone need to enter into the pit/septic tank?
	WHO Ws9. When it was emptied, were the people doing the emptying wearing any special equipment, such as rubber boots or gloves? BGD - Did emptier use any of the following? Boots, gloves, face mask, body cover, ash/kerosene/etc. SRB - Did emptier use any of the following? Boots, gloves, face mask, body cover, eye goggles, helmet, protective coat, not applicable, don't know
	WHO Ws10. When it was emptied, was there any spillage or leakage of the excreta in your dwelling, in your own yard/plot or elsewhere?
	SRB - Did you have to pay for the emptying and transportation? How much money did you pay? Is your household subsidized for the cost for the services of emptying and transport?

JMP Core questions for household survey 2018[22]	From other sources
	ZAM (urban) - The last time your pit was emptied, how much were you charged?
	SRB - Were you satisfied with emptying service last time? SRB - What was/were the reason/reasons you were not satisfied with the emptying service?
TRANSPORT / DISPOSAL	
JMP S5. The last time it was emptied, where were the contents emptied to? Was it removed by a service provider?	Who WS11. When it was emptied, where were the contents discharged? ECU – Where does the septic tank/pit waste end up? SRB - Is fecal content being transported after emptying from the pit/septic tank? SRB - SRB - Who transported the emptied fecal content last time after emptying? BGD - Where was the fecal contents transported to after emptying from the pit/septic tank? SRB - Where was fecal content disposed last time, after emptying and transport? BGD - What was the disposal point for the fecal contents emptied and transported from your pit/septic tank containment last time? ZAM (rural) - When the pit latrine is full how do you dispose of the excreta? ZAM (urban) - The last time it was emptied, where were the contents emptied to?
	BGD/SRB - What were the means of transportation? And Who was the owner of the transportation means
	SRB - What is the distance from the household to disposal site?
	SRB - Did you have to pay for the emptying and transportation? How much money did you pay? Is your household subsidized for the cost for the services of emptying and transport? ZAM (urban) - The last time your pit was emptied, how much were you charged?
	SRB - Are there any abandoned (closed) pit latrine / septic tanks on the premises in your household? AND How was it performed/what procedure was used to close pit latrine / septic tank?
	SRB - Do you treat fecal sludge from your septic tank or latrine pit on-site? SRB - Does anyone of the household engage in any sort of fecal sludge treatment process? SRB - Do/did the household use any of the fecal contents while is in the pit of the latrine?
	SRB - Are you aware that fecal sludge is needed to be treated before disposal and/or reuse? BGD - Do you know the purpose of fecal contents transporting outside the compound? SRB - Do you agree that the treated fecal sludge could be used as fertilizer for agricultural cultivations? BGD - What are the purposes of fecal contents transporting outside the compound?
	SRB - Where is the on-site treated fecal sludge (solids) disposed (or given/sold) to?

Table A4. Comparison of answers for key questions

JMP 2018 Core question	Indonesia Inspection pilot	Bangladesh Pilot	Serbia Pilot		Zambia Pilot		Ecuador – ENEMDU
What kind of toilet facility do members of your household usually use? (If not possible to determine, ask permission to observe the facility.)	Where is the discharge of blackwater from this toilet? (Based on respondent perspective)	What is the latrine/toilet containment (spot check)?	What is the type of toilet which the household members are using?	Where is fecal sludge drained and contained from the toilet?	Urban - What type of toilet facility do members of your household usually use?	Rural - What type of toilet facility is it?	Type of toilet service
Flush / pour flush Flush to piped sewer system Flush to septic tank Flush to pit latrine Flush to open drain Flush to don't know where Dry pit latrines Pit latrine with slab Pit latrine without slab / Open pit Composting toilets Twin pit with slab Twin pit without slab Other composting toilet Bucket Container based sanitation Hanging toilet / hanging latrine No facility / Bush / Field Other (specify)	Containment in the form of septic tank Containment in the form of pit latrine Containment in the form of cubluk Containment in the form of composting pit Containment in the form of anaerobic digester Not contained in the containment or tank, directly discharge to IPAL Not contained in the containment or tank, directly discharge to drainage or open canal Not contained in the containment or tank, directly discharge to pond/field/river/lake/ocean Not contained in the containment or tank, directly discharge to coast/open-space/forest Other comment (please specify)	1= Composting latrine 2= Urine diversion latrine 3=Soak pit (no ring or brick) 4=Ring slab (single direct pit) 5=Ring slab (single offset pit) 6=Ring slab (twin offset pit) 7=Septic tank with sealed bottom and outlet connected to soak well or sewer 8= Septic tank with unsealed bottom and outlet connected to soak well or sewer 9= Septic tank with outlet connected to open drain/water body/open land 10=No pit, directly connected to drain/ditch/open source 11=Hanging latrine/latrine in bush or open land	1=Flush toilet connected to piped water 2=Pour flush toilet(manual flush from the bucket) 3=Dry toilet (no water flush) with toilet slab 4=Dry toilet (no water flush) without toilet slab [RISK] 5=Defecation into bucket or similar object [RISK] 6=Open defecation (field, yard, bush, open land) [RISK]	1=Impermeable septic tank (regardless of no. of chambers) 2=Permeable septic tank with unsealed bottom [RISK] 3=Impermeable twin pits 4=Permeable twin pits [RISK] 5=Holding tank 6=Permeable pit (no ring or brick) [RISK] 7=With solid waste [RISK] 8=No containment [RISK]	Flush to piped sewer Flush to septic tank Flush to pit latrine VIP Sanplat Pit latrine with slab Pit latrine without slab or platform Compositing toilet	Flush to piped sewer Flush to septic tank Flush to pit latrine Flush to somewhere else	Sewer Septic tank Cesspit Latrine No facility
Has your (pit latrine or septic tank) ever been emptied?	a) Do you regularly empty your containment? b) When is the last time you empty the containment?	a) How many times has your pit filled up/septic tank overflowed till date? b) When was the last time, your latrine pit/septic tank required emptying? c) When the pit/septic tank last needed emptying", what did you do?	a) When was the last time your latrine pit/septic tank filled up?	b) When the pit/septic tank last needed emptying, what did you do?	Has your pit latrine or septic tank ever been emptied? How long ago (months) was your pit latrine /septic tank emptied?		Has every emptied?

JMP 2018 Core question	Indonesia Inspection pilot	Bangladesh Pilot	Serbia Pilot		Zambia Pilot		Ecuador – ENEMDU
Yes emptied Never emptied Don't know	a) 1. Yes, every … year (please input the number of the year) 2. No (input number 0) b) 1. … years ago (please input the number) 2. Never (please input 0) 3. Do not know (please input 999)	a) Number of times 999= Do not know b) 0 = never did emptying; 1= required emptying) c)_0 (Left it as it is/nothing was done) _2 (Dug/opened new pit) _3 (Switched to second pit) _4 (Emptied and continued using) _other ot (Drained into water/open sources)	Never 1-2 years ago 2-5 years ago 5-10 years ago More than 10 years ago Not applicable (no septic tank) Do not know	1=Emptied pit/septic tank and continued using it 2=Dug/opened new pit 3=Switched to second pit (if twin pit) 4=Left it/nothing was done 5=Use of mercury for deepening the pit 6=Others: specify 88=Not applicable (no septic tank) 999=Do not know	Yes, emptied Never, emptied Don't know (Less than 30 days to be considered a month)		Yes, no, don't know
Who emptied included in below question on disposal		a) Who did the emptying? b) Who provided the emptying/digging equipment?	Who did the emptying?		The last time your pit or septic tank was emptied, who emptied it?		
Removed by service provider Emptied by household Other Don't know		a) 1: Emptied by self-initiatives 2: Sweeper/Sanitation workers helped emptying 3: all others together b) 1= Provided by the household 2= Hired from WASH committee 3= Hired from UP/Ps/CC 4= Hired from a company 5= NGO 6=Self 7= Other: specify____ 8= Not applicable 9= Do not know	1=Public Utility Company 2=Private service provider 3=Other entities/individuals: specify: _____ 4=Emptied by yourself 88=Not applicable (no emptying) 999=Do not know		Water supply and Sanitation Company Licensed Vacuum tank operator Water trust Community based enterprise Others (specify)		
The last time it was emptied, where were the contents emptied to?		What was the disposal point for the fecal contents emptied and transported from your pit/septic tank containment last time?	Where was fecal content disposed last time, after emptying and transport?		The last time it was emptied, where were the contents emptied to?	When the pit latrine is full how do you dispose of the excreta?	Where does the waste from septic tank/pit end up?

JMP 2018 Core question	Indonesia Inspection pilot	Bangladesh Pilot	Serbia Pilot	Zambia Pilot		Ecuador – ENEMDU
Removed by service provider • to a treatment plant • buried in a covered pit • to don't know where Emptied by household • buried in a covered pit • to uncovered pit, open ground, water body or elsewhere Other (specify) Don't know		1=Buried <10 m away from the premise 2=Buried in 10-30 m 3= Buried >30 m 4=Into moving body of water 5=Into static body of water 6=Into field/drain/bush outside as waste 7=Directly to crop field (to fertilize crops) 8=Into waste treatment plant 9= Into fecal waste disposal point allocated by the authority outside (no treatment is done here) 10= safely stored somewhere for composting (safely means does not create environmental hazard/contamination) 11= unsafely stored somewhere for composting 77= Not applicable 88= Other _ specify 99=Do not know	Disposed to: 1= Wastewater treatment plant 2= public sewer 3=sanitary landfill 4=non-sanitary / wild landfill 5= moving water body 6= moving water body 7= the farm 8=Crop field as fertilizer 9=Buried in situ 10=Disposed to open pit 88=Not applicable (no emptying or no transport) 999=Do not know	Treatment plant Buried in a covered pit Drainage Stream I don't know Others (specify)	Buried in a covered pit Abandon it Others (no specify box)	Some open place They remain in the septic tank Another part as long as it is not an open site Don't know

A4. Household sanitary inspection questions

Table A5. Comparison of inspection questions WHO, M-Water review and country surveys

	WHO sanitary inspection forms	Indonesia	Bangladesh (Grey not necessarily observed)	Serbia (Grey not necessarily observed)
LOCATION & SETTING	Area names, GPS,	(O) Q3: Take the GPS coordinates (optional)		
	Number of hh served by this facility		How many people, including children, use this latrine?	How many people, including children, use this toilet?
	Population density			Location (urban/rural)
	Accessibility for mechanical emptying	(O&I) Q2: Estimate the width of the road		
	Risk to groundwater used for drinking			
	Water availability			
	Risk of flooding			
	Soil hardness (rock soil)			
	Soil permeability			
	Land availability			
		House ownership		

	WHO sanitary inspection forms	Indonesia	Bangladesh (Grey not necessarily observed)	Serbia (Grey not necessarily observed)
TOILET	1. Is the toilet not accessible for all intended users?			
	2. Is the toilet superstructure absent, incomplete, damaged and/or does not provide privacy and security to the intended users?		Are 'the walls' and/ or "the door" of the toilet in place?	Are the walls and / or the door of the toilet in place? (privacy and security)
	3. Is the toilet dirty with visible excreta on surfaces?		Is the toilet free from faecal smears on pan, wall and floor?	Is the toilet free from fecal smears on pan, wall and floor?
			Is the toilet pan free from used cleaning materials? (paper, stones and sticks)	Is the toilet pan free from used cleaning materials? (paper, stones and sticks)
			Did you see the presence of child feces in the yard or compound? (spot check)	
	4. Is anal cleansing material (e.g. toilet paper, leaves, water) absent or inappropriate for the technology?		What do you use for anal cleansing?(ask and then verify by spot checks)	
			Is water available in the toilet or nearby within 5m from the latrine? (Spot check)	
	5. Are handwashing facilities absent inside or next to the toilet?			Where is the nearest hand washing spot in relation to the toilet?
	6. Can flies and other insects easily enter and leave the pit/container/tank?	(O&I) Q3: Observe the items of water-trap, slab, lid, or pipe functioning to separate human contact to excreta in the containment		
CONTAINMENT	7. Are there excreta overflowing from the squat hole, pan or pedestal; and/or are there ponds of effluent visible on the ground outside the toilet?			Did you see the presence of human feces in the yard or compound?
		(I) Q2: Where is the discharge of blackwater from this toilet? (Based on respondent perspective)	What is the latrine/toilet containment (observe/spot check)? (Integrate effluent and containment type)	Where is fecal sludge drained and contained from the toilet? (permeability and type of containment)
		(I) Q4: What is the material used for containment wall? (I) Q5: What is the material used for containment bottom/base?	Can (ground) water get in or out of the pit/septic tank? (so the pit/septic tank is not "water tight or sealed") (spot check)	
		(O) Q6: Observe the accessibility of containment equipment/infrastructure (Look at show-card B): Ventilation, control hole, lid/manhole		
		(O&I) Q15: What is the dimension of the containment? a) Rectangular (LWD) b) Circle (Dia, D) c) Other		What is the capacity of the containment facility? (cubic meters)
EFFLUENT DISCHARGE	12. Is effluent flowing from the tank outlet to an open drain, water body or to open ground? (Note only asked for septic tanks and not pits)	(O&I) Q7: Where does the wastewater discharge from this containment? Ask and observe the effluent discharge (O&I) Q8: What is the type of the advance treatment? Show the show-card B and let		Where/how is fecal effluent drained from septic tank/pit latrine? **Note*: Responses 3-6 must be observed and confirmed on site

	WHO sanitary inspection forms	Indonesia	Bangladesh (Grey not necessarily observed)	Serbia (Grey not necessarily observed)
		the respondent choose the answer* Yes, which is ...		
GROUNDWATER RISK	9. Is the bottom of the pit less than 1.5 m from the water table where groundwater supply is used for drinking?		How deep is the latrine pit or septic tank below the ground surface? (meters) (if pit, ask how many rings and then measure) (only do for 10% hh)	
	10. Is the toilet and pit located within 15 m of a well or hand pump that is used for drinking?	(O&I) Q4: Estimate the distance between containment and nearest groundwater sources	Observe and measure: what is the distance in meter (If <200m) to the nearest DRINKING water source from the latrine pit/septic tank? (Note: if the household owning more than one latrine, consider the one which is nearest to the drinking water source)	What is the distance to nearest drinking water source? **Note*: If there is no septic tank, put 88
			What is the nearby (in 100 meter) available drinking source water type? (Note: if the household owning more than one latrine, consider the one which is nearest to the drinking water source) (spot check)	
	11. Is the pit/septic tank located on higher ground from the drinking water source?		Is that drinking water source uphill or downhill from the latrine pit/soak well/septic tank? (Spot check)	Is that drinking water source uphill or downhill from the containment facility? **Note*: If there is no septic tank, put 88
DAMAGES, FUNCTION AND SLUDGE DEPTH	8. Is the pit poorly maintained such that the cover slab is cracked or damaged, and/or the side walls are not stable?			
	13. Are the toilet and cartridges poorly maintained with broken components, visible cracks or defects in the side walls?			
			Did the pit/tank leak, overflow or flood at any time in last one year so that pit/tank contents came out? (Reported)	Did the pit/tank leak, overflow or flood at any time in last one year so that pit/tank contents came out?
	15. Is the pit/container/septic tank almost full?	O) Q7 (optional): Put the septic checker or stick into the containment as deep as it can. Next, pull out the septic checker or stick and observe the parts of water and sludge. (O) Q8 (optional): Observe and estimate the depth of supernatant/ liquid and sludge in the containment. If not observable or visible, leave the cells blank.	Approximately how full is your latrine pit/septic tank at the moment? Can you show me? (Spot check) 10% hh	Approximately how full is your latrine pit/septic tank at the moment?

	WHO sanitary inspection forms	Indonesia	Bangladesh (Grey not necessarily observed)	Serbia (Grey not necessarily observed)
		Automatic assessment of containment category and compliance with Indonesian standard	Assessment of - Latrine category that the household members are using (spot check only). Note: If the household owns>1 functional latrine those remain in use by household members, take data for the latrine that remains in bad condition	
ACCESS FOR EMPTYING		(O) Q1: Observe the location of the containment	Where is the sanitation facility located? (spot check)	Where is the toilet / sanitation facility located?
			Distance of the latrine from the user household (approximately in meter, spot measurement only)?	Distance of the toilet from the user household? *Note*: If toilet is inside the dwelling, put 0
	14. Is the container/pit/septic tank not accessible for emptying?	(O) Q12: What is the access hole for emptying? (Look at show-card A)	Was the pit/septic tank easily accessible for the emptier? (Spot check)	Was the pit/septic tank easily accessible for the emptiers? *Note*: If there was no emptying but other measures were taken, put 88

Table A6. Comparison of response categories to common questions for household sanitary inspections

WHO Sanitary inspection	JMP Household Q's	Indonesia	Bangladesh	Serbia
12. Is **effluent** flowing from the tank outlet to an open drain, water body or to open ground? (Note question is only asked for septic tanks and not pits)	XS10. Where does your septic tank discharge to?	Where does the wastewater discharge from this containment? Ask and observe the effluent discharge	Latrine category that the household members are using (spot check only).	Where/how is fecal effluent drained from septic tank/pit latrine? *Note*: Responses 3-6 must be observed and confirmed on site
Yes No NA Unknown	To a leach field, soak pit To a sewer To an open drain To open ground or watercourse Other (specify) Don't know	1. Drainage or open canal 2. Pond/field/river/lake/ocean 3. Leaching to the ground 4. Unknown 5. No effluent 6. Coast/open-space/farm 7. Advanced treatment and then discharge to the drainage, surface water, or soil	0= Do not use any specific latrine 1= Unimproved latrine 2= Improved latrine but excreta may not transportable (pit latrine) 3= Improved latrine where excreta are disposed in septic tank and the tank is not connected to any open network (drain, lake, open sources, …)	1=Emptying by service provider/PUC, other entities/persons, on their own 2=Drained underground (for permeable septic tanks or pits) [RISK] 3=Drained to the surface due to overflow [RISK] 4=Drained by pipes to the surface [RISK] 5=Drained by pipes into water body [RISK] 6=Drained by pipes on leach field 7=Drained by pipes into soak pit
Is the pit/container/septic tank almost full?		Calculation based on either	Approximately how full is your latrine pit/septic tank at the moment? Can you show me? (Spot check) 10% hh	Approximately how full is your latrine pit/septic tank at the moment?
Yes No NA Unknown		Sludge depth measured (TBC criteria) Estimated sludge volume from calculation less than containment volume ((Users*0.2*Years*365)/130)	1= Almost full 2= one-third portion empty 3= Half portion empty 4= More than half empty 5= Can not see the pit/septic tank 777= Not taken 999= Do not know	1=Almost full 2=One-third portion empty 3=Half portion empty 4=More than half empty 5=Cannot see the latrine 999=Do not know

A5. Service chain inspection /Spot check example questions

Table A7. WHO - Draft questions for piloting in emptying, transport and treatment service provider surveys

Developed as proof of Concept for SDG Indicator 6.2.1 & 6.3.1

WHO 2016 - DRAFT QUESTIONS FOR PILOTING IN EMPTYING AND TRANSPORT SERVICE PROVIDER SURVEYS[24]	WHO 2016 - DRAFT QUESTIONS FOR PILOTING IN TREATMENT SERVICE PROVIDER SURVEYS
• ET1. What is your employment status (self-employed, company owner, employee)? Et2. What is the name of the company or organisation? Et3. Are you a member of, or affiliated to, an association of 'emptiers'? Et4. Which location(s) do you [or insert name from et2] work in (describe by district, zone, village etc. of the urban or rural location)? Et5. Are there other E&T service providers working in the same areas? • ET6. How many other E&T service providers working in the same areas? • ET7. What sort of toilet facilities do you empty? • ET8. What type of equipment do you use for emptying? • ET9. What type of equipment do you use for transport? • ET10. When emptying and/or transporting the faecal sludge, do you [or your colleagues or employees] wear any special clothes or equipment? • ET11. What special clothes or equipment is worn? [Selection options: 1. Gloves; 2. Boots; 3. Masks; 4. Overalls; 5. Others (specify); 8. Don't know.] • ET12. On average, how many septic tanks, pit latrines and other systems do you empty per day/week/month? • ET13. Do you discharge each [truck/vacutug/cart] load to the same location? • ET14. How many different sites or locations do you visit and discharge loads? • ET15. Do you visit one site or location more than others? • ET17. Do you keep a record of all household emptying and transport activities? ET18. Please can i see records for the past two years?	T1. What types of faecal waste does this facility treat/receive? T12. Which emptying service providers deliver to this treatment works? (do you keep a record of all deliveries to the treatment plant? If so, please can i see it? T13. What is the faecal sludge treatment plant design capacity? T14. What is the faecal sludge flow that is currently treated (annual average)? (do you have records that could verify these flows? How do you calculate/monitor it? T15. What is size of population that the treatment plant serves? (do you have records to verify this figure?) T16. Where does the faecal sludge come from and in what proportions? (do you have records to verify these figures?) T17. Which treatment processes are used in the treatment plant? _t18. Considering shutdown time for maintenance, failures or electricity blackout, what is the treatment efficiency of the plant during the year? T19. What percentage of the treated faecal sludge complies with national performance (discharge) standards? (please provide annual average) T20. Where is the treated faecal sludge (solids) disposed (or given/sold) to? Sludge liquid fraction _t21. Is the liquid fraction resulting from sludge treatment, treated? T22. Which treatment processes are used to treat the liquid fraction? T23. Considering shutdown time for maintenance, failures or electricity blackout, what is the treatment efficiency of the plant during the year? T24. What percentage of the treated liquid fraction complies with national performance (discharge) standards? (please provide annual average) _t25. Where is the treated liquid fraction (effluent) disposed (or given/sold) to? T26. Please can i take a look at the treatment plant? If so, can i take photos of the facility? Infrastructure assessment _T27 Take a look at the treatment plant If permission has been given by the service provider, take a photo at the: • Inlet of the wastewater plant (1 photo-only) • Wastewater treatment processes (1 photo-only) • Sludge treatment processes (1 photo-only) • Outlet of the wastewater (1 photo-only) If permission has been given by the service provider, take a photo at the: • Sludge acceptance/receiving location (1 photo-only) • Sludge treatment processes (1 photo-only) • Effluent treatment processes (1 photo-only)

[24] See below table for useful notes for the interviewer prior

Notes for the interviewer from the Draft questions for piloting in emptying and transport service provider surveys (WHO 2016)

Objective: the objective of the survey is to obtain sufficient information in order to be able to estimate the scale and effectiveness of the service provided by Emptying and Transport (E&T) service providers, i.e. the proportion of households in the service area using septic tanks, pit latrines and other systems (e.g. compost toilets) whose containers are 'emptied for transport', and the proportion of this which is 'transported and delivered to a treatment plant'.

Interviewee: the survey questionnaire is intended for use with any of the following:

- The head of a department within a public organization responsible for E&T of fecal sludge for a defined service area of a city, town, or rural district (e.g. a municipality/utility/district administration etc.);
- The owner or manager of a private company that carries out E&T service provision in a formal or informal manner for a defined service area of a city, town, or rural district, village etc.; or with
- A single informal E&T service provider (i.e. one man and a barrow).

However, it is very important to record both the name of the interviewee and their position, as their role and level of responsibility will influence the type of responses they give and this will be useful in determining the overall objective stated above.

Question sequence: The order of the questions is for guidance only; in order to improve the quality/clarity of the interview, the interviewer is encouraged to adjust the sequence depending on the interviewee and responses given.

Context: Before starting the interview it is important to understand the local context, for instance:

- Number of formal and informal emptying & transport service providers operating in the area?
    - How they are organized, if at all? (e.g. through an association or licenced by the municipality)
- Name(s) of local treatment plant(s)?
    - Where they are located?
    - Whether or not they receive fecal sludge? And if so,
    - How frequently and from who?
- Location of other sites where emptied excreta is reportedly discharged, both formal and informal?
    - Who manages these sites, if anyone?
    - And how frequently they receive fecal sludge, if at all?

Background knowledge of these issues will help with understanding the validity and quality of the responses given and whether or not further probes are required in order to elicit more useful and/or appropriate information.

A6. Administrative data and service provider surveys

Table A8. Summary of topics included in Serbia national survey

SERBIA LOCAL GOVERNMENT SURVEY CATEGORIES	SERBIA SERVICE PROVIDER SURVEY CATEGORIES
• Basic data on the local self-government unit • Management of emptying, transport and treatment of fecal sludge from pit latrines, septic and holding tanks and small-scale sewage systems (up to 2000 PE) at the local self-government unit • Assembly Decisions governing the performance of utility services • Scope and management of utility services • Inspection surveillance over management of containment, emptying, transport and treatment of fecal sludge on-site • Planning in the field of sanitation at the level of the local self-government unit • Human resources for performing tasks involving emptying, transport and treatment of fecal sludge from septic and holding tanks and small-scale sewage systems • Financing services and investments in the local self-government unit • Coordination	• General data about service provider • Regulations, standards and guiding documents for emptying, transport and treatment provided by public utility companies • Monitoring/ records of emptying, transport and treatment of fecal sludge from pit latrines, septic and holding tanks and small-scale sewage systems (up to 2000 PE) • Emptying, transport, treatment and disposal • Human resources • Financing

Figure A1. Ecuador on-site sanitation survey questions in National System for Municipal Information (SNIM) survey 2019