WASH Discussion Paper DP/03/2020

unicef for every child

What do safely managed sanitation services mean for UNICEF programmes?

SUMMARY

This discussion paper summarizes challenges to monitoring and service provision along the sanitation service chain and proposes a way forward for UNICEF to support the monitoring and safe management of sanitation services. It aims to inform internal discussion on adjustments needed to UNICEF's sanitation programming guidance and practice to align better with the new SDG target on access to safely managed sanitation services. The paper summarizes the requirements of the SDG sanitation target; highlights specific issues relevant to UNICEF sanitation policy and programming; and suggests potential solutions where current practices and sanitation outcomes are not achieving sustainable use of safely managed sanitation services.

SDG 6.2: Use of safely managed sanitation services (SMSS)

The SDG global sanitation target (6.2) is: "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".

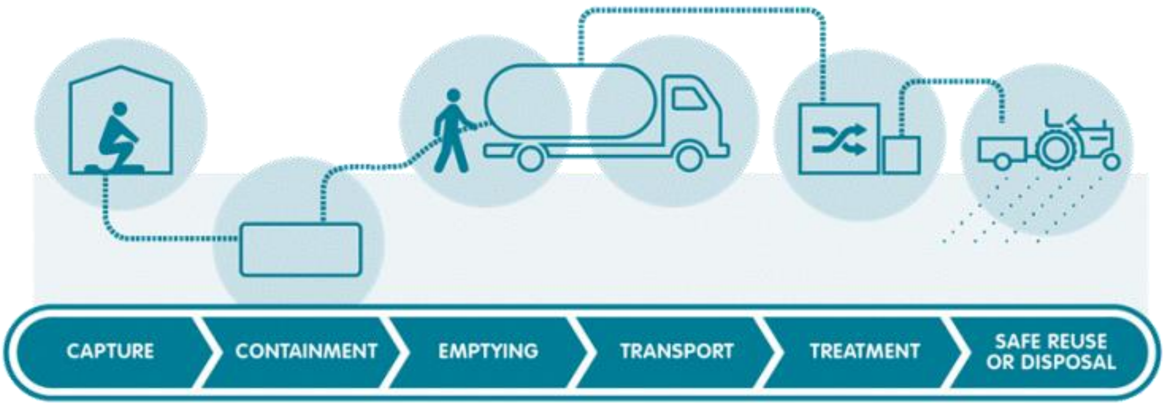
The indicator for SDG sanitation target 6.2.1 is the **percentage of the population using safely managed sanitation services, including a handwashing facility with soap and water**[1]. The Joint Monitoring Programme for Water Supply and Sanitation (JMP) states that there are three main ways to meet the criteria for use of a **safely managed sanitation service**: i) people should use improved sanitation facilities which are not shared with other households, ii) the excreta produced should either be:

- Treated and disposed on-site.
- Stored temporarily and then emptied and transported to treatment off-site.
- Transported through a sewer with wastewater and then treated off-site, and

iii) Human waste needs to be safely managed across the entire **sanitation service chain** (Figure 1). However, the extent of the sanitation service chain varies widely with context – in urban

[1] JMP agreed with the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDG) that this indicator should be reported and monitored as two separate time series: 6.2.1a Population using safely managed sanitation services; 6.2.1b Population with a basic handwashing facility with soap and water available on premises.

Figure 1 Sanitation service chain (source: IRC)



settings, the full chain may be required, with emptying, transport, treatment and disposal of faecal sludge; whereas in remote rural settings, latrine pits are often covered and replaced when full, with no requirement for the other parts of the service chain.

The safe management of sanitation services in each part of the chain may change over time, due to variations in operation and maintenance by different users and service providers, natural degradation of service components, and external events (e.g. storms or flooding). Consequently, the safe management of services across the chain needs to be regularly monitored, ideally through observation of critical on-site services such as safe containment.

A. Capture (toilet)[2]

The main function of the toilet is to capture excreta in a way that safely separates people from the excreta. However, the toilet should also provide security, privacy, and protection from external factors (e.g. climate or animals).

The toilet is usually connected to a containment or transport system (e.g. a latrine pit or a sewer). The main hazard at this stage is excreta that are unsafely returned to the environment before reaching containment (which means that 100% of the pathogens are unsafely released). There are three main risks to examine:

- Open defecation: by those without toilets, or by members of households with toilets (e.g. due to different intra-household practices; or when the toilet is busy; or when outside the home).
- Unsafe sanitation facilities: toilets without containment (e.g. hanging toilets, or toilets that flush to the open).
- Unsafe child excreta disposal: toilet use by young children is generally low, and unsafe disposal of child excreta is often under-reported. High incidence of enteric disease in infants suggests high pathogen load in these unsafe excreta flows.

Some hazard is also possible from unsafe management of the toilet (e.g. excreta-soiled slabs, missing covers, blocked water seals, erosion around pit), or failure to wash hands with soap after defecation. Limited evidence is available on the health hazard from unclean toilets, or from difficult to clean toilets (e.g. toilets

[2] Also referred to as the “user interface” or “point of use” e.g. in Verhagen & Scott (2019).

with mud slabs). However, cleanliness, pleasant smell and toilet functionality are factors that affect regular toilet use.

B. Containment

Safe containment in non-sewered sanitation systems is provided by a toilet containment technology or system (e.g. a pit or tank or mobile container) in which excreta "*are retained within the containment technology, or discharged to the local environment in a manner that does not expose anyone to the hazard*"[3].

The 2019 UNC models of unsafe excreta return study[4] found that **unsafe containment contributed between 40% and 90% of the hazard release** along the sanitation service chain (excluding that from open defecation). The UNC study also found that pit latrines tended to have less unsafe excreta return than septic tanks, in part because septic tanks in low income countries are rarely well designed or well managed.

Septic tanks examined in urban areas of Tamil Nadu, India (Manga, 2019) had: no outlet (fully lined holding tank); outlets to open drains; outlets to rivers or open land; or no tank (direct flush to open drain). Almost 60% of the septic tanks had no partition walls; none had baffles on inlets or outlets; and 98% of the septic tanks observed had adjacent inlet and outlet pipes[5] (so that fresh excreta entering the tank can flow directly out of the outlet).

In-use pit latrines and septic tanks contain fresh excreta, and any outflows (e.g. effluent from septic tanks, or leaks and overflows from the containment system) are likely to contain large numbers of viable pathogens. The effluent discharged daily from a well-designed and functioning septic tank may contain 10^5 to 10^{10} 'minimum infective doses' of helminth eggs, protozoa, bacteria and viruses[6]. In low-income countries, septic tanks are rarely emptied and are often inadequately emptied[7], which can result in deteriorating effluent quality over time. Wastewater outflows from containment systems are rarely monitored[8]; and – based on the limited data available – are rarely safely managed (e.g. disposed to a soakaway system).

Unsafe outflows: discharge of effluent or faecal sludge into the local environment

Many septic tanks lack effective leach fields or soakpits, and some continuously discharge effluent into the local environment, often close to the house. In addition, full containment systems and badly constructed pits or tanks may leak, overflow or collapse (particularly after rainfall or flooding). Any unsafe outflows tend to be close to the home, with significant risk of faecal exposure. While some of the outflows are seasonal or occasional (thus hard to monitor), many unsafe outflows are continuous and visible (thus relatively easy to monitor).

Unsafe containment: effect of high groundwater table

Saturated soils provide lower pathogen reduction by natural processes (due to lower adsorption, filtration and temperature effects on leachate) hence increase the risk of groundwater contamination by on-site sanitation (particularly in the presence of transmissive soils or fractured rock). High groundwater tables may also prevent pit contents from drying out (which can slow the rate of inactivation of pathogens).

[3] WHO (2018). *Sanitation and health guidelines.*
[4] Kolsky et al (2019): this study found that "80% to 98% of the unsafe return occurs prior to transport" i.e. relates to on-site management of sanitation services.
[5] Manga M (2019)
[6] Mitchell C, Abeysuriya K & Ross K (2016).
[7] For example, often the liquid fraction of the faecal sludge is emptied, but the solid fraction is not, thus the solids become increasingly consolidated and gradually fill up the containment system.
[8] For instance, the 'sanitation service chain' schematic does not depict any outflows from the containment system, and most faecal sludge management efforts focus on sludge management.

Potential groundwater contamination from on-site sanitation

The discharge of liquids from containment systems to the ground has the potential to contaminate groundwater with faecal pathogens. Dry soils generally provide effective secondary treatment of leachate or effluent, including filtration, absorption and other physical and biological pathogen removal mechanisms - recent research in Bangladesh found that only 1% of the groundwater contamination risk in unsaturated alluvial soils arose from groundwater flows (with the other 99% from "above ground" contamination routes into the well-pump system, or after water collection)[9]. However, groundwater contamination risks need to be checked in: transmissive soils (e.g. coarse sand or fractured rock); where groundwater is shallow (within 5m); where a significant proportion of sanitation facilities are within 10m of drinking water sources; or where wastewater loading is high (i.e. from a large communal facility, or from a high density of household facilities).

C. Emptying

Emptying refers to the movement of faecal sludge from a containment system for transport, off-site treatment, use or disposal. In rural areas, emptying rates are often low, particularly where full dry latrine pits are covered and replaced. However, where users want to re-use the containment system (e.g. a pour-flush latrine with lined pit), the containment system is either emptied manually[10] or mechanically[11] before transport to disposal, treatment or use of the faecal sludge.

Emptying of containment systems can be problematic in rural areas, as few safe emptying services exist, access to the containment systems may be difficult, and ability to pay for services may be limited. As a result, rural households may empty the containment system themselves (or pay someone else to empty the containment system manually), with a **high risk of faecal exposure by those handling the faecal sludge; and subsequently by others living nearby**. In rural areas, faecal sludge is often dumped into nearby fields, drains, water bodies or open spaces to limit transport and disposal costs – for instance, research in Cambodia found that 73% of households dumped the faecal sludge from latrine pits within 500m of the sanitation facility[12].

Unsafe emptying: flooding out of toilet containment systems

Safe emptying costs may be avoided by "flooding out" of faecal sludge in the rainy season (through pipes or holes opened in the pit lining, or by removing pit covers). To check whether emptying is being avoided (which may indicate that unsafe discharges are taking place, and increase the hazard of any outflows), some organisations (e.g. CSE[13] and SNV) now assess whether pits or tanks have exceeded the typical "timely emptying threshold"[14].

Unsafe emptying: inadequate personal protection

Emptying in rural areas is often ad hoc and informal, which makes it difficult to monitor or regulate. Workers often use inadequate personal protection and employ unsafe emptying practices (e.g. workers enter pits to empty sludge; and fail to clean spillages on soil).

[9] Ravenscroft et al (2017)
[10] Often using buckets, spades and other readily available tools that risk faecal exposure (although sometimes using hand-operated pumps e.g. gulper or diaphragm pump).
[11] Vacuum tankers, farm pumps into mobile tanks (towed by tractors or other vehicles), waste pumps direct to disposal, or other powered or manual mechanical emptying technologies.
[12] SNV (2018)
[13] Centre for Science and Environment (CSE) India has completed shit flow diagrams for around 100 cities in India, which surveys to assess timely emptying of pits and septic tanks.
[14] Estimated time before the containment system is full and requires emptying, based on technology type, size of containment, number of users and typical local practices.

Safe emptying: alternating twin pit latrines

Alternating twin pit latrines provide a simple and appropriate solution where households prefer offset latrine pits and have space for a second pit. Where households cannot afford to build an alternating twin pit latrine at the outset, latrine designs that allow the easy addition of a second alternating pit should be encouraged (e.g. iDE Cambodia upgrade package, which includes lime dosing to disinfect the full pit).

D. Treatment

Off-site treatment of faecal sludge is relatively rare in rural areas. Few low-income countries have the capacity or resources to develop and sustain adequate faecal sludge treatment facilities outside large urban settlements. In rural settings, a number of factors – including low population densities, high transport costs, and low willingness to pay for services – mean that centralised treatment is rarely a viable or appropriate option[15].

Treatment may also be affected by local demand for faecal sludge (or wastewater). In many rural contexts, farmers value faecal sludge and wastewater as soil conditioner or to irrigate crops (in dry climates), and may be willing to accept direct application of sludge or wastewater to their fields (see below).

E. End use and disposal

Land disposal of faecal sludge adds nutrients and carbon to the soil[16], but uncontrolled use of untreated sludge poses risks to the health of agricultural users and consumers of farm produce[17], particularly where:

- waste is applied to land where fruit or vegetables are grown on the ground;
- crops are harvested within three months of sludge application (i.e. before pathogen die-off and inactivation can be assured); and
- fruit or vegetables grown in these areas may be consumed unwashed.

Unsafe disposal or use

Faecal sludge is heavy and difficult to transport, thus is often dumped onto nearby fields or into the open close to the emptying site. In alternating twin pit or vault systems, faecal sludge is sometimes emptied before the sludge is safe to handle or use.

Safe disposal: burial or trenching

In rural areas, where land is available, safe disposal options include trenching or burial in appropriate locations. Disposal sites should be a safe distance away from water sources; at least 5m above the maximum groundwater level; and the faecal sludge should be covered and left for a safe period (at least 4 months before planting crops in the soil; and at least 2 years before any use or other contact with the buried material).

Research suggests that trenching is effective in inactivating pathogens and can provide nutrients for improved tree and crop growth. Shallow and deep trenching for faecal sludge disposal have been used successfully in several countries, including Malaysia (where sludge trenching was used to increase the productivity of forestry plots in rural areas).

Safe transport of faecal sludge to safe disposal sites requires safe handling and personal protection systems, including containers capable of holding and transporting the sludge without spillage. High transport costs also dictate that safe disposal sites should be located as close to

[15] Failed waste stabilisation pond systems and wastewater treatment plants have been documented in a number of low income countries. WaterAid (2019) *Functionality of wastewater treatment plants in low- and middle-income countries* reported 95% failure rates in Mexico, 80% failure rate in Ghana etc.
[16] Tayler K (2018)
[17] WHO (2006)

the emptying site as possible (otherwise there is a high risk of unsafe disposal closer to the emptying site).

Monitoring of SMSS

The current JMP approach to classification of household sanitation services gives greater weight to the toilet and slab type, and to the number of households using the toilet, than to the safe management of the excreta. A latrine with a non-durable slab (e.g. mud-covered wooden slab) is classified as an unimproved sanitation service, even if the excreta are safely contained and managed; shared use of a toilet is classified as a limited sanitation service, even if the toilet is clean, and the excreta are safely contained and managed; yet a latrine with a durable slab (e.g. concrete) is classified as a basic sanitation service even if the slab is not clean, and the containment, emptying and disposal services are unsafe.

The 2019 UNC study on unsafe return of excreta suggests a reversed hierarchy of sanitation technologies based on unsafe excreta flows. The current JMP classification approach reflects the constraints of data collection from nationally representative household surveys that often do not allow observation of sanitation facilities.

However, the UNC findings suggest that, where toilet observation is possible, the classification should reflect a more risk-based approach, with services likely to lead to large unsafe excreta returns classed as a lower level of service than services that contain and manage the excreta safely, with other distinctions used to differentiate the marginally lower service provided by safely managed facilities with unclean toilet slabs, or that allow potential contamination.

Table 1. Current JMP classification approach

FACILITY TYPE	CONTAINMENT	DISPOSAL	OVERALL
Pit latrine without slab	Safe	Safe	UNIMPROVED
Shared improved latrine	Safe	Safe	LIMITED
Pit latrine with slab	Unsafe	Unsafe	BASIC
Pit latrine with slab	Safe	Safe	SAFELY MANAGED

Proposed approach for SMSS

In low income countries, little reliable information is currently available on the SMSS issues and practices discussed above. As a result, sanitation programmes are rarely designed to respond to SMSS issues.

1. Monitoring of SMSS

For practical reasons, most national household surveys and sanitation monitoring systems limit the number of sanitation indicators included, and often do not allow toilet observation. Therefore, **alternative monitoring instruments will be required for adequate monitoring of the use of SMSS (including observation)** – in particular, programme surveys and monitoring systems should be used to develop and refine SMSS monitoring; and national coordination mechanisms should be used to work towards national assessments of SMSS and encourage long term alignment and harmonisation of sub-national and programme monitoring systems around these SMSS indicators.

Example: JMP core and expanded questions[18] *on toilet use, emptying and unsafe containment (S1, S4, S5, XS2, XS3, XS5, XS9, XS10, XS12, XS13, XS15).*

Example: SNV SSH4A performance monitoring system[19] *(detailed questions on SMSS that have been implemented in 13 country projects using smartphone household surveys).*

Monitoring of service providers and local authorities will also be required, including efforts to document, regulate and test whether faecal sludge is safely managed at treatment works and local disposal sites (e.g. trenching or burial sites operated by local governments).

2. Use Shit Flow Diagrams (SFDs) to analyse SMSS challenges

The SMSS monitoring data should be used to produce Shit Flow Diagrams (SFDs). SFDs were developed for use in urban settings but can be used in rural settings to present complex SMSS data in a simple and comprehensible manner. The SFD production process also highlights any missing data or information that are required for full assessment of SMSS, thus can reinforce the SMSS monitoring processes.

Example: SNV Nepal (2018) Estimating safely managed sanitation in Nepal (includes rural SFDs for three different contexts: hill districts, mountain districts and terai districts; highlights the range from only 13% safely managed sanitation services in the terai districts to 81% safely managed in the hill districts).

Separate SFDs will be required for different contexts, or where people use different facilities and services, or have different practices. New research[20] suggests that variations in pathogen loads should also be considered (within the SFD), and that child excreta flows should be considered separately in rural SFDs[21], but further work is required to operationalise these new approaches.

3. Identify high risk SMSS issues

The SMSS monitoring data, SFDs and any pathogen flow assessments should be used to identify high risk areas (e.g. geographical areas with high proportions of unsafe management of sanitation services), high risk facility types (e.g. particular sanitation technologies that are associated with unsafe management) and high risk services or practices. Specific responses

[18] WHO/UNICEF Joint Monitoring Programme report (2018).
[19] SNV SSH4A performance monitoring system: http://www.snv.org/public/cms/sites/default/files/explore/download/2019-1-impact-indicators-ssh4a-performance-monitoring-review.pdf

[20] Kolsky et al (2019)
[21] Peal and Robinson (forthcoming GSF study on safely managed sanitation services).

should be developed for each of these high risk SMSS issues.

4. Map groundwater vulnerability (to contamination by on-site sanitation)

- Macro-assessments should be used to map groundwater vulnerability
- Identify areas with highly transmissive soils or fractured rock
- Map areas with high groundwater tables (permanent or seasonal)
- Map areas with high density of sanitation facilities (with contamination risks)
- Intensify monitoring of water quality, safe containment and safe management of sanitation services in these critical areas.

The SFD website includes a groundwater pollution risk estimation tool[22]. This tool was designed to assess groundwater contamination risk in cities but will enable an initial estimate of groundwater contamination risk. More detailed assessments should be based on the 2001 ARGOSS Guidelines[23].

5. Formative research on high risk SMSS issues

Where appropriate solutions or responses to high risk SMSS issues are not apparent, formative research may be required to examine the drivers of the high-risk issues and develop appropriate responses. The formative research should be carefully targeted in the areas or groups with high risk issues (rather than conducted across the whole programme or country).

Example: SNV Nepal discovered through its SSH4A household surveys that SMSS issues were particularly bad in one terai district (among 7 project districts), thus undertook formative research on SMSS in this district to improve policy, programming and practice.

[22] https://sfd.susana.org/risk-groundwater

Key principles to promote for SMSS in rural areas

1. Keep excreta in the ground (and avoid emptying if possible)

Wherever possible (i.e. where space and groundwater conditions allow), keep excreta and any outflows from containment systems in the ground to encourage pathogen die-off and limit the risk of faecal exposure. Safe emptying, transport, treatment and disposal are challenging in rural areas, thus should be avoided unless there is no alternative. Where twin (alternating) latrine pits are used, ensure that the toilet design and operational practices allow the faecal sludge in the out-of-use pit to dry and decompose for as long as possible before emptying, handling or using.

2. Bury fresh faecal sludge

Where faecal sludge (containing excreta stored for less than two years) has to be emptied, and suitable land is available, encourage burial in nearby pits or trenches, and minimise handling, transport and disposal risks (e.g. through the use of manual diaphragm pumps and personal protective equipment, and by minimising transport distances).

Where the available land is insufficient or unsuitable for nearby burial or trenching (e.g. due to high population density and sludge loading rates, or vulnerable groundwater), and capacity for managing services is low, consider the lowest-cost options available (as FSM services in small towns and peri-urban areas are rarely sustainable).

3. Promote communal emptying and disposal processes

Every year: identify pit or tanks that need emptying; dig communal pits or trenches for safe burial of faecal sludge (supported by local government and sanitation stakeholders); inform

[23] Lawrence et al (2001)

service providers of annual process (demand for emptying services); provide protective personal equipment and mechanical pumps (e.g. manual diaphragm pumps) for pit and tank emptying; monitor, regulate and supervise safe emptying, transport and disposal practices.

4. Raise household awareness on SMSS requirements and costs (before investment)

Households should be aware of future emptying, treatment, disposal and use requirements and related costs (before investing in sanitation facilities or services) – large families should be encouraged to build bigger containment systems; twin pit latrine designs should be considered; toilet containment systems and superstructures should be designed for easy emptying or replacement.; and households should be encouraged to safely operate and maintain toilets and containment systems.

5. Raise awareness of risks associated with agricultural use of faecal sludge

Raise awareness of the risk of direct application of pathogenic wastewater or sludge to crops that grow on the ground, or that are consumed unwashed. Monitor and regulate surface sludge applications (e.g. survey service providers and agricultural users).

6. Don't forget handwashing with soap

Handwashing with soap remains a critical barrier to faecal-oral contamination, even where people are using safely managed sanitation services. SNV and GSF household surveys confirm the low practice of handwashing with soap related to the care and feeding of young children, even in places where handwashing at other critical times has increased. More frequent and more rigorous monitoring of handwashing practice will be important for the regular feedback to policy and programming that is needed to improve handwashing response rates.

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About the Series

UNICEF's water, sanitation and hygiene (WASH) country teams work inclusively with governments, civil society partners and donors, to improve WASH services for children and adolescents, and the families and caregivers who support them. UNICEF works in over 100 countries worldwide to improve water and sanitation services, as well as basic hygiene practices. This publication is part of the UNICEF WASH Learning Series, designed to contribute to knowledge of good practice across UNICEF's WASH programming. In this series:

Discussion Papers explore the significance of new and emerging topics with limited evidence or understanding, and the options for action and further exploration.

Fact Sheets summarize the most important knowledge on a topic in few pages in the form of graphics, tables and bullet points, serving as a briefing for staff on a topical issue.

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WASH Diaries explore the personal dimensions of users of WASH services, and remind us why a good standard of water, sanitation and hygiene is important for all to enjoy. Through personal reflections, this series also offers an opportunity for tapping into the rich reservoir of tacit knowledge of UNICEF's WASH staff in bringing results for children.

WASH Results show with solid evidence how UNICEF is achieving the goals outlined in Country Programme Documents, Regional Organizational Management Plans, and the Global Strategic Plan or WASH Strategy, and contributes to our understanding of the WASH theory of change or theory of action.

COVID-19 WASH Responses compile lessons learned on UNICEF's COVID-19 response and how to ensure continuity of WASH services and supplies during and after the pandemic.

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