

CWIS LEARNING BRIEF SERIES

CWIS | CITYWIDE
INCLUSIVE
SANITATION



Photos: CS Sharada Prasad

MONITORING TOOLS FOR FECAL SLUDGE COLLECTION & TRANSPORT

FEBRUARY 2020

#LB1

About the Learning Brief Series

City-Wide Inclusive Sanitation (CWIS) Learning Brief Series is part of the Bill & Melinda Gates Foundation funded CWIS Monitoring, Learning and Evidence initiative and is meant to facilitate peer learning, and delve into questions of practice, so that practitioners and implementing organizations can learn from one another. This learning initiative covers experiences from 8 cities namely Lusaka, Kampala, Dakar, Khulna, Trichy, Warangal, Narsapur and Wai. Each of these cities have active investments designed to achieve the CWIS goals of equitable, safe, and sustainable sanitation service delivery. The creation of these briefs will be structured as timely, iterative, on-going presentations of examples of learning-by-doing: this will be a space for empirical observation, and applied analysis, not theories or honorifics. Topics may be repeated, but each will build on the previous. The learnings here are meant to provide a seed for discussions across partners in the CWIS network, but also to engage interested actors outside of the network as well. This brief was developed by Athena Infonomics with the KCCA, SNV, CEPT and ASCI.

PROGRAM CITY PARTNERS

Bangladesh-Khulna

*SNV Netherlands Development Organisation
(SNV)*

Uganda-Kampala

*Kampala Capital City Authority
(KCCA)*

Zambia-Lusaka

*Lusaka Water Supply and Sanitation Company
(LWSC)*

Senegal-Dakar

*Office National de l'Assainissement du Sénégal
(ONAS)*

India-Narsapur & Warangal

*Administrative Staff College of India
(ASCI)*

India-Trichy

*Indian Institute for Human Settlements
(IIHS)*

India-Wai

*Center for Water and Sanitation, CRDF, CEPT University
(CEPT)*

ATHENA
INFONOMICS

BILL & MELINDA
GATES *foundation*

Introduction

Among the eight CWIS cities, five of them have developed and implemented some form of monitoring tool for fecal sludge management (FSM). These tools all focus on the containment, collection and transport steps of the sanitation service chain (SSC), they all involve participation from many actors, and they are all at relatively early stages of development. The tools differ in size and scope, in how they engage and incentivize their use, and, ultimately, they differ in the motivations driving their design and implementation. This brief offers a summary description of those tools based on key determinants of: scope, motivating challenge, incentives for user compliance, adoption/deployment rate, costs to develop and operate tool, tool development approach, pathway to scale. This summary and analysis are followed by some additional observations.

The five cities included in this brief are Kampala, (Uganda); Khulna, (Bangladesh); Wai, (Maharashtra, India); Warangal (Telangana, India); and Narsapur (Andhra Pradesh, India). Each of these locations is part of a larger City-Wide Inclusive Sanitation (CWIS) investment network. In Kampala, the implementing partner is the city government itself, the Kampala Capital City Authority (KCCA). In Khulna, it is SNV, an international NGO that has a long history of working on sanitation issues in the city. In Warangal and Narsapur, the Administrative Staff College of India (ASCI), a national level think tank is the technical support partner while in Wai it is the Center for Water and Sanitation, CRDF, CEPT University. Wai is the smallest city, at a population of only 40k; Kampala is the largest, with 1.5 million in the city proper, and an additional 1.5 million in the greater urban conglomeration surrounding the city (see Table 1 for further information).

ICT Platforms: Apps, Databases and Trackers

In this learning brief, we will cover four apps, a database and three trackers. All of them share common elements: data collection, aggregation, storage and use. For the purposes of this brief, apps have a graphical interface for data collection, designed to be used on a mobile device in the field, a tracker has passive data collection through a device (in this case, a GPS unit) and a database requires a technician to directly input data on a computer terminal, located in an office, and therefore requires a paper form for data collection in the field, although to be clear, all three types of data collection require a database in the backend, in which data is aggregated and stored. In addition, all of these tools have some way of sharing the collected data, either through a dashboard or datatables in an excel sheet. These tools have been developed for purposes from sanitation planning to monitoring the performance of private operators as well as illegal dumping - whether they are achieving their targets or not and whether they are performing as per the terms of contract., and the functions of each tool also differ (see Table 1). The sections below will start by providing a local context for each tool and how the motivations for these tools have evolved, followed by tool characteristics regarding data collection, coverage, costs of tool development and operation, and distribution of responsibilities and data collection. The last section discusses the challenges and opportunities surrounding these tools, with a focus on ways to ensure private desludger participation and distribution of roles and

responsibilities for effective usage of tools. A full list of data points collected at the desludging point and at the FSTP is available in Annex 1.

Table 1: Cities, ICT tool names, motivation for developing the tools, and tool functions.

City	ICT Tool Name	Motivation	Functions
Kampala	Weyonje App	FSM services planning	Data collection at containment unit
Khulna	Customer Database	Sanitation planning	Data collection at containment unit
	GPS Tracker	Monitoring of illegal dumping	GPS of truck route, warning system for unexpected stops
Narsapur & Warangal	FSM App	FSM services planning	Data collection at containment unit
	GPS Tracker	Monitoring of illegal dumping	GPS of truck route, warning system for unexpected stops, logistical support for service requests
Wai	SANITab App	FSM services planning and monitoring of emptying services	Data collection at containment unit, tracking of operator performance

Local Context and Motivations for Tool Creation

The sanitation service chain (SSC) is in various states of development across the five cities in this brief. Sewer access is limited in Kampala and non-existent in the other cities (see Table 2). Collection and transport is done either by manual emptying, which is usually disposed of nearby, or mechanical emptying, using vacutugs, vacuum trucks or other types of mechanical removal and transport. All five cities have some form of formal treatment available; treatment capacity of fecal sludge has either been recently constructed, or is in some stage of construction, in all five cities. Although we don't have data on the volume of fecal sludge (FS) being treated in Kampala, its treatment plants (TPs) are operating above their capacity; this is in contrast to the other TPs, which are operating below capacity (see Table 2).

Manual emptying in Kampala is largely limited to hard-to-reach areas of informal settlements. There is a call center in Kampala which functions to connect customers to private, mechanical desludging operators, of which there are many, and aims to do so as quickly as possible. In Khulna, manual emptying is wide-spread, and mechanical emptying is employed by only a small percentage of households. There are many reasons for this, but one of them is the response time: the fastest possible response time for a mechanical emptier is two days, whereas a manual emptier might begin within a few hours. It is hard to say what percentage of desludging is done using mechanical equipment in Warangal and Narsapur; answering that question is one of the motivations for the ICT tools being used in both locations. In Wai, CEPT has found no evidence of manual emptying at all, since mechanical emptying has become scheduled, and a uniform sanitation tax is levied for financing the emptying service regardless of whether the household chooses to utilize the scheduled desludging

service or not. This delinking of payment from service provision hence incentivizes households to avail the scheduled mechanical emptying service.

Table 2: Collaborating partners, city size, treatment plant (TP) capacity, including both fecal sludge treatment plants (FSTPs) and sewage treatment plants (STPs), and the percentage of the capacity currently being used.

City	Local Partner	Population	Informal Settlements	Sewer Access (open or closed)	FSTP/STP	TP Capacity	TP Usage
Wai	CEPT	43,000	3.74%	0%	1 FSTP	70 m ³ /day	50%
Narsapur	ASCI	58,901	61%	0%	1 FSTP	15 m ³ /day	11%
Warangal	ASCI	800,000	35%	0%	2 FSTP	25 m ³ /day	19%
Khulna	SNV	1.5 mill	31%	0%	1 FSTP	180 m ³ /day	3%
Kampala	KCCA	1.5 mill	60%	8%	2 STP/FSTP	400 m ³ /day	135%

The motivations for creating these ICT tools also varied across cities and has shown a tendency to evolve over time. In Kampala the main goal was to establish demand patterns and use that to improve FSM services. In addition, identification of informal settlements assisted more general outreach efforts aimed at low income households. In Khulna the goal for the Customer Database was primarily for sanitation planning, but in time it was realized that the collection of customer information was useful in the preparation for potentially instituting scheduled desludging. SANITab started out with the goal of assessing a city's sanitation scenario, which resulted in the creation of an onsite sanitation database that could be used for planning purposes. It has since evolved to also monitor the performance of the private operator carrying out scheduled desludging services against set targets and the operation procedure. The data from SANITab is now also used to schedule desludging services, and is associated with a data display dashboard, used by WMC fortnightly to track progress of desludging activities and calculate compensation for the desludging operators, in a performance-based payment system. The FSM App in Narsapur and Warangal was developed to understand and assess desludging operations across the two cities. The GPS Trackers in Narsapur, Warangal and Khulna were installed on desludging trucks in order to monitor their routes, but in Narsapur and Warangal it is now also used to identify the nearest trucks when a new customer requests desludging services. The private contractor undertaking the scheduled desludging service in Wai also installs GPS devices on all their trucks as a company-wide initiative for route mapping, including in Wai. However, this data independently captured by the private contractor is not integrated with the SANITab or shared with CEPT or WMC, hence it is not covered in this learning brief.

Tool Characteristics

The number of users, the time in operation, and the scale of the ICT tools varies across the cities collaborating in this learning brief. The youngest was the Weyonje App, which was implemented

only a year ago, in Kampala, while the two with the most field experience were the SANITab App in Wai and the Customer Database in Khulna (see Table 3). Even though it is the youngest, Weyonje also has the highest number of registered users (these are all desludging operators), although it is still only 1/5 of the total fleet of trucks in Kampala. Khulna, a city of a comparable size, has registered all possible desludging operators, but because the fleet is miniscule, the ICT tool user base is as well. CEPT and ASCI have succeeded in empanelling all of the mechanical emptier service providers in the towns where they are working (see Table 3).

Table 3: Cities, ICT tool names, time in operation and the method of data collection at the containment unit, during transport and at the FSTP. Note: manual data collection indicates that it was recorded on a paper form or in a logbook.

City	ICT Tool Name	Time in Operation	Data Collection			Desludging Operators		
			At Containment	During Transport	At FSTP	Government	Private	Registered
Kampala	Weyonje App	1 year	Operator/ App	None	FSTP Technician/ Manual	7	456	97
Khulna	Customer Database	4 years	City Officer/ Manual	None	None	1	1	2
	GPS Tracker	2 years	None	Passive	None			
Narsapur & Warangal	FSM App	3 years	Operator/ App	None	FSTP Technician/ RFID Scan	0	3	3
	GPS Tracker	3 years	None	Passive	None	0	11	11
Wai	SANITab App	2 years in the present form (earlier used for other surveys and assessments)	CEPT or City Officer / App	None	FSTP Technician/ RFID Scan	1	1	2

Development and Operational Costs

The development of these ICT tools required development costs, training of staff to maintain the platforms, training and/or outreach to potential users, and sometimes license renewal fees. The GPS Tracker in Khulna did not have records of the costs involved with development, operations or maintenance, so unfortunately there is not much information to compare. On the other hand, the SANITab system in Wai has been used for various purposes including doing surveys for toilet coverage in a city and toilet credit assessments. The tool in its current form for FSSM planning is built upon earlier developments and the development cost of the current tool is not independent from earlier investments.

But the ASCI team did track the development costs for the FSM App in Warangal and Narsapur: INR 200k (US\$ 2,800) to develop the app, and INR 30k (US\$ 420) annual O&M. SNV also tracked cost data for the Customer Database in Khulna: BDT 1 million (US\$11,800) to develop and a BDT 46k (US\$ 542) annual licensing renewal fee. Similarly, KCCA recorded that UGX 350 million (US\$95,200) was used for developing and adding features to the Weyonje App, GBP 15,000 (US\$19,400) for purchasing phones for the desludgers and for the monitoring staff, and around UGX 2-3 million (US\$544 – US\$815) internet data package for desludging operators. It is hard to compare costs without standard definitions of what types of costs are included, and without more data from different locations, but this is a start, and we hope that more cost data becomes available in the future. Such information is vital for cities currently making decisions about whether to develop ICT tools for FSM, or not.

Distribution of Responsibilities and Data Collection

The distribution of responsibilities, which carry some amount of cost with them, in terms of money or time, is also an important distinguishing factor between these different ICT tools. We identified an allocation of responsibilities for eight major tasks (i) tool development (initial and on-going), (ii) system maintenance, (iii) data collection, (iv) data input, (v) data aggregation, (vi) data storage, (vii) data analysis, display and sharing and (viii) data application. In Kampala, the Weyonje App is being developed and administered by the KCCA; all tasks, except for data collection and input, are implemented by the KCCA. In Khulna, the Customer Database and the GPS Tracker systems were developed by SNV but system maintenance, data collection, input, aggregation, storage, analysis, sharing and application are all the responsibility of the KCC, with some additional data collection by Community Development Committees (CDCs). In Wai, Warangal and Narsapur, tool development (initial and on-going), system maintenance, data aggregation, storage, analysis and display are all handled by CEPT and ASCI, respectively. Data is shared with local municipal governments (in the form of a dashboard in some cases), and then they decide how to apply it in their operational, monitoring or planning activities (sometimes even these decisions are also guided by suggestions from CEPT and ASCI).

There are three points of data collection, which are done at specific times, and which are common across many of these tools: at the containment unit, at the time of desludging, during transport, and at the FSTP (or STP) at the time of discharge (see Table 3). In Kampala, Warangal and Narsapur, data collection and input at the containment unit is the responsibility of the desludging operator; in Wai it is done by a member of the CEPT team for households and by municipal workers who desludge the septic tanks of CTs and PTs.¹ Passive data is collected during transport only in the GPS Tracker tools; the GPS Tracker tool in Narsapur and Warangal is integrated with the platform of the FSM App, but in Khulna it is not integrated with the Customer Database.

The Khulna Customer Database, the Weyonje App and FSM App all collected the customer name, mobile number, GPS location, the type of containment and an estimate of the containment volume. In addition, the Customer Database also collected several more pieces of information, but the SANITab collected far more information at the point of desludging than any of the other ICT tools

¹ A much smaller questionnaire is administered by city officials for community/public toilets

(see Annex 1 or the SANITab Manual)². The Weyonje App, and the FSM App both collected only the most necessary data: a few questions for identification and a few more for characterization of the containment unit. During transport, the full route taken is passively recorded by both GPS Tracker tools; in addition, they both send a system alert whenever the truck stops for more than five minutes in a location other than the FSTP. At the FSTP, all cities collected the truck plate number, the driver's name and the truck size (to estimate the volume of FS); in addition, in Warangal, Narsapur and Wai an RFID scanner tracked the trucks electronically, and in Narsapur, the weight of FS in the trucks is measured using a bridge scale. The list of all the information collected at the point of desludging, and at the FSTP can be found in Annex 1.

Challenges and Opportunities

One of the largest challenges for these systems is ensuring participation of the desludging operators. Registering is the first hurdle, but even after registration, participation isn't guaranteed. Table 4 shows the incentives offered to encourage participation, and the active desludging operators. All of the cities require that desludging operators participate with the ICT tools listed in Table 4, but only the SANITab system has any penalty for non-compliance: payments are performance based, and participation is the only way to record work progress.

Many different reasons were given for why desludging operators might not participate. To the extent that the systems are perceived to be monitoring them, desludging operators who engage in illegal dumping are incentivized to avoid participation. Operators can also forget to log a single trip, leave their mobile phone at home, have internet connectivity issues or find the data input interface in the smart phone app to be difficult to use. Some desludging operators don't like to bring their phone to work, as they don't want it to become dirty or damaged. The Khulna Customer Database did not involve operator participation, but similar challenges were experienced there as well: KCC and CDCs considers the customer database as an additional responsibility that is imposed on them. They usually keep records in a paper form, and they view inputting the same data into the Customer Database as doubling their work, for which they do not have sufficient time nor manpower. While in Khulna the customer database is a separate initiative, in Warangal and Narsapur, a customer database is created using the data collected through the FSM app while desludging. The GPS Trackers in Khulna, Warangal and Narsapur were observed to be inaccurate at times. However, in Warangal and Narsapur, the inaccuracy happened not due to technical challenges but rather the usage of the GPS equipped phones. In some cases, the owners of the mobile phones are not the truck drivers of desludging vehicles but their employers, hence the GPS location shown could be that of the owner and not the truck.

Various strategies were used to encourage participation: offering incentives, such as a free mobile and data bundle (as with the Weyonje App), is one example. Making participation as easy as possible, was another strategy. Initial informal meetings were held in both Warangal and Narsapur to

² The SANITab Manual can be found at: <https://www.pas.org.in/Portal/document/UrbanSanitation/uploads/Manual%20for%20Sanitab%20tool.pdf>

introduce the application to the people and motivate participation. Since some operators found using a smart phone app to be cumbersome, ASCI is considering moving to a paper format for data collection, as that might be more manageable. On the other hand, the SANITab data entry responsibility is split by operator and establishment type—the municipal operator who desludges public and community toilets enters the data directly; for household emptying done by the private contractor, a member of the CEPT team is entirely responsible for data input, which takes the burden off the private operator.

Table 4: The active desludging operators (government and private, who have used the app/tracker in the past 30 days) and the incentives for participation.

ICT Tool Name	City	Incentives	Active Gov Operators	Active Private Operators
Weyonje App	Kampala	Free mobile & data bundle	3	20
Customer Database	Khulna	Computer (for inputting data), printer, staff training	1	0
GPS Tracker	Khulna	None	0	0
FSM Tracker	Narsapur	None	0	3
FSM Tracker	Warangal	None	0	5
SANITab	Wai	Performance-based Payments	1	1

ICT Tools have two potential advantages: **(i)** make the delivery of a service or the functioning of an operation more efficient or cost effective **(ii)** allow the generation of reliable information, which can be leveraged as an asset for specific kinds of decisions. In the tools presented here, there are examples of improved monitoring, the potential for better planning through better baseline data, and improved processes for service delivery. The organizations participating in the CWIS network show evidence that, before developing an ICT tool for FSM processes, they first took a good look at the reasons why they should do it, what the tool should be for, and what the incentives were for registration and participation of desludging operators. They involved operators at the very beginning of the design phase, in most cases, and followed up with regular solicitations for feedback from users. For example, in CEPT, the foundation of their work in Wai was a new and innovative process vision: to make desludging a scheduled, regular, routine event. The use of ICT was designed to support that vision, not the other way around, and they did it by making the participation of desludging operators as simple as possible.

A great deal can be learned from comparing the experiences across these tools. For example, if a customer calls to request desludging in Warangal or Narsapur, they call the 'S-line', and the person receiving the S-line phone calls, first checks the location of the household or business in need of the service and then checks which of the operators' vehicle is nearer to that location and assigns the same.

This is in contrast to the call center in Kampala, where the operators randomly select an operator, to see if they have any available trucks, and are willing to take the price offered by the household or business, going down their list until they find a truck that is willing and available. This requires less time than the two days required in Khulna, but it is more time than is required in Warangal or Narsapur. Furthermore, the first available truck in Kampala may not be the closest, implying that the systems in India, by utilizing the GPS tracker, may also save on fuel costs as well. The KCCA is considering installation of GPS trackers on their trucks as well; if it is a way for operators to save on time, fuel costs and provide a better service to customers, it may give them an incentive to participate.

The distribution of responsibilities, and the allocation of ownership, for different tasks within the ICT tools also varied between these cities. In India, CEPT and ASCI not only developed their tools, they also retained important aspects of their administration. In Bangladesh, SNV developed their tools, but then handed them over to the KCC for their administration, which offers lessons on institutionalizing the system created for sustainability. And in Uganda, it was the city authority that developed the tool and was also responsible for its administration. At the same time, the extensive involvement of non-government partners in developing and sustaining these apps, while a sign of initiative and ownership, leaves open the question about what will happen with these systems after these outside organizations move on to the next city. In all three countries, the development of these tools is on-going, and best practices are still being formed: comparisons among different systems is an important part of this development process.

Annex 1: Information collected at the point of desludging and at the FSTP

Kampala - Weyonje App			
General	On-Site	Service Info	At FSTP
Name	Lined/Unlined	N/A	Truck Plate Number
Mobile Number	Slab/no slab		Driver's name
GPS	Flush to septic		Driver's phone number
	Composting toilet		Truck Size
	Containment Volume		
Khulna - Customer Database			
General	On-Site	Service Info	At FSTP
Name	Tank/Pit	Last emptied	N/A
Mobile Number	Containment Volume	Amount of paid advance	
Type of Building Use	Accessibility of vacutug	When emptied	
Address	Distance from road	Time required to empty	
Customer feedback	Number of people using	Place where dumped	

Warangal & Narsapur - FSM App			
General	On-Site	Service Info	At FSTP
Name	Single chamber septic	Booking date	Truck plate number
Mobile Number	Double chamber septic	Next empty date	Driver's name
Type of Building	Twin pit	Truck IDs recorded	Driver's phone number
Address	Single pit		Company name
GPS	Containment Volume		RFID scanner at FSTP
Email (optional)			Truck Size
Aadhaar (optional)			FS weight (Narsapur only)
Wai - SANITab App			
General	On-Site	Service Info	At FSTP
Name	Containment Volume	Emergency or Scheduled	Truck Size
Mobile Number	Ready for service?	Number of Trips	Driver's name
Type of Building	Shape/Measurements	Operators used PE?	Truck plate number
Address	Covering type	Volume Removed	
GPS	Septic w/ Soak Pit	Last emptied	
Type of Property	Septic to Open Drain	Problems during empty	
Owner/Renter	Single Pit		
BPL Card Holder	Double Pit		
Slum/Non-Slum	Direct to Open Drain		
Number of Households	Sewer connection		
Institution type	Number of septic tanks		
Commercial type	Shared septic?		
Apt building name	Septic to open land		
Contact of building Sec.	Accessibility of pit/septic		
Number of toilets	Private toilet?		
Number of Flats	[Option to take a photo]		
Name of Owner			

