SFD Lite Report

Gurugram, Haryana
India

This SFD Lite Report was prepared by
TRCSS, JNU in collaboration with
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1 The SFD Graphic

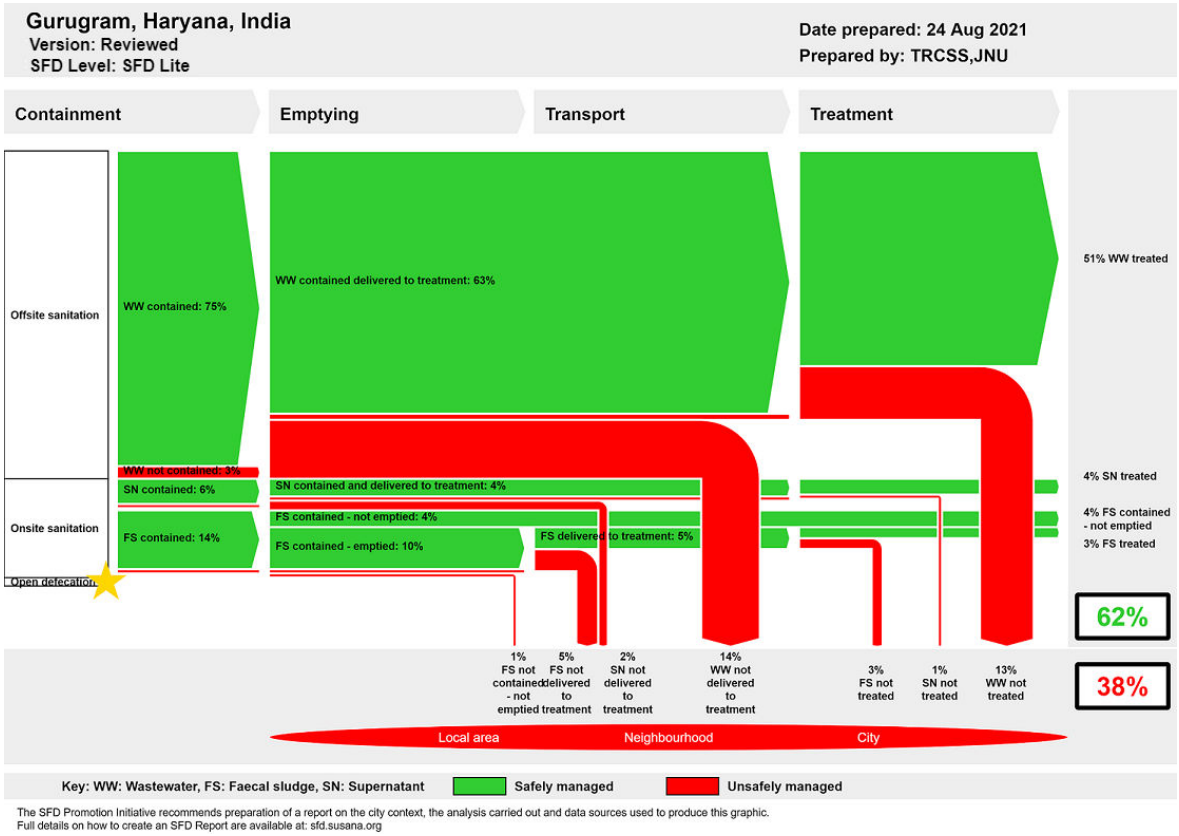

Figure 1: SFD Graphic for Gurugram.

2 SFD Lite information

Produced by:

- Uma Dey Sarkar, Transdisciplinary Research Cluster on Sustainability Studies (TRCSS), JNU.
- This report has been made as part of Blended Online and Residential Training Programme on Preparation of Shit Flow Diagram (SFD) conducted by Centre for Science and Environment (CSE) from 02/04/2021 to 27/05/2021 and compiled as part of SFD Promotion Initiative (SFD-PI) Project (Phase 3) funded by Bill and Melinda Gates Foundation (BMGF). Further, the report has been funded by CSE and compiled by Ms. Uma Dey Sarkar.
- We would like to thank Mr. Abhinav Verma (Executive Engineer, GMDA), Mr. Sunil Kumar and Mr. Sanjeev Singh (GMDA), Dr. Anita Phaswal (MCG), Dr. Harbhajan Singh (MCG) for providing the requisite secondary data and cooperating for KII interviews, Mr. Manjeet Singh for his time during the field visits for MCG desludging operations, and Mr. Rajendra Saroha for facilitating FGDs.
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Collaborating Partners:

- Municipal Corporation of Gurugram, Gurugram, Haryana.
- Centre for Science and Enoivironemnt, New Delhi.

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3 General city information

Gurugram, located 30 kilometres (km) southwest of the national capital of New Delhi, etymologically traces its roots to the ancient legend of *Guru Dronacharya* (Figure 2). The city is located at 28° 7'21" N and 77° 1'44" E with a mean elevation of 217 m above sea level. While there are no perennial rivers in the city, smaller seasonal streams drain the city which have been concretized as the city expanded. The natural topographical and climatic characteristics do not favour intensive agriculture in the district. However, Gurugram grew as an industrial hub in the early 1980s with the setting up of the automobile industry and since the early 2,000s, Information Technology (IT) industry and the financial sector has propelled the city's extraordinary economic development and Gurugram is now often also known as the "Millennium city".

According to the Census of India, 2011, Gurugram city had 208,229 households spread over an area of 184.59 sq. km. However, like the preceding decade, the city has grown exponentially to house over 400,000 households spread over 314 sq. Km (Table 1). The Municipal Corporation of Gurugram (MCG) has divided the city into 4 zones and 35 wards for provisioning of civic services while the Gurugram Metropolitan Development Authority (GMDA) has divided the sectors in 8 zones. While the GMDA is responsible for the provisioning and maintenance of trunk infrastructure in the city (such as water supply, sewer lines and stormwater drains), the MCG is responsible for provisioning and maintenance of infrastructure within colonies and urban villages under its jurisdiction. The total water supply in the city is 525 Million Litres per Day (MLD) during 2021 sourced from surface water from Gurgaon Water Supply (GWS) canal and National Capital Region (NCR) channel[1]. The per capita water supply in the city is estimated at 250 litres per capita per day (lpcd) with 90 percent of households with access to piped water supply[2].

Gurugram has tropical steppe, hot and semi-arid type of climate with four distinct seasons and an average rainfall of 505.4 mm (DCHB, Census of India 2011). The city is situated in a transitional zone between the Ganga Plain in the north and the Aravalli hills in the southeast and is covered by alluvium consisting of micaceous sand, silt, and clay with kankar[3]. Heavy seasonal flooding has become a common feature in the city as many of the natural catchment areas in the city have been completely concretized due to rapid urbanization. Unplanned growth of colonies in and around the city has also led to significant loss of natural drainage channels (such as the *Sahibi* river) and water bodies are currently being revived by the MCG. As the city is situated in a semi-arid zone, availability of water has always been a thorny issue. Over extraction of groundwater in the city has resulted in massive groundwater depletion with levels declining from 19.8 metres below ground level (mbgl) in 2006 to 36.9 mbgl in 2021.Though Gurugram is a planned city with fairly spaced out housing colonies, urban villages face typical problems of high density housing and inadequate civic services. Since the city has high coverage of piped water supply, piped water is the main source of drinking water (80 percent) in the city followed by bottled water (15 percent)[4].

[1] KII with Mr. Abhinav Verma, Executive Engineer, Water Supply Division, Infra-2, GMDA
[2] KII with Dr. Anita Phaswal, Consultant (SSC), MCG
[3] *Kankar* is a local term for deposits of calcium carbonate which usually occur in nodules ranging in diameter between <1 cm to 5 cm. They are typically found in older alluvial plains.
[4] KII with Dr. Anita Phaswal, Mr. Rajendra Saroha and field observation.

Table 1 : Population Growth Rate for Gurugram (Source: Census of India (2011) and MCG/ Compiled by Uma, TRCSS, JNU (2021)).

Census Year	Population	Decadal Growth Rate (%)	Source
1991	121,486	36.32	DCHB, Census of India, 2011
2001	201,322	65.72	DCHB, Census of India, 2011
2011	886,519	340.30	DCHB, Census of India, 2011
2021	1,894,644		MCG (Estimated)

MCG was certified as Open Defecation Free City (ODF) in 2017 by the Ministry of Housing and Urban Affairs (MoHUA) under the Swachh Bharat Mission (SBM). Further, in 2020, MCG was also declared as ODF++ which adds the condition that "faecal sludge/septage and sewage is safely managed and treated, with no discharging and/or dumping of untreated faecal sludge/septage and sewage in drains, water bodies or open areas."

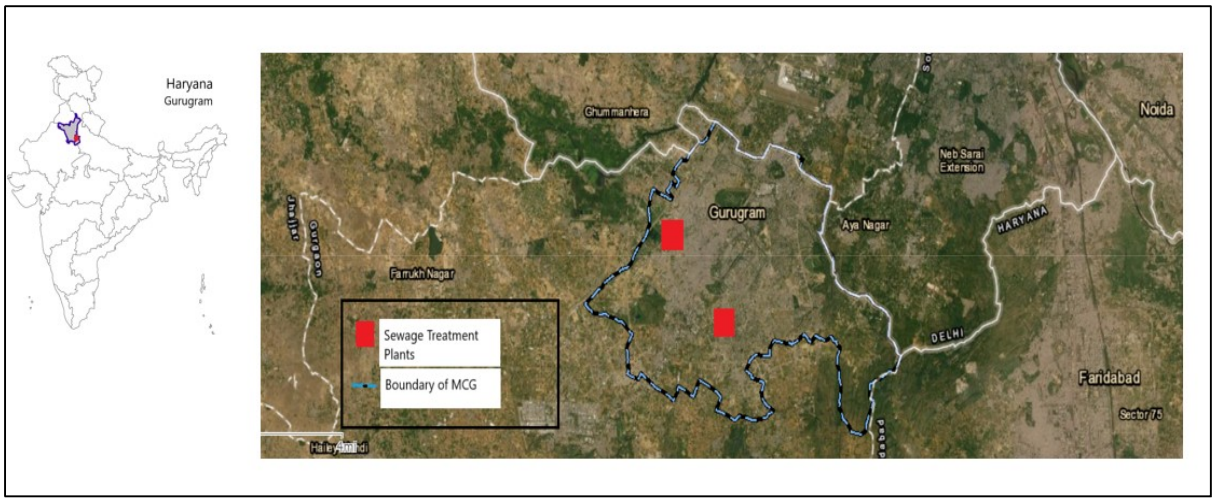

Figure 2: Map of Gurugram and the location of the Sewage Treatment Plants (STPs) in Gurugram (Data Source: Onemap Gurugram (GMDA), Compiled by: Uma/TRCSS, JNU (2021)).

4 Service outcomes

Gurugram, Haryana, India, 24 Aug 2021. SFD Level: SFD Lite
Population: 1894644
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 100%

Containment														
System type	Population	WW transport	WW treatment	WW transport	WW treatment	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment	SN transport	SN treatment
	Pop	W4a	W5a	W4b	W5b	W4c	W5c	F3	F4	F5	S4d	S5d	S4e	S5e
System label and description	Proportion of population using this type of system (p)	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of wastewater in sewer system, which is delivered to decentralised treatment plants	Proportion of wastewater delivered to decentralised treatment plants, which is treated	Proportion of wastewater in open sewer or storm drain system, which is delivered to treatment plants	Proportion of wastewater delivered to treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in sewer system, which is delivered to treatment plants	Proportion of supernatant in sewer system that is delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	50.0	80.0	80.0											
T1A1C4 Toilet discharges directly to a decentralised foul/separate sewer	25.0			90.0	80.0									
T1A1C6 Toilet discharges directly to open drain or storm sewer	3.0					50.0	80.0							
T1A2C6 Septic tank connected to open drain or storm sewer	2.0							50.0	50.0	50.0			50.0	80.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	2.0							80.0	50.0	50.0				
T1A3C2 Fully lined tank (sealed) connected to a centralised foul/separate sewer	12.0							60.0	50.0	50.0	70.0	80.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	6.0							80.0	50.0	50.0				

Table 2: SFD Matrix for Gurugram (Source: Uma/TRCSS, JNU (2021)).

The outcome of the SFD graphic shows that only 62 percent of the excreta flow is classified as 'Safely Managed' while 38 percent of all excreta flow is classified as 'Unsafely Managed' (Figure 1). The unsafely managed excreta originate from Faecal Sludge (FS) not contained-not emptied (1%), FS not delivered to treatment (5%), FS not treated (3%), Supernatant (SN) not delivered to treatment (2%), SN not treated (1%), Wastewater (WW) not delivered to treatment (14%), and WW not treated (13%). The safely managed excreta originate from WW delivered to treatment and treated (51%), SN treated (4%), FS contained - not emptied (4%) and FS delivered to treatment and treated (3%).

Overview on technologies and methods used for different sanitation systems throughout the sanitation service chain is as follows:

4.1 Offsite Systems

Gurugram has been developed as a planned city with major participation by private developers. Gurugram has a centralized sewerage network which MCG and GMDA are in charge of while there are a number of colonies developed by private developers which have their own sewerage network and decentralized Sewage Treatment Plants (STPs) within the colonies[5]. Even though the city has witnessed exponential growth over the last two decades, it is estimated that 90 percent of all areas within the city limits are covered by sewerage network[6]. The total length of sewerage network maintained by MCG is 3,484 km (within colonies) while GMDA maintains another 355 km of master sewerage network collecting wastewater from the colonies to the STPs. As such it is estimated that 50 percent of all households have toilets directly connected to centralized sewerage network (T1A1C2)

[5] KII with Mr. Sunil Kumar, Infrastructure Division (Sewerage), GMDA.
[6] KII with Dr. Anita Phaswal, Consultant (SSC), MCG.

maintained by MCG and GMDA (Figure 4) while 25 percent of all households live in colonies where toilets are connected to decentralized sewerage network and STPs maintained by individual colonizers within the colony (T1A1C4). During field work, it was also observed that some households in urban villages, other low-income areas located in the city's periphery have toilets which are connected to either open (*kaccha*) drains or storm water drains[7]. Moreover, 3 percent of the households use a toilet discharging directly to open drain or storm sewer (T1A1C6) (Figure 3).

Figure 3: Toilet in a low income settlement releasing wastewater into the open which further drains into an open drain (Source: Uma/TRCSS, JNU (2021)).

Since sewerage network has been extended to several colonies after they were already established, almost 12 percent of households have a hybrid system of onsite sanitation systems (OSS) such as a Fully Lined Tank (FLT) whose outlet is connected to sewer lines[8] (T1A3C2).

There are three main sewage pumping stations maintained by GMDA and numerous intermediate pumping stations being maintained by the MCG[9]. Currently, there are 5 STPs located in two main locations *(Dhanwapur and Behrampur)*. While the total installed capacity of the STPs is 388 MLD, the plants usually treat around 333 MLD. Out of the 5 plants, two of the treatment plants have co-treatment facilities while three of them are STPs[10]. *Dhanwapur* has 3 STPs which have a capacity of 100 MLD, 68 MLD, and 50 MLD while *Berhampur* has two STPs with a capacity of 120 MLD and 50 MLD. Each of the sites have one plant with co-treatment facility each.

Figure 4: A toilet directly connected to underground sewer (left) and wastewater in *kaccha* drain before joining the drain (right) (Source: Uma/TRCSS, JNU (2021)).

[7] Field observation.
[8] Field observation; FGD with masons (2021).
[9] KII with Dr. Anita Phaswal (Consultant, SSC, MCG) and Mr. Sanjeev Kumar, Sewerage Division, Infra-3, GMDA.
[10] KII with Mr. Sunil Kumar, Infra-3 , Sewerage Division, GMDA.

4.2 Onsite Sanitation Systems (OSS)

Containments: Based on the field observations and FGDs[14], it is estimated that roughly 22 percent of population depends on Onsite Sanitation Systems (OSS). Since sewerage network has been extended to several colonies after they were already established, almost 12 percent of households have a hybrid system of onsite sanitation systems (OSS) such as a Fully Lined Tank (FLT) whose outlet is connected to sewer lines (T1A3C2)[15]. The containment systems prevalent in the city are Fully Lined Tanks (FLTs) no outlet or overflow (T1A3C10, 2 percent), Septic Tanks (STs) connected to open drain (T1A2C6, 2 percent), and lined tank with impermeable walls and open bottom with no outlet or overflow (T1A4C10, 6 percent) (Figure 5). It is to be noted that most OSSs are in areas where trunk infrastructure is yet to reach, areas which have been recently added to the city limits, or areas in which sewer lines were laid once the area was already settled[16]. There is no general consensus on the size of STs or FLTs which are usually constructed as it depends on what the household size is or what purposes the household is used. In many areas with migrant workers renting accommodation or houses in plotted colonies, the volume of containment tanks is sizably larger[17].

Figure 5: Lined tank with open bottom and impermeable walls in a household in Gurugram.

Community Toilets/Public Toilets: There are 11 Community Toilets (CTs) and 110 Public Toilest) PTs in Gurugram with a total of 674 seats (Figure 6). The toilets are all directly connected to the sewerage network[18].

Figure 6: PT at Sikanderpur, Sector 26 (left) and CT at Block B, Sector 14 (right). (Source: Uma/TRCSS, JNU (2021)).

[14] FGD with masons (2021); KII with Mr. Rajendra Saroha.
[15] Field observation; FGD with masons (2021).
[16] KII with Mr. Rajendra Saroha, Dr. Anita Phaswal (Consultant, SSC-MCG) and field observation.
[17] FGD with masons (2021).
[18] KII with Dr. Harbhajan Singh, Consultant (SBM, MCG) and field visit.

Emptying: The city is largely dependent on mechanized desludging services provided by MCG for main sewer lines as well as for emptying of FS from FLTs (KII, Field Observation). The MCG contracts private operators for their services and currently, there are 6 operators with 24 desludging tankers who operate on behalf of the MCG. The contractors usually use a super sucker machine for cleaning and emptying, often in combination with high pressure jetting machines if required. Since the machines have long hoses, manual cleaning is almost non-existent or very rare[19].

MCG and GMDA have offered helpline services to the citizens where households can place calls for emptying services or desludging of sewer lines. This is especially prevalent in areas where the density of population is high and population exceeds the capacity of installed sewer lines[20]. Recently, MCG has also invested in acquiring two 'robot' desludgers for use in cleaning manholes of smaller dimensions (Figure 7). While MCG recommends emptying tanks at least once every three years, emptying cycle varies depending on the size of the tank[21]. Hence, variable F3 (emptying) is taken between 50-60 percent for tanks which are connected to sewer networks or open drains or storm water drains. On the other hand, F3 is taken as 80 percent for tanks which do not have any outlet or overflow as they would require more frequent emptying.

There are non-registered private vacuum tankers which operate in the city as well and while people do not prefer using their services as their rates are not fixed, they are active in peri-urban areas[22].

Figure 7: Cleaning of a sewer line in Sector 56 (left) and 'Robot' desludger used for cleaning small manholes (right). (Source: Uma/TRCSS, JNU (2021)).

Transport: MCG uses the same contractors and their machines for transporting sludge for most areas of the city while there are also a few tractor-mounted desludging machines though they are not widely used[23]. While desludging is free for sewer lines, individual households are charged between Rs 2,000-4,000 (US$ 27-55) by authorized private contractors if they avail these services. Wastewater generated by toilets which are directly connected to centralized or decentralized sewerage systems are estimated to reach STPs

[19] KII with Mr. Manjeet (Consultant, MCG).
[20] KII with Mr. Rajendra Saroha; Field Observations.
[21] FGD with masons (2021).
[22] KII with private operator of desludging tanker.
[23] KII with Mr. Manjeet, Consultant (MCG).

due to fairly recent infrastructure in most areas[24]. Hence, variable W4a is taken at 80 percent accounting for leakages in sewer lines in older sewer lines. Given that it is mandatory for larger colonies run by colonizers to have their own decentralized STPs in or near the colonies[25], variable W4b has been estimated at 90 percent. However, there are open drains which are yet to be intercepted and diverted by GMDA[26]. Therefore, variables W4c and S4e are taken as 50 percent. S4d is estimated as 70 percent as diversion of supernatant from FLTs to underground sewer lines is sometimes interrupted due to leakages and failure of proper connection between the FLT and underground sewerage network[27].

Treatment and Disposal: The designated sites for disposal of FS is any of two STPs with co-treatment facility available (Figure 2). The sludge generated in STP is usually disposed of or sold by the private operators engaged in STP management. Some treated wastewater is reused for various uses such as horticultural activities (5 MLD), irrigation and construction sector (70 MLD), and use in the textile industry (10 MLD) while the rest of the treated wastewater is discharged in the *Badshahpur nalla*[28].

On the other hand, untreated WW by some colonies and drains which are yet to be diverted to the STPS is often disposed of in storm water drains which ultimately drain into the *Badshahpur nalla*. Many private operators also dispose of FS from individual households into open fields on the outskirts of the city or into open drains[29]. The test reports from the STP revealed that discharge standards prescribed by CPCB were met by all the 5 STPs. GMDA and MCG also maintain some level of checks on decentralized STPs maintained by private developers.

Since the STPs are not utilized to their full capacity, it was informed that they can usually treat wastewater that is delivered to the STPs through the sewerage network. Since the STPs are usually not operating at full capacity, wastewater which reaches the STPs is never diverted without treatment[30]. Moreover, STP test sample reports provided by MCG and GMDA showed that critical parameters were within permissible limits. Hence, variables W5a, W5b, W5c, S5d and S5e are taken as 80 percent. Since OSS are prevalent in places where trunk infrastructure is yet to reach and no data is available on treatment of FS, F5 is taken as 50 percent.

5 Data and assumptions

Considering Census of India (2011) as the baseline, data for all stages of the sanitation chain were updates based on the data collected from field through KIIs, FGDs, field observations, and secondary data made available by relevant stakeholders. Following assumptions were made for developing the SFD graphic for Gurugram:

- Volume of wastewater generated is estimated as 80 percent of the volume of total water supplied.

[24] KII with Dr. Anita (MCG).
[25] KII with Dr. Anita (MCG) and Mr. Sanjeev Kumar, Infra-3, Sewerage Division, GMDA.
[26] KII with Mr. Sunil (GMDA) and Mr. Rajendra Saroha.
[27] FGD with masons (2021).
[28] KII with Mr. Sanjeev Kumar, Infra-3, Sewerage Division, GMDA.
[29] KII with private operator.
[30] KII with Mr. Sunil, Infra-3, Sewerage Division, GMDA.

– As per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website, it is assumed that 50% of the contents of septic tanks and fully lined tanks is FS and 100% for lined tanks with impermeable walls and open bottom.

6 Context-adapted SFD Graphic

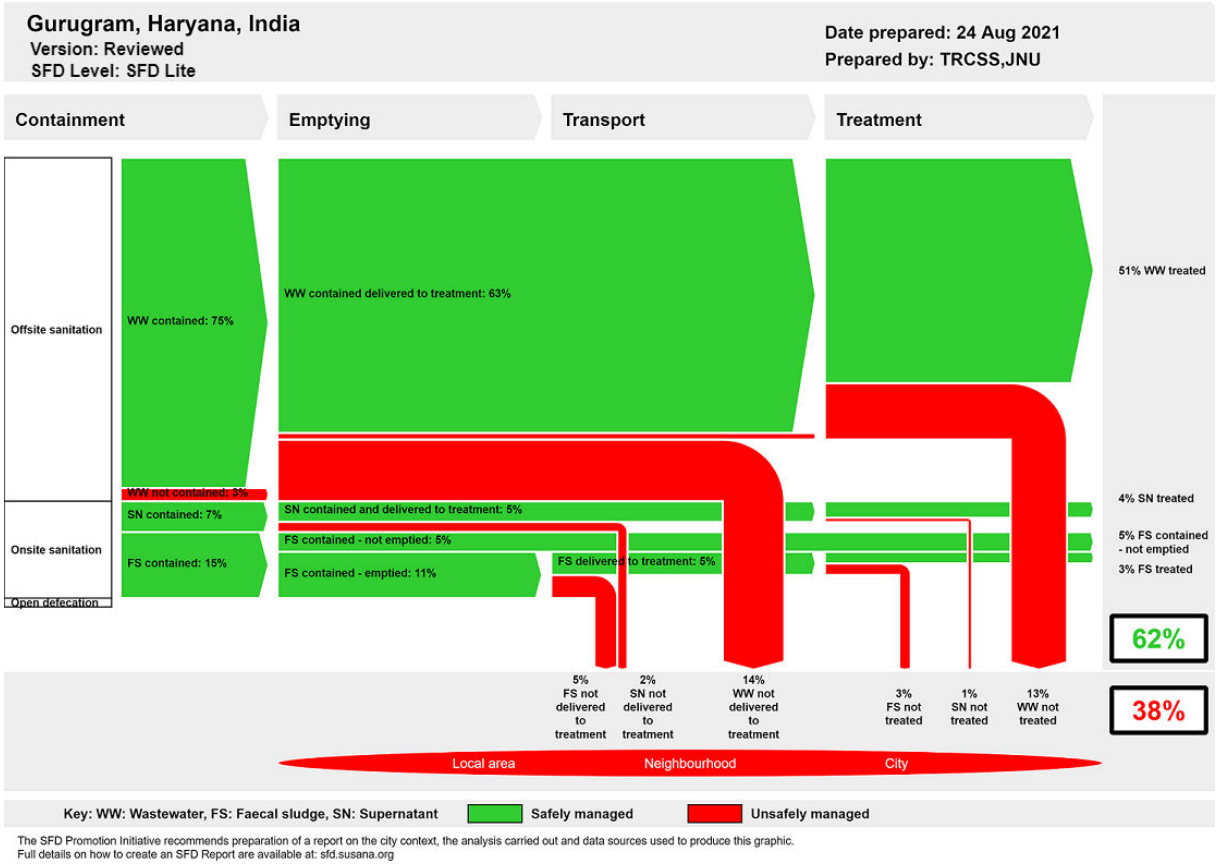

Figure 6: Context-adapted SFD Graphic for Gurugram (Source: Uma/TRCSS, JNU (2021)).

The only difference suggested in the context-adapted SFD is at the containment stage for correctly designed septic tanks, though connected to open drains. Based on the assumptions, 50% of the proportion of the content of the septic tank is solid FS, which is generated and collected inside the septic tanks. The remaining 50% of the content is supernatant, which attributes to be 1% of the population flows through open drains (shown in red at containment side).

The solid FS collected in the septic tank is considered to be contained and hence 15% of FS is contained (represented green in colour at containment stage). Followed by this, 11% of FS contained is emptied, and the remaining 8% is FS remaining in the tank which is contained and never emptied. The supernatant generated from the septic tank connected to the open drain is not contained and hence is considered to be unsafely managed (represented in red). Overall, however, because the proportion of population relying on septic tanks to open drain in Gurugram is very less (2 percent), there is no difference to the overall proportion of excreta being safely managed (62 percent).

7 List of data sources

Reports and literature

- Centre for Science and Environment (2007), Gurgaon- The Water Waste Portrait, available at http://cdn.cseindia.org/userfiles/gurgaon.pdf
- District Census Handbook 2011, Gurgaon, Census of India, 2011 Part-A, Statement-III, p.252-253
- District Census Handbook 2011, Gurgaon, Census of India (Houses and household amenities and assets, Table HH-08) https://www.censusindia.gov.in/2011census/Hlo-series/HH08.html
- MoUD. 2017. National Policy on Faecal Sludge and Septage Management. Ministry of Urban Development
- GMDA (2020), "Status report in EA no. 52/2018 in O.A. No. 454/2018 Subhash Gupta vs. UoI", available at https://greentribunal.gov.in/sites/default/files/news_updates/STATUS%20REPORT%20in%20OA%20454%20Of%202018%20(Subhash%20Gupta%20&%20Ors.%20VS.%20Union%20Of%20India%20&%20Ors.).pdf
- Gurugram District profile (2009), Central Ground Water Board, available at http://cgwb.gov.in/District_Profile/Haryana/Gurgaon.pdf
- Groundwater Yearbook of Haryana State (2017-2018), CGWB, Ministry of Water Resources, River Development And Ganga Rejuvenation, available at http://cgwb.gov.in/Regions/NWR/Reports/2017-18%20Haryana%20GWYB.pdf

Key Informant Interviews (KIIs)

- Mr. Abhinav Verma, Executive Engineer, GMDA.
- Sri Sanjeev Kumar, Infrastructure Division (III- sewerage), GMDA.
- Sri Sunil Singh, Infrastructure Division (III- sewerage), GMDA.
- Dr. Harbhajan Singh, Consultant at CMO's office, MCG (Swachh Bharat Mission).
- Dr. Anita Phaswal, Consultant, MCG (Safaimitra Suraksha Program).
- Mr. Manjeet, Consultant, MCG (Safaimitra Suraksha Program).
- Private desludger operator (wants to remain anonymous).
- Mr. Rajendra Saroha, CITU (Informal sanitation workers).

Focus Group Discussions (FGDs)

- FGD-1, 2020; FGD with masons.

Field Visits

- Public toilets (Sikanderpur Community Center, Sec-17 Market), Community toilets (District Court, Block B, Sec-14).
- Random household survey at Sarai Alawardi, Chakkarpur, Sikanderpur, and Surat Nagar Extension.

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