SFD Lite Report

Rudrapur
Uttarakhand, India

This SFD Lite Report was prepared by
Sanitation Capacity Building Platform (SCBP),
National Institute of Urban Affairs (NIUA).

Date of production: 13/04/2022

1 The SFD Graphic

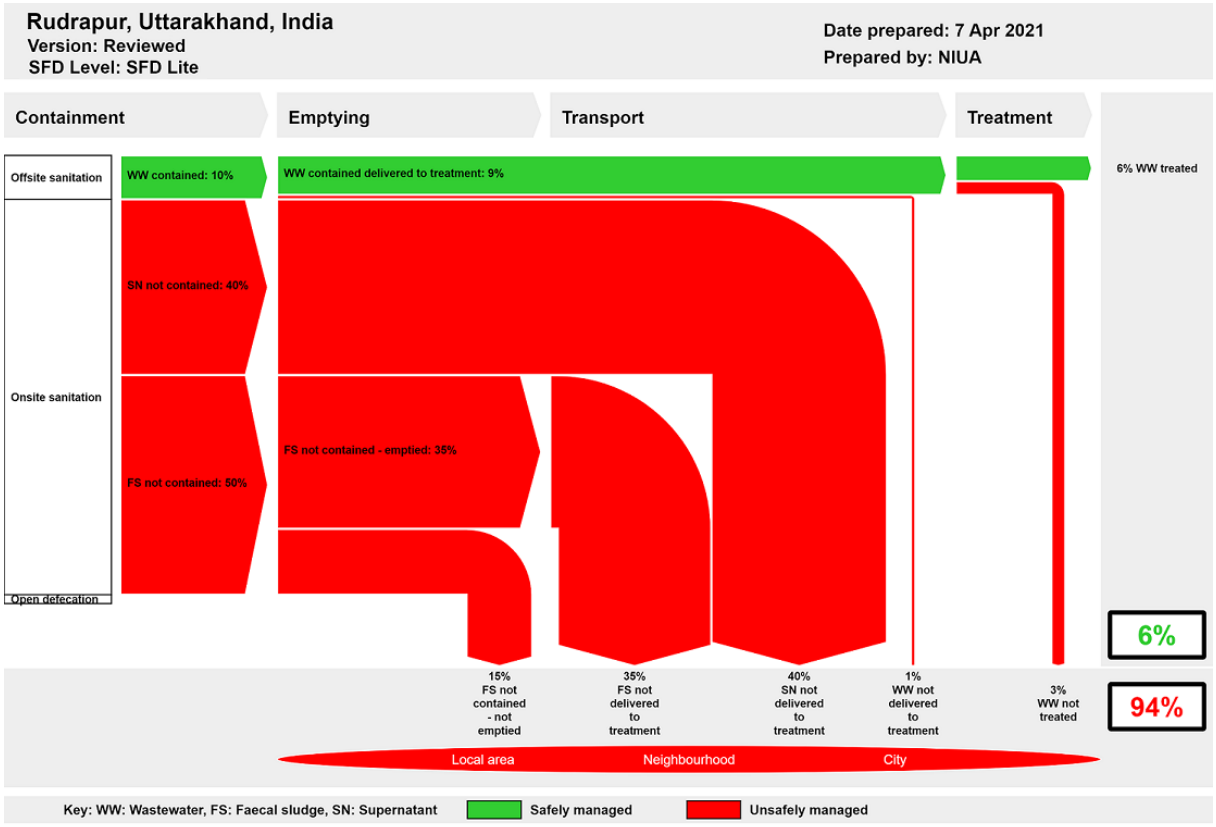

Figure 1: SFD Graphic for Rudrapur.

2 SFD Lite information

Produced by:

- Sanitation Capacity Building Platform (SCBP), National Institute of Urban Affairs (NIUA), New Delhi, India
- This report was prepared as part of the support to Uttarakhand State for Scale up of Faecal Sludge and Septage Management solutions.
- We would like to thank Mr. Rinku Bisht, Municipal Commissioner, Rudrapur Nagar Nigam (RNN), and Mr. Ajay Bansal, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Urban Infrastructure expert, RNN. Mr. A.K Kataria, Executive Engineer (EE), Pey Jal Nigam, RNN and Sanitation Worker for supporting and providing the data required and cooperating for Key Informant Interviews (KIIs) & Focused Group Discussions (FGDs).
- Special thanks to Mr. Ravi Pandey, SE (Superintendent Engineer), Urban Development Directorate (UDD) for their overall guidance and facilitation on the study.

Collaborating partners:

- Rudrapur Nagar Nigam

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3 General city information

Rudrapur (Kumaoni: Rudrpur) is a city in Udham Singh Nagar district in the Indian state of Uttarakhand, located (28°59'09.1"N 79°24'41.7"E) at a distance of about 250 km (160 miles) northeast of the national capital, New Delhi and 250 km (160 miles) south of State capital Dehradun(Figure 2). Rudrapur has a history of over 500 years, it was established in the 16th century by King Rudra Chand, and was the residence of the governor of Tarai region of Kumaon (between the Siwalik range and the Indo-Gangetic Plains). The city continues to serve as the headquarters of the Udham Singh Nagar district apart from being a major industrial and educational hub. In 2021, Rudrapur Nagar Nigam (RNN) has an overall population of 175,723[1] residing in the municipal area of 55.25 sq. km[1] with 40 wards and population, density is around 3,180 persons per sq. km[1] (Table 1).

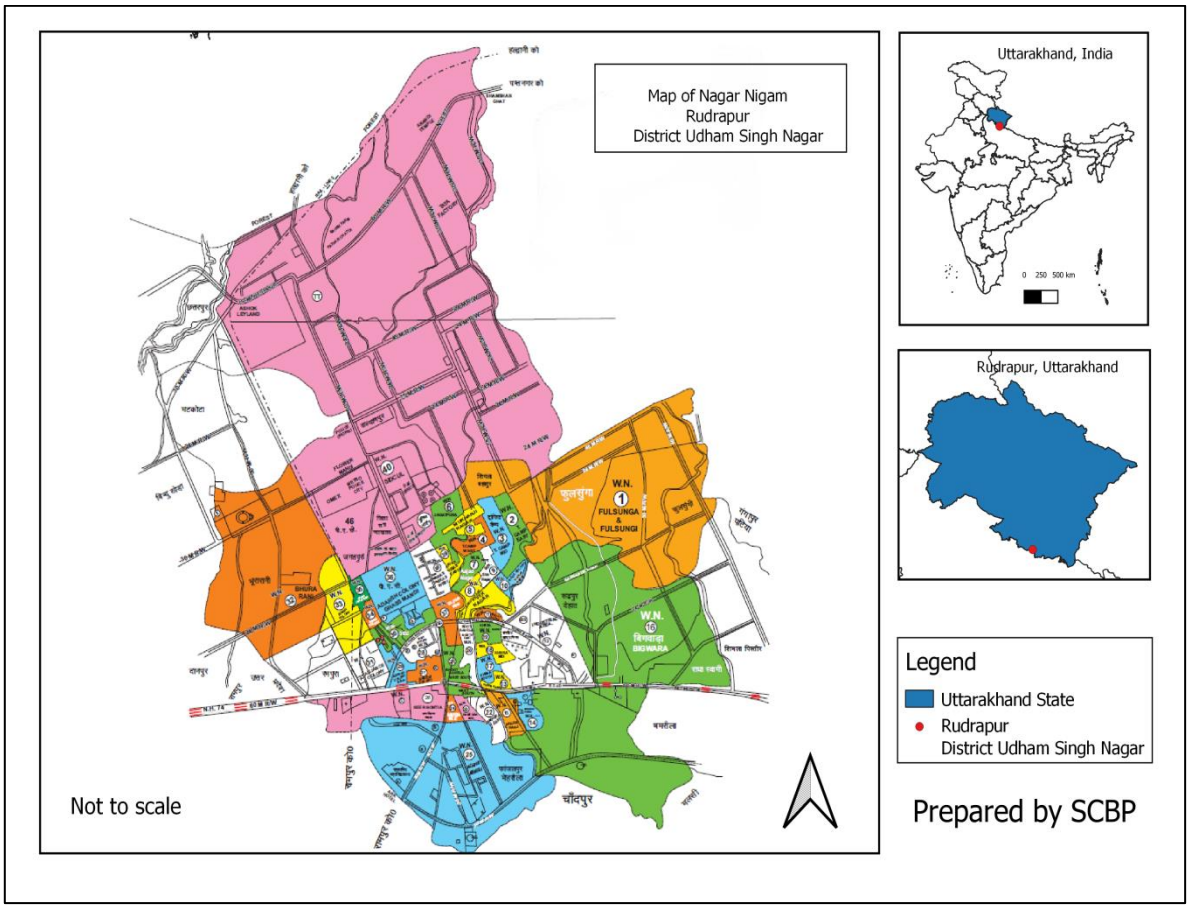

Figure 2: Rudrapur Nagar Nigam Ward Map (Source: Rudrapur Nagar Nigam/2021).

The region is largely a part of the alluvial plain and the soil comprises of clay, sandy clays, fine to medium sand, and occasional gravel. The average annual rainfall is about 1,230.3 mm, with maximum rainfall received in the monsoon months of June to September. The Kalyani River flows through the municipal area, which is a spring-fed river originating from the forests of Nainital district in the north. The river flows roughly north to south direction of the city, crossing seven of its forty wards. The average depth of water table in Rudrapur is in the range of 1.5 m to 3.78 m (for the year 2017-18), with a long-term decadal range of 2.02 to 4.14 m[2]. During field-based study, it has been observed in different parts of the municipal area that households

[1] Rudrapur Nagar Nigam Portal 2021
[2] Central Groundwater Board (CGWB), Uttarakhand Groundwater Yearbook 2019-2020

tap water directly through hand pump/ tube well at depths of around 150 – 180 ft). The State Infrastructure and Industrial Development Corporation of Uttarakhand Limited (SIIDCUL) is located in the city, which is therefore an important industrial and trading centre. SIIDCUL zone has a Common Effluent Treatment Plant (CETP).

Table 1: Population Growth (Source: Udham Singh Nagar District Census Handbook/ 2001-2011).

Census Year	Population	Decadal Growth	Source
2001	88,815		Census Handbook,2001
2011	154,554	74%	District Census Handbook,2011
2021	175,723	13%	Rudrapur Nagar Nigam Portal

Currently only 11 wards out of 40 in RNN have piped water connection with a supply of 49 Lpcd (litre per capita per day) in ward numbers 27, 28, 29,30, 31, 34, 35, 36, 38, 39 and 40[3] which is 28.72% of the overall population. Other wards are mostly dependent on groundwater by extracting water for daily use through hand pumps and tube wells.

Under the AMRUT water supply schemes, five zones have been planned covering a population of around 50,000, to provide 135-lpcd piped water supply. The source of water for targeted population will be 10 tube wells [each of 200 m depth (600-700ft)] with an overhead tank constructed in each zone[4].

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[3] Primary data from KII in Rudrapur Nagar Nigam
[4] Primary data from KII in Jal Nigam

4 Service outcomes

Table 2: SFD Matrix for Rudrapur, Udham Singh Nagar, Uttarakhand (Source: Sachin/NIUA/2022).

Rudrapur, Uttarakhand, India, 7 Apr 2021. SFD Level: SFD Lite
Population: 175723
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

Containment								
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	W4a	W5a	F3	F4	F5	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 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 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	10.0	90.0	65.0					
T1A2C6 Septic tank connected to open drain or storm sewer	40.0			100.0	0.0	0.0	0.0	0.0
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	40.0			50.0	0.0	0.0	0.0	0.0
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	10.0			100.0	0.0	0.0		

A field-based study was conducted in the city covering 8 wards and around 30 households spreading across areas adjacent to Kalyani River. Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were conducted with the relevant stakeholders in accordance to SFD Manual. The interviews with households covered different types of settlement typologies from densely populated, newly developed colonies and gated societies, high-income group settlements to low income and informal settlements. Municipal boundary is considered for the current study.

The output of the SFD graphic represents that only 6% of the human excreta flow is attributed to be safely managed and the remaining 94% is unsafely managed (Figure 1). The unsafely managed excreta of 94% are contributed by offsite sanitation as well as onsite sanitation. Under offsite component, Wastewater (WW) not delivered to treatment due to leakages and transportation inefficiency is attributed by 1% of the population, WW not treated due to non-operational and inefficacy of treatment facilities is attributed by 3% of the population; Under onsite components, Faecal Sludge (FS) not contained i.e. FS from septic tanks connected to open drains and soak pits together constitutes 50% and fully lined tanks connected to open drains is attributed by 40% of the population. Henceforth, FS not contained – not emptied (15%) represents portion of FS, which remains in tanks and infiltrate into the ground. Faecal Sludge (FS) emptied but not delivered to treatment, hence discharged in the neighbourhood is attributed by 35% of the population. Supernatant (SN) generated from systems (septic tanks + fully lined tanks) to open drains (i.e. 50% proportion of the content in the tank is FS and 50% is SN) largely gets SN discharged into open drains and not delivered to treatment facility is attributed by 40% of the population,

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

4.1 Off-site Systems

The city does not have a sewer network and is largely dependent upon Onsite Sanitation Systems (OSS). Further State Infrastructure and Industrial Development Corporation of Uttarakhand Limited (SIIDCUL) industrial area, which falls under ward 40, has a ward-level sewer network connected to a CETP. The CETP receives and treat domestic sewage as well as industrial effluent both. There are a few privately developed residential colonies often called as “township” that consists of majorly multi-storey apartments and villas. The Omaxe Township is having 1,500 households and Metropolis Township is having 1,200 apartments and 250 independent villas. Both the townships are having their own sewerage system. The average household size is considered four for SFD calculation.

The sewage from these households is conveyed through sewers to decentralized Sewage Treatment Plant (STP) within the society premises for which the system selected was ‘Toilet discharges directly to a centralized foul/separate sewer (T1A1C2)’ comprising of 10% of the total population. A small Sewage Treatment Plant of 1,200 Kilo Litres per Day (KLD) capacity (Figure 3) is operating within Omaxe gated society, which receives sewage from around 1,000 households on the premises. The treated wastewater is used for horticulture and landscaping purposes.

Figure 3. Sewage Treatment plant in Private Societies (Source: Aparna/NIUA/2021).

Community Toilets (CTs)/Public Toilets (PTs)

For floating population and public gatherings, often mobile toilets are used. These toilets are maintained by Nagar Nigam.

Figure 4. Public Toilet (Source: Laila/NIUA/ 2021).

4.2 Onsite Sanitation System

The city is primarily dependent on Onsite Sanitation Systems (OSS) with 90% of the population. During the field-based study, it was observed by the researcher as well as through interviews with households and masons, that the predominant type of sanitation systems in households across Rudrapur are septic tanks and fully lined tanks. The grey water generated from households dependent on OSS is discharged into open drains (Figure 5).

Figure 5: Grey water discharge into open drains (Source: Aparna/NIUA/2021).

***Containment*:** Based on field based study, it is estimated that 40% of the population is dependent on septic tanks which are connected to open drains or storm water drains followed by 10% of the population dependent on septic tanks which are connected to soak pit (Figure 6). Rest, 40% of the population is dependent on fully lined tanks (sealed) connected to open drains (Figure 7 and Figure 8). Containment systems, which are rudimentary designed septic tanks and emptied for more than 5 years, are considered as fully lined tanks. These systems are connected to open drains and selected as T1A3C6. However, few septic tanks were observed correctly designed as septic tank system with emptying frequency of less than 5 years but are connected to open drains and thus selected system T1A2C6. Households in the government quarters and institutions were found to have correctly designed septic tanks connected to soak pits and hence selected system T2A2C5. The septic tanks are rectangular in shape and the dimensions reported mostly around 8 ft (2.4 m) length 4 ft (1.2 m) breadth and 6 ft (1.8 m) depth.

Figure 6: Septic tank connected to soak pit in ward no. 21 (Source: Aparna/NIUA/2021).

Figure 7: Fully lined tank connected to open drain (Source: Aparna/NIUA/ 2020).

Figure 8: Fully lined tank without access-hole (Source: Aparna/NIUA/ 2020).

Figure 9: Hand pump adjacent to open drain in ward no.22 (Aparna/NIUA/2021).

Ground Water Risk Assessment

As per the risk assessment done on the groundwater pollution risk estimation tool provided by the Graphic Generator, the rock type in the unsaturated zone was selected 'fine sand with silt and clay deposits' with the groundwater depth[2] less than 5m. Due to high groundwater table, the tool estimated - high risk of groundwater contamination - and hence considered for the same in the selection of the systems.

Emptying and Transportation

Offsite sanitation: Out of 10%, Wastewater (WW) contained, 1% is assumed as leakages and transportation losses of wastewater (variable W4a set to 90%). Thus, it is attributed that only 9% of the population's excreta reaches to the treatment facilities.

Onsite Sanitation: There are 9 private vacuum tanker operators operating in the city out of which deven tankers have been registered by the ULB as of February 2021 (Figure 10 and Figure 11). The urban local body has two vacuum tankers. On an average, each private operator gets one trip per day. Many containments require multiple trips to empty containment units. These trucks had an average capacity of 4,000 litres with a desludging cost of INR 1,500 (US$ 19[5]) to INR 2,000 (US$ 26).

[5] 1 US$ = 76.17 INR

While interviewing and discussions with the households, 50% of households responded that, they have never emptied their tanks. The other 50% of the households reported emptying only when user interface is blocked or overflow occurs from access-hole. Thereby, 50% (variable F3) is assumed for the proportion of faecal sludge emptied for system 'fully lined tanks connected to open drains'. As properly designed septic tanks are emptied regularly than fully lined tanks, hence 100% (variable F3) of emptying is assumed for proportion of faecal sludge emptied.

Figure 10: Private Desludgers in RNN (Source: Laila/NIUA/2021).

Figure 11: Vacuum Tankers owned by RNN (Source: Laila/NIUA/2021).

Treatment and disposal

There is no operational centralized Sewage Treatment Plant (STP) or Faecal Sludge Treatment Plant (FSTP) available in the city. Although, there is one Common Effluent Treatment Plant of capacity 4 Million Litres per Day (MLD) at SIIDCUL area in ward no. 40 of Rudrapur Nagar Nigam. The plant is currently receiving 2 MLD raw effluent, which is run and operated by Ramky Enviro. This CETP also treats domestic wastewater from the respective ward, which mostly includes institutional, commercial buildings as well as factories. Recently, Ramky has been given No-objection to Rudrapur Nagar Nigam for discharge of septage in the CETP (co-treatment of FS with wastewater) with a tipping fee of INR 200 (US$ 2.63). This CETP is being planned to be used as a temporary septage disposal site until the individual FSTP is operational. The plant has received 4-5 tankers in past 4 months[6] since permitted for co-treatment by CETP. Therefore, the volume of FS collected and treated as a practice is insignificant and hence not been considered in the SFD graphic, thereby variables F4, F5, S4e and S5e for all onsite systems were set to 0%.

There are two decentralised STPs each of capacity 1,200 KLD at two private housing colonies in the city. During the field-based study, it was observed that one STP at Metropolis City Township was receiving wastewater from the township but the plant was not in operation. The other STP at Omaxe Society was working properly as reported during the key informant interview conducted with the management staff of the gated society. Thus, it is attributed that only 65% (variable W5a) of the population's WW is delivered to centralized treatment plants, which is treated.

Open Defecation (OD)

[6] This figure is since January-April 2021.

As no Open Defecation Free (ODF) certification is provided to RNN and the percentage of population practising open defecation was less than 1% of overall population it cannot be justified over the graphic whether to consider it ODF or not.

5 Data and assumptions

District Census Handbook 2011 for Udham Singh Nagar and Master Plan Uttarakhand,2031(draft) were considered as the baseline and the data for all the stages of sanitation chain were updated based on the data collected from field through KIIs, FGDs, observations and secondary data collected from relevant stakeholders. Following assumptions were made for developing the SFD graphic for Rudrapur:

- Volume of wastewater generated is estimated as 80% of volume of water supplied.
- Since there is no clear differentiation between % of faecal sludge and supernatant, it is assumed to be 50% each.
- Less than 25% of the sanitation facilities are located <10 metres away from groundwater sources.
- More than 25% of drinking water is produced from groundwater resources.

6 Context-adapted SFD Graphic

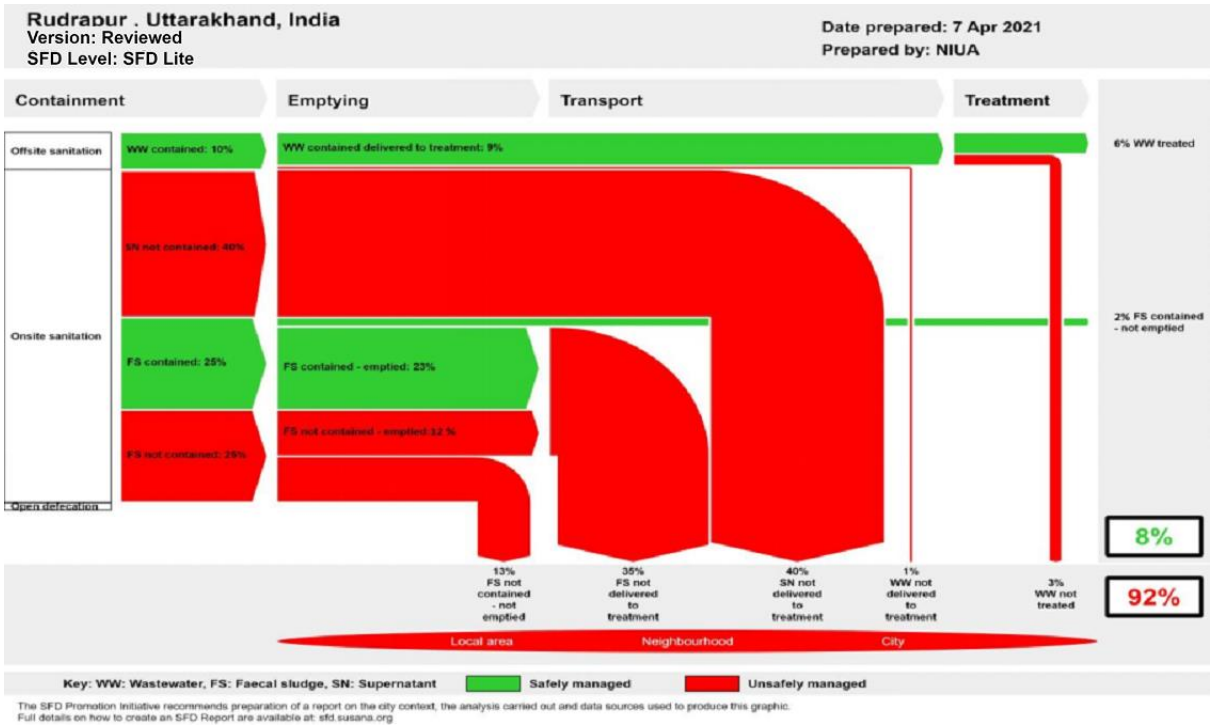

Figure 12. Context-adapted SFD graphic for Rudrapur (Source: SCBP/2021).

The only difference suggested in the context-adapted SFD is at the containment stage for correctly designed septic tanks but connected to open drain and soak pits with high groundwater table. Although, these systems are considered to be unsafe practices, but to represent that those containment systems are correctly designed and properly functioning with regular emptying, hence a revised SFD context-adapted graphic is created manually for advocacy purposes. According to the assumption, 50% of the proportion of the content of the septic tank is solid Faecal Sludge (FS), which remains in the septic tanks. The remaining 50% of the content is Supernatant (SN) that attributes to 40% of the population, which flows through open drains. The FS collected in the septic tank is considered to be contained in the context-specific of local conditions, hence 25% of FS is contained and 23% is emptied (represented green in colour at the containment stage) and the remaining 2% is FS still contained - not emptied, since a small portion of FS remains in the septic tank even after the desludging process. Overall, the excreta of 8% of the population is safely managed according to the context-adapted SFD graphic.

7 List of Data Sources

Reports and Literature

- District Census Handbook of Udham Singh Nagar, Census of India, 2011.
- Ground Water Year Book of Uttarakhand, CGWB, 2019-2020.
- Revised Action Plan for Rejuvenation of Kalyani River Stretches.

Key Informant Interviews (KIIs)

- KII-1, 2021; Interview with Rinku Bisht, Municipal Commissioner, Rudrapur Nagar Nigam.
- Ajay Bansal, Atal Mission for Rejuvenation and Urban Transformation (AMRUT).
- A.K Kataria, Executive Engineer (EE), Pey Jal Nigam, RNN.

Focus Group Discussions (FGDs)

- FGD-1, 2021; Focus Group Discussion with Sanitation Workers.
- FGD-2, 2021; Focus Group Discussion with Local People, Masons.

Field Observations

- Conducted households, covering Slums, Lower Income Groups (LIG), Middle Income Groups (MIG) and Higher Income Groups (HIG) spread throughout the city.
- Survey of Public Toilet (1 No.).

Rudrapur, Uttarakhand, India 2021

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