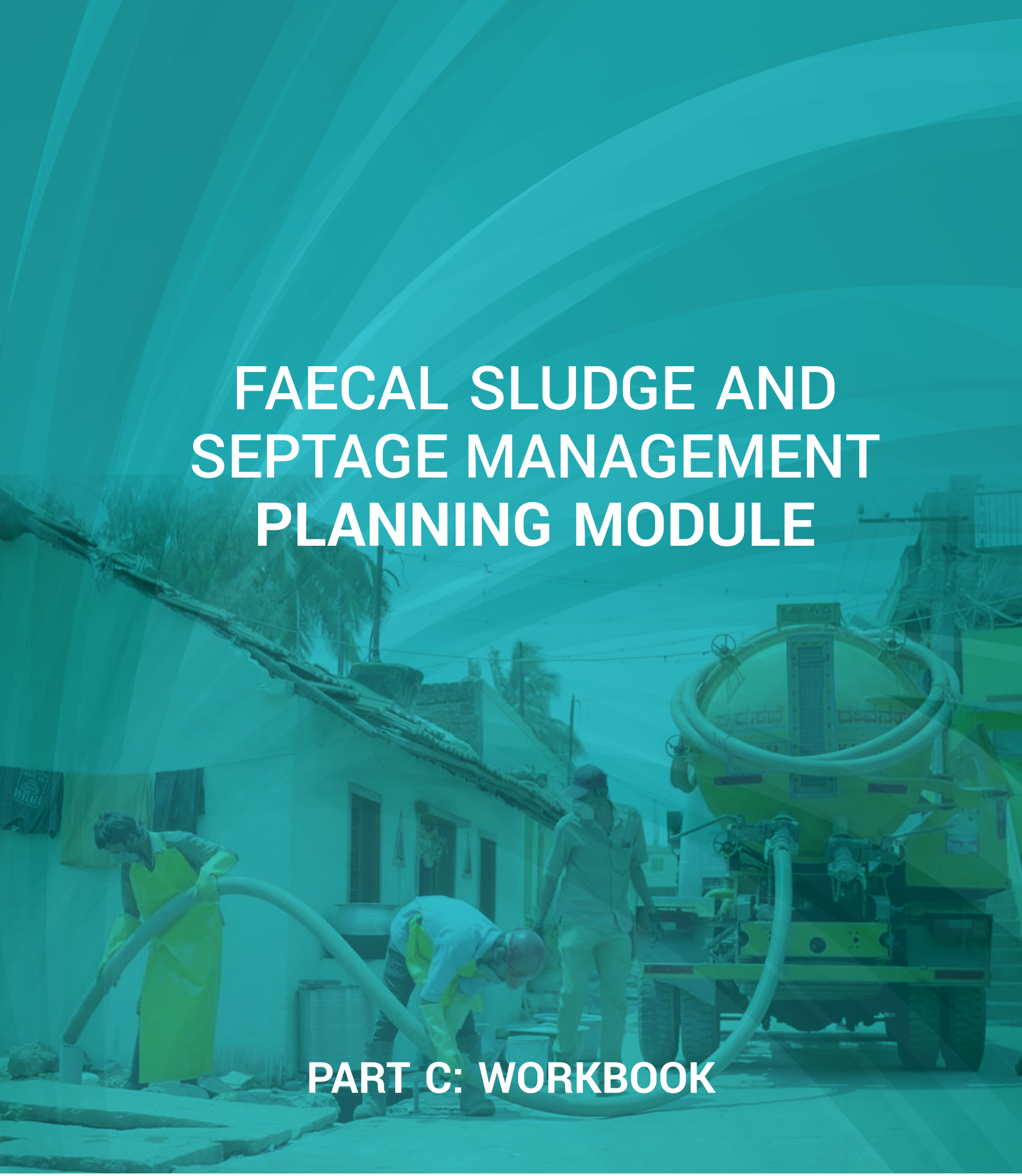
FAECAL SLUDGE AND SEPTAGE MANAGEMENT PLANNING MODULE



PART C: WORKBOOK

National Institute of Urban Affairs

NFSSM Alliance

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FAECAL SLUDGE AND SEPTAGE MANAGEMENT PLANNING MODULE

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COLLABORATIVE EFFORT UNDER TRAINING MODULE REVIEW COMMITTEE (TMRC)

National Institute of Urban Affairs

NFSSM Alliance

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TITLE

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CONTENT

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Foreword

Acknowledgements

ABOUT NATIONAL FAECAL SLUDGE AND SEPTAGE MANAGEMENT ALLIANCE (NFSSMA)

The 'NFSSM Alliance' was formed with a vision to "Create an enabling environment which amplifies scaling of safe, sustainable and inclusive FSSM through knowledge, partnerships and innovative solutions by 2024."

Convened by Bill and Melinda Gates Foundation in 2016, the Alliance is a voluntary body that aims to:

- Build consensus and drive the discourse on FSSM at a policy level, and
- Promote peer learning among members to achieve synergies for scaled implementation and reduce duplication of efforts

The Alliance currently comprises 32 organizations across the country working towards solutions for Indian states and cities. The Alliance works in close collaboration with the Ministry of Housing and Urban Affairs (MoHUA) and several state and city governments through its members to support the progress and derive actions towards mainstreaming of FSSM at state and national level. The NFSSM Alliance works on all aspects of city sanitation plans to regulatory and institutional frameworks across the sanitation value chain. The NFSSM Alliance working in collaboration with the Ministry of Housing and Urban Affairs has been instrumental in the passage of India's First Policy on FSSM launched in 2017. This resulted in 19 out of 36 states adopting guidelines and policies for FSSM in India.

The strength of the Alliance lies in its diverse membership, which includes research institutes, academic institutions, think-tanks, quasi-government bodies, implementing organizations data experts, consultants and intermediaries. This enabled a multi-disciplinary view of urban sanitation, with members building on each other's expertise. The alliance has had enormous success in championing FSSM as a viable solution to the Government of India by broadly focussing on:

1. Influencing and informing policy
2. Demonstrating success through innovation and pilots
3. Building capacities of key stakeholders across the value chain

The collaborative effort continues to work towards promoting the FSSM agenda through policy recommendations and sharing best practices which are inclusive, comprehensive, and have buy-in from several stakeholders in the sector.

NFSSM Alliance

- ASCI
- Athena Infonomics
- BBC Media Action
- BMGF
- Borda
- CEPT University
- CSTEP
- CDD
- CPR
- CFAR
- CSE
- Dasra
- EY
- GIZ
- IIHS
- ISC
- IWMI
- KPMG
- NIUA
- PSI
- RTI International
- Tide Technocrafts
- UMC
- UNICEF
- USAID
- WASHi
- Water Aid
- World Bank Group

ABOUT TRAINING MODULE REVIEW COMMITTEE (TMRC)

To ensure quality control in content and delivery of trainings and capacity building efforts, a **Training Module Review Committee (TMRC)** was formed with the collaborative effort of all Alliance partners. TMRC which is **anchored by National Institute of Urban Affairs (NIUA)**, has the following broad objectives:

- Identification of priority stakeholders and accordingly training modules for Capacity Building
- Development of a Normative Framework – For Capacity Building at State Level
- Standardization of priority training modules – appropriate standardization of content with flexibility for customization based on State context
- Quality Control of Trainings – criteria for ensuring minimum quality of training content and delivery
- Strategy for measuring impact of trainings and capacity building efforts.

ABOUT THE PLANNING MODULE

Title	**Faecal Sludge and Septage Management - Planning Module**
Purpose	To build the capacities of ULB and state officials on planning of faecal sludge and septage management. This course will introduce the target audience to components of FSSM planning starting with approach and methodology for state and city level FSSM planning, aspects of FSSM, stakeholder's engagement, treatment approaches, financial aspects and O&M mechanisms. This module is crucial for officials of cities to be able to achieve the objectives under SBM-U 2.0 and AMRUT 2.0..
Target Audience	Decision makers from state and ULBs, experts/sector partners working as TSU/ PMUs, faculties from nodal training institutes with professional experience in Faecal Sludge and Septage Management.
Learning Objective	1. Understand the approaches and methodologies for preparing a state investment plan for FSSM. 2. Linking city level planning approaches with citywide inclusive sanitation. 3. Understanding the steps involved in carrying out the situation or feasibility assessment. 4. Leverage various funding avenues and understand business models for FSSM at city level. 5. Comprehend the aspects of FSSM, stakeholder's engagement, treatment approaches and financial and sustainability aspects.
Structure of the Module	The training module is based on case methodology where sessions are complemented with exercises based on real-life scenarios. This will help trainees to apply the knowledge grasped during the session and reinforce it further in their work. The module is structured and divided into the following parts: 1. Part A: This contains the slides used during the session in the presentation format. 2. Part B: This is a comprehensive compilation of the all the session briefs and further reading material which helps to strengthen the learning. **3. Part C: This contains the exercise developed for training based on the real-life cases.**
Duration	In a face-to-face training format, this training is conceptualized for two days without site visits and can be adopted for including the site visits depending upon the city where it is being conducted.

Contents

LIST OF TABLES

LIST OF UNITS

SI units

Quantity	Name of Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	S
Volume	cubic meter or kilo litre	m^3 or KL

Conversion Tables

Length

	Millimeter (mm)	Centimeter (cm)	Meter (m)	Kilometer (km)
1 Millimeter (mm)	1	0.1	0.001	0.000001
1 Centimeter (cm)	10	1	0.01	0.00001
1 Meter (m)	1000	100	1	0.001
1 Kilometer (km)	1000000	100000	1000	1

Mass

	Milligram (mg)	Gram (g)	Kilogram (kg)
1 Milligram (mg)	1	0.001	0.000001
1 Gram (g)	1000	1	0.001
1 Kilogram (kg)	1000000	1000	1

Time

	Second (s)	Min (m)	Hour (h)	Day (d)
1 Second (s)	1	1/60	1/3600	1/86400
1 Min (m)	1000	1	1/60	1/1440
1 Hour (h)	3600	60	1	1/24
1 Day (d)	86400	1440	24	1

Volume

	Litre (L)	Cubic meter (m^3) or Kilolitre (KL)	Million litre (ML)
1 Litre (L)	1	0.001	0.000001
1 Cubic meter (m^3) or Kilolitre (KL)	1000	1	0.001
1 Million litre (ML)	10,00,000	1000	1

The Manual on Sewerage and Sewage Treatment Systems published in November 2013 by Central Public Health and Environmental Engineering Organization elaborates in its Preamble the main cause of water pollution is the challenges faced by ULBs for planning, implementation, procurement of materials, operate and maintain the centralized sewerage system. This exercise is based on Case Method, where the trainee will be working on a town and planning for its wastewater management. The exercise is technology agnostic in terms of collection, conveyance and treatment of septage and sewage emphasizes on selection of appropriate approach and plan for wastewater management at town level without compromising on the environmental sanitation.

SECTION

01

FOUNDATION

1. Foundation

The State under consideration is a landlocked state and is bound by other Indian states from all the four sides. Approximately 60% of the State is covered by mountains and hills. The State has a bowl shape geography, hence, most of the towns are situated in the centre of the state in the valley region. The State has 55 towns and 148 villages. The villages are scattered in the mountains and 42 villages are notified as tribal villages.

1.1 Demography

As per the Census of India (2011), the total population of the state is 23.73 lakhs. Only 34% of the population resides in urban areas where as 66% of the population resides in rural areas. However, in the past one decade, the population has increased to approximately 28 lakhs. In the past decade, there has been above average increase in the urban population due to migration and urbanization in few major towns.

1.2 Access to Water

The State has 6 rivers and 27 major tributaries. Most of the towns are situated on the banks of the river and have expanded along the line of the river. The groundwater table is also high in the valley regions. As per the 2011 Census, 47% of the households in the State are directly dependent on the surface water as their main source of water. Only 14% of the households are dependent on subsurface water. 39% of the households have access to water through piped water supply in the state. The following Table 1 provides details of access to water in urban and rural areas of the State.

Table 1: Main source of drinking water in urban and rural areas of the State

Sr. No.	Type of Setting	Households	Main Source of Drinking Water		
			Tap	Subsurface water	Surface water
1	State level	5,07,152	1,95,600	72,521	2,39,031
			39%	14%	47%
2	Urban	1,71,400	96,449	17,259	57,692
			56%	10%	34%
3	Rural	3,35,752	99,151	55,262	1,81,339
			30%	16%	54%

The location of the source is as important as the source of drinking water. The access to drinking water is average across the state and that is inferenced from the smaller percentage of households having drinking water source within the premise. The details on location of source of drinking water in the State is provided in the Table 2.

Table 2: Location of source of drinking water across the State

Sr. No.	Type of Setting	Households	Location of Source of Drinking Water		
			Within premises	Near premises	Away
1	State level	5,07,152	81,420	2,34,183	1,91,549
			16%	46%	38%
2	Urban	1,71,400	54,435	62,031	54,934
			32%	36%	32%
3	Rural	3,35,752	26,985	1,72,152	1,36,615
			8%	51%	41%

Table 3 provides district wise details of urban areas. It can be observed that the districts D4, D6, D7 and D8 have higher percentage of the households having taps.

Table 3: District wise access to sanitation in urban areas

Sr. No.	District Code	No. of HH	Main Source of Drinking Water			Location of Source of Drinking Water		
			Tap	Subsurface water	Surface water	Within premises	Near premises	Away
1	D1	1,519	49%	5%	46%	27%	56%	17%
2	D2	3,408	34%	19%	47%	16%	55%	29%
3	D3	3,269	9%	81%	10%	44%	40%	16%
4	D4	16,744	62%	3%	35%	17%	50%	33%
5	D5	30,642	26%	12%	62%	8%	48%	44%
6	D6	69,881	73%	5%	22%	43%	28%	29%
7	D7	37,792	58%	9%	33%	35%	32%	33%
8	D8	4,908	51%	5%	44%	34%	48%	18%
9	D9	3,237	18%	77%	5%	47%	30%	23%

Table 4 provides town wise details of access to water. It provides details of main source of drinking water and location of the source for each town.

Table 4: Town wise access to water

District	Town Code	No. of HH	Main Source of Drinking Water			Location of Source of Drinking Water		
			Tap	Subsurface water	Surface water	Within premises	Near premises	Away
D1	D1.1	1,519	49%	4%	47%	27%	56%	17%
D2	D2.1	3,408	34%	19%	47%	16%	55%	29%
D3	D3.1	373	30%	49%	21%	29%	22%	49%
D3	D3.2	1,354	2%	97%	1%	45%	49%	6%
D3	D3.3	1,542	9%	76%	15%	47%	36%	17%
D4	D4.1	2,334	81%	7%	12%	47%	35%	18%
D4	D4.2	1,851	32%	1%	67%	3%	60%	37%
D4	D4.3	1,287	21%	5%	74%	9%	68%	23%
D4	D4.4	3,719	72%	1%	27%	10%	48%	42%
D4	D4.5	3,349	55%	3%	42%	4%	53%	43%
D4	D4.6	2,656	83%	2%	15%	35%	43%	22%
D4	D4.7	1,548	64%	4%	32%	6%	61%	33%
D5	D5.1	637	0%	36%	64%	1%	18%	81%
D5	D5.2	7,158	45%	5%	50%	11%	39%	50%
D5	D5.3	2,232	55%	10%	35%	5%	42%	53%
D5	D5.4	3,922	22%	16%	62%	17%	64%	19%
D5	D5.5	1,024	31%	0%	69%	12%	77%	11%
D5	D5.6	1,533	1%	37%	62%	1%	23%	76%
D5	D5.7	1,095	2%	71%	27%	3%	44%	53%
D5	D5.8	9,385	7%	5%	88%	6%	51%	43%
D5	D5.9	1,745	80%	1%	19%	15%	65%	20%
D5	D5.10	1,911	22%	19%	59%	2%	34%	64%
D6	D6.1	43,558	81%	5%	14%	57%	21%	22%
D6	D6.2	2,337	74%	0%	26%	16%	22%	62%

D6	D6.3	1,792	71%	22%	7%	17%	35%	48%
D6	D6.4	788	72%	0%	28%	17%	36%	47%
D6	D6.5	3,773	71%	3%	26%	31%	39%	30%
D6	D6.6	4,461	31%	1%	68%	3%	60%	37%
D6	D6.7	1,210	31%	0%	69%	2%	42%	56%
D6	D6.8	1,612	66%	1%	33%	31%	25%	44%
D6	D6.9	1,143	78%	0%	22%	45%	20%	35%
D6	D6.10	2,178	74%	0%	26%	23%	27%	50%
D6	D6.11	1,136	4%	85%	11%	31%	36%	33%
D6	D6.12	1,152	97%	1%	2%	69%	23%	8%
D6	D6.13	2,916	51%	0%	49%	5%	58%	37%
D6	D6.14	1,825	66%	0%	34%	18%	57%	25%
D7	D7.1	1,663	27%	31%	42%	6%	43%	51%
D7	D7.2	991	95%	1%	4%	35%	45%	20%
D7	D7.3	1,320	7%	21%	72%	0%	39%	61%
D7	D7.4	17,457	67%	8%	25%	48%	23%	29%
D7	D7.5	1,355	13%	61%	26%	36%	26%	38%
D7	D7.6	1,421	77%	1%	22%	19%	22%	59%
D7	D7.7	1,583	67%	3%	30%	32%	49%	19%
D7	D7.8	1,155	81%	0%	19%	6%	34%	60%
D7	D7.9	1,901	2%	0%	98%	1%	72%	27%
D7	D7.10	1,135	56%	13%	31%	34%	33%	33%
D7	D7.11	1,028	84%	2%	14%	29%	50%	21%
D7	D7.12	913	10%	0%	90%	0%	42%	58%
D7	D7.13	394	1%	0%	99%	0%	90%	10%
D7	D7.14	732	25%	18%	57%	14%	23%	63%
D7	D7.15	1,246	94%	1%	5%	87%	8%	5%
D7	D7.16	2,254	75%	0%	25%	46%	30%	24%
D7	D7.17	1,244	48%	0%	52%	19%	46%	35%
D8	D8.1	4,908	51%	5%	44%	34%	48%	18%
D9	D9.1	3,237	18%	77%	5%	47%	30%	23%

1.3 Access to Sanitation

Access to sanitation is documented in three parts: (a) Access to toilet, (b) Type of toilet and (c) Wastewater management.

1.3.1 Access to toilet

As per the 2011 Census, the access to toilet was much better as compared to access to water. 89% of the households in the state had access to toilet within the premise. Only 2% of the households were dependent of community toilet and 9% household were believed to practice open defecation. The details about access to toilet across the state is provided in the Table 5 below. It can be seen that the household practicing open defecation in the urban areas were significantly low when compared to the State's average.

Table 5: State-wide access to toilet

Sr. No.	Type of Setting	Households	Access to toilet within premise	Access to CT	Open Defecation
1	State level	5,07,152	4,52,865	9,057	45,230
			89%	2%	9%
2	Urban	1,71,400	1,64,152	3,226	4,022
			96%	2%	2%
3	Rural	3,35,752	2,88,713	5,831	41,208
			86%	2%	12%

Table 6 provides district wise access to toilet. It can be inferenced that the access to toilet was above the State's average in all the districts when only urban areas are considered.

Table 6: District-wise access to toilet in urban areas

Sr. No.	Code	Urban Households	Access to toilet within premise	Access to CT/PT	Open Defecation
1	D1	1,519	98%	1%	1%
2	D2	3,408	97%	1%	2%
3	D3	3,269	99%	0%	1%
4	D4	16,744	94%	3%	3%
5	D5	30,642	94%	3%	3%
6	D6	69,881	97%	2%	1%
7	D7	37,792	96%	2%	2%
8	D8	4,908	96%	1%	3%
9	D9	3,237	97%	2%	1%

Table 7 provides town wise details of access to toilet. It can be inferenced that most of the towns have access to toilet above the State's average of 89% except for the towns D5.6, D6.4, D7.1 and D7.13. Similarly, the open defecation is D5.6 and D7.1 is above the state's average of 9%.

Table 7: Town-wise access to toilet

District	Code	Households	Access to toilet within premise	Access to CT/PT	Open Defecation
D1	D1.1	1,519	98%	1%	1%
D2	D2.1	3,408	97%	1%	2%
D3	D3.1	373	97%	1%	2%
D3	D3.2	1,354	99%	1%	0%
D3	D3.3	1,542	99%	0%	1%
D4	D4.1	2,334	98%	1%	1%
D4	D4.2	1,851	91%	6%	3%
D4	D4.3	1,287	98%	1%	1%
D4	D4.4	3,719	93%	3%	4%
D4	D4.5	3,349	91%	5%	4%
D4	D4.6	2,656	94%	3%	3%

D4	D4.7	1,548	99%	0%	1%
D5	D5.1	637	92%	2%	6%
D5	D5.2	7,158	95%	5%	0%
D5	D5.3	2,232	98%	2%	0%
D5	D5.4	3,922	95%	1%	4%
D5	D5.5	1,024	98%	0%	2%
D5	D5.6	1,533	83%	1%	16%
D5	D5.7	1,095	95%	3%	2%
D5	D5.8	9,385	94%	2%	4%
D5	D5.9	1,745	91%	3%	6%
D5	D5.10	1,911	95%	5%	0%
D6	D6.1	43,558	97%	2%	1%
D6	D6.2	2,337	97%	1%	2%
D6	D6.3	1,792	93%	3%	4%
D6	D6.4	788	84%	8%	8%
D6	D6.5	3,773	97%	2%	1%
D6	D6.6	4,461	95%	1%	4%
D6	D6.7	1,210	98%	2%	0%
D6	D6.8	1,612	98%	2%	0%
D6	D6.9	1,143	99%	1%	0%
D6	D6.10	2,178	97%	1%	2%
D6	D6.11	1,136	97%	2%	1%
D6	D6.12	1,152	99%	0%	1%
D6	D6.13	2,916	95%	3%	2%
D6	D6.14	1,825	90%	4%	6%
D7	D7.1	1,663	71%	1%	28%
D7	D7.2	991	98%	2%	0%
D7	D7.3	1,320	95%	2%	3%
D7	D7.4	17,457	97%	2%	1%
D7	D7.5	1,355	90%	1%	9%
D7	D7.6	1,421	99%	1%	0%
D7	D7.7	1,583	99%	0%	1%
D7	D7.8	1,155	98%	1%	1%
D7	D7.9	1,901	99%	1%	0%
D7	D7.10	1,135	99%	1%	0%
D7	D7.11	1,028	90%	8%	2%
D7	D7.12	913	97%	2%	1%
D7	D7.13	394	80%	19%	1%
D7	D7.14	732	92%	0%	8%
D7	D7.15	1,246	100%	0%	0%
D7	D7.16	2,254	98%	1%	1%
D7	D7.17	1,244	98%	2%	0%
D8	D8.1	4,908	96%	1%	3%
D9	D9.1	3,237	97%	2%	1%

1.3.2 Type of toilet

There are different typologies of toilets which are recorded in the census:

- Flush toilet refers to a water closet pan having S or P trap and uses water to flush the excreta out of the toilet.
- Pit latrine refers to the toilet having pits (but no pan) with or without a slab. The pit can be lined or unlined.
- Other type of toilet refers to the toilet built above the surface drain such that the excreta drop directly into the drain and is washed off by the water flowing in the drain.
- Service latrine refers to the toilet in which the excreta get accumulated in a vault and needs to be emptied manually or by use of animals.

As per the Swachh Bharat Mission (2014), the pit latrines, other type of toilets and service latrines are termed as insanitary latrines and as per the Mission and the Prohibition of Employment of Manual Scavenger and their Rehabilitation Act (2013), the insanitary latrines are to be converted in to sanitary toilets. Table 8 provides details of type of toilets across the State.

Table 8: State-wide details of type of toilet

Sr. No.	Type of Setting	Households with access to Toilet	Flush toilet	Pit latrine	Other type of toilet	Service latrine
1	State Level	4,52,865	2,36,563	1,75,563	27,713	13,026
			52%	39%	6%	3%
2	Urban	1,64,152	1,09,180	39,871	10,688	4,413
			67%	24%	7%	2%
3	Rural	2,88,713	1,27,383	1,35,692	17,025	8,613
			44%	47%	6%	3%

Table 9 provides district wise details of type of toilets in the urban areas. It can be inferenced that district D1, D2 and D5 have less percent of households with flush toilets.

Table 9: District-wise details of types of toilets in urban areas

Sr. No.	Code	Households with access to Toilet	Flush toilet	Pit latrine	Other type of toilet	Service latrine
1	D1	1,482	49%	45%	1%	5%
2	D2	3,294	42%	56%	0%	2%
3	D3	3,230	80%	19%	1%	0%
4	D4	15,801	55%	33%	10%	2%
5	D5	28,843	48%	33%	13%	6%
6	D6	67,543	74%	19%	6%	1%
7	D7	36,106	76%	17%	4%	3%
8	D8	4,717	58%	40%	1%	1%
9	D9	3,136	59%	41%	0%	0%

Table 10 provides town wise details of the type of toilets. The key inferences from the analysis of the table are provided below:

- 20 towns (36%) have flush toilets less than the State's average
- 16 towns (29%) have pit latrines more than the State's average
- 22 towns (40%) have other type of toilets more than the State's average
- 23 towns (42%) have services latrines more than the State's average

Table 10: Town-wise details of type of toilets

District	Code	Households	Flush toilet	Pit latrine	Other type of toilet	Service latrine
D1	D1.1	1482	49%	45%	1%	5%
D2	D2.1	3294	42%	56%	0%	2%
D3	D3.1	362	96%	2%	0%	2%
D3	D3.2	1346	64%	34%	2%	0%
D3	D3.3	1522	91%	9%	0%	0%
D4	D4.1	2294	64%	36%	0%	0%
D4	D4.2	1693	49%	39%	11%	1%
D4	D4.3	1267	20%	74%	2%	4%
D4	D4.4	3476	40%	29%	30%	1%
D4	D4.5	3048	64%	29%	7%	0%
D4	D4.6	2494	80%	19%	1%	0%
D4	D4.7	1529	56%	34%	3%	7%
D5	D5.1	587	60%	39%	1%	0%
D5	D5.2	6824	57%	33%	1%	9%
D5	D5.3	2195	31%	16%	45%	8%
D5	D5.4	3720	48%	39%	6%	7%
D5	D5.5	1007	27%	72%	1%	0%
D5	D5.6	1277	44%	45%	1%	10%
D5	D5.7	1035	18%	58%	24%	0%
D5	D5.8	8799	47%	28%	19%	6%
D5	D5.9	1591	60%	27%	7%	6%
D5	D5.10	1808	54%	25%	16%	5%
D6	D6.1	42423	87%	13%	0%	0%
D6	D6.2	2257	63%	36%	1%	0%
D6	D6.3	1674	63%	29%	8%	0%
D6	D6.4	665	83%	17%	0%	0%
D6	D6.5	3643	70%	20%	6%	4%
D6	D6.6	4225	41%	33%	25%	1%
D6	D6.7	1180	38%	17%	34%	11%
D6	D6.8	1587	70%	27%	1%	2%
D6	D6.9	1137	61%	17%	6%	16%
D6	D6.10	2108	44%	18%	35%	3%
D6	D6.11	1101	46%	43%	11%	0%

D6	D6.12	1144	57%	43%	0%	0%
D6	D6.13	2757	20%	51%	28%	1%
D6	D6.14	1642	54%	28%	13%	5%
D7	D7.1	1174	30%	56%	6%	8%
D7	D7.2	971	82%	16%	2%	0%
D7	D7.3	1250	54%	16%	1%	29%
D7	D7.4	16919	85%	13%	2%	0%
D7	D7.5	1226	47%	46%	7%	0%
D7	D7.6	1406	64%	28%	5%	3%
D7	D7.7	1562	83%	6%	8%	3%
D7	D7.8	1131	50%	14%	26%	10%
D7	D7.9	1880	61%	21%	5%	13%
D7	D7.10	1125	88%	4%	8%	0%
D7	D7.11	927	74%	13%	2%	11%
D7	D7.12	886	53%	40%	7%	0%
D7	D7.13	314	30%	1%	18%	51%
D7	D7.14	673	96%	3%	1%	0%
D7	D7.15	1244	90%	10%	0%	0%
D7	D7.16	2200	81%	13%	6%	0%
D7	D7.17	1218	73%	22%	5%	0%
D8	D8.1	4717	58%	40%	1%	1%
D9	D9.1	3136	59%	41%	0%	0%

1.3.3 Wastewater management

Wastewater management is documented into three types:

- Closed drains – this refers to some sort of closed drains such as covered lined nalla, sewer or even a pipe collecting and conveying the wastewater from group of households to the nearby surface drain.
- Open drainage – this refers to open surface lined and unlined drains along the roads which are meant for storm water management but also collect and convey the wastewater during dry weather.
- Non drainage – this refers to onsite sanitation system, where all the wastewater is managed at the household level.

The percent of households connected to open drainage is the highest (49%) suggesting that the wastewater management is not adequate.

Table 11: State-wide details of wastewater management

Sr. No.	Type of Setting	Households	Wastewater outlet connected to		
			Closed drainage	Open drainage	No drainage
1	State level	5,07,152	20,580	2,47,412	2,39,160
			4%	49%	47%
2	Urban	1,71,400	10,350	1,10,315	50,735
			6%	64%	30%
3	Rural	3,35,752	10,230	1,37,097	1,88,425
			3%	41%	56%

Table 12 provide details of wastewater management in the urban areas in the state. It can be inferenced that the district D6, D7 and D5 which ate the top three populated districts have the highest percent of households connected to open drainage. This possess considerable risk to the groundwater pollution as well as vector borne diseases. Hence, there is immediate need of improving the wastewater collection and conveyance across the major towns of the state.

Table 12: District-wise details of wastewater management in urban areas

Sr. No.	Code	Urban Households	Wastewater outlet connected to		
			Closed drainage	Open drainage	No drainage
1	D1	1482	7%	69%	24%
2	D2	3294	3%	37%	60%
3	D3	3230	11%	65%	24%
4	D4	15801	3%	47%	50%
5	D5	28843	3%	61%	36%
6	D6	67543	9%	69%	22%
7	D7	36106	6%	69%	25%
8	D8	4717	4%	52%	44%
9	D9	3136	11%	59%	30%

Table 13 provide town wise details of wastewater management. The key inferences from the analysis of the data are provided below:

- 38 towns have less percent of connection to closed drainage as compared to the State's average.
- 42 towns have higher percent connections to surface drains as compared to the State's average of 49%.
- Only 14 towns have higher percent households having complete on-site sanitation (non sewered) as compared to the State's average of 47%.

Table 13: Town-wise details of wastewater management

Sr. No.	District	Code	Households	Wastewater outlet connected to		
				Closed drainage	Open drainage	No drainage
1	D1	D1.1	1,519	7%	69%	24%
2	D2	D2.1	3,408	3%	37%	60%
3	D3	D3.1	373	19%	76%	5%
4	D3	D3.2	1,354	8%	77%	15%
5	D3	D3.3	1,542	14%	51%	35%
6	D4	D4.1	2,334	4%	70%	26%
7	D4	D4.2	1,851	3%	40%	57%
8	D4	D4.3	1,287	1%	27%	72%
9	D4	D4.4	3,719	3%	38%	59%
10	D4	D4.5	3,349	5%	27%	68%
11	D4	D4.6	2,656	4%	72%	24%
12	D4	D4.7	1,548	3%	60%	37%
13	D5	D5.1	637	0%	32%	68%
14	D5	D5.2	7,158	1%	92%	7%
15	D5	D5.3	2,232	5%	88%	7%
16	D5	D5.4	3,922	5%	30%	65%

17	D5	D5.5	1,024	1%	17%	82%
18	D5	D5.6	1,533	0%	25%	75%
19	D5	D5.7	1,095	2%	69%	29%
20	D5	D5.8	9,385	3%	56%	41%
21	D5	D5.9	1,745	2%	60%	38%
22	D5	D5.10	1,911	3%	64%	33%
23	D6	D6.1	43,558	12%	75%	13%
24	D6	D6.2	2,337	2%	86%	12%
25	D6	D6.3	1,792	1%	70%	29%
26	D6	D6.4	788	2%	62%	36%
27	D6	D6.5	3,773	6%	65%	29%
28	D6	D6.6	4,461	2%	48%	50%
29	D6	D6.7	1,210	1%	61%	38%
30	D6	D6.8	1,612	2%	67%	31%
31	D6	D6.9	1,143	2%	85%	13%
32	D6	D6.10	2,178	5%	74%	21%
33	D6	D6.11	1,136	1%	79%	20%
34	D6	D6.12	1,152	2%	23%	75%
35	D6	D6.13	2,916	3%	34%	63%
36	D6	D6.14	1,825	4%	53%	43%
37	D7	D7.1	1,663	3%	38%	59%
38	D7	D7.2	991	12%	75%	13%
39	D7	D7.3	1,320	2%	59%	39%
40	D7	D7.4	17,457	6%	78%	16%
41	D7	D7.5	1,355	2%	10%	88%
42	D7	D7.6	1,421	1%	71%	28%
43	D7	D7.7	1,583	11%	55%	34%
44	D7	D7.8	1,155	1%	82%	17%
45	D7	D7.9	1,901	3%	68%	29%
46	D7	D7.10	1,135	2%	73%	25%
47	D7	D7.11	1,028	4%	90%	6%
48	D7	D7.12	913	1%	56%	43%
49	D7	D7.13	394	1%	99%	0%
50	D7	D7.14	732	8%	75%	17%
51	D7	D7.15	1,246	14%	61%	25%
52	D7	D7.16	2,254	3%	62%	35%
53	D7	D7.17	1,244	5%	73%	22%
54	D8	D8.1	4,908	4%	52%	44%
55	D9	D9.1	3,237	10%	60%	30%

1.3.4 Wastewater Treatment

The data in this case has been collected from the state pollution control board and municipal bodies of the town. There are 4 towns in which Sewage Treatment Plant (STP) exists. The design capacities of the STPs are provided in the Table 14. However, in absence of appropriate collection and conveyance network, the STPs are largely underutilized.

Currently, demand desludging is being practiced across the State. Out of the 55 towns, 19 towns do have vacuum truck for emptying the septic tank and the daily collection of septage is given in the Table 14. The state had published a regulation in 2019 stating that all the ULBs who do not

have access to treatment facilities, should start exploring Deep Row Entrenchment (DRE) option for safer disposal of faecal sludge and septage. However, due to lack of enforcement, the collected septage is still being disposed indiscriminately in the environment.

The remaining 36 towns do not have vacuum trucks and hence, the households call the desludging operator from the nearby town for emptying the septic tanks.

Table 14: Town-wise details of assets for wastewater and septage management

Sr. No.	District	Code	Households	Year of commissioning	Existing STP Capacity {MLD}	Existing septage collection [KLD]	Desludging trucks [no.]
1	D2	D2.1	3,408			4	1
2	D4	D4.1	2,334	2018	2.0	3	1
3	D4	D4.4	3,719			4	1
4	D4	D4.5	3,349			4	1
5	D4	D4.6	2,656			3	1
6	D5	D5.2	7,158			8	1
7	D5	D5.3	2,232			3	1
8	D5	D5.4	3,922			4	1
9	D5	D5.8	9,385			10	2
10	D6	D6.1	43,558	2015	45.0	30	4
11	D6	D6.2	2,337			3	1
12	D6	D6.5	3,773			4	1
13	D6	D6.6	4,461			5	1
14	D6	D6.10	2,178			3	1
15	D6	D6.13	2,916			3	1
16	D7	D7.4	17,457	2016	12.0	12	2
17	D7	D7.16	2,254	2019	2.0	3	1
18	D8	D8.1	4,908			5	1
19	D9	D9.1	3,237			4	1
17	D7	D7.16	2,254	2019	2.0	3	1
18	D8	D8.1	4,908			5	1
19	D9	D9.1	3,237			4	1

1.4 Progress by the State

In the past decade after the census, the State has taken steps to improve the access to water. The current water supply in the towns is provided in the Table 17.

The State prioritized towns based on the inferences mentioned in the Section 1.3.1 and 1.3.2 to increase the access to sanitation. The State launched a Swachh Program in line with the SBM 2014 in 2015. Converting insanitary latrines to sanitary latrines with septic tank and soak pits was the top agenda of this program. The State was declared ODF in 2016 and subsequently ODF+ in 2019.

In order to move forward in the direction of ODF++; in the year 2021, the state collated the city-wide wastewater infrastructure data and proposed appropriate solution for each town. The state is mobilising the funds through different Swachh Bharat Mission Urban, AMRUT and Finance Commission. The state has also shown commitment to invest their own funds. The base year for the projects is estimated to be 2025. Following are the proposed solutions:

Sewered Sanitation System: Towns with water supply of 135 LPCD and design population more than 1 lakh have been identified for sewered sanitation. These are the towns D6.1 and D7.4 where STPs with design capacity of 45 MLD and 12 MLD exists. In this system, the sewerage network consisting of separate sewers will be completed on priority to increase the collection, conveyance of the wastewater to the existing STPs. Until then, Co-treatment of septage collected from the households having septic tanks at the STP will continue.

Hybrid Sanitation System: Towns with water supply less than 135 LPCD and design population less than 1 lakh and moderate population density have been identified for hybrid sanitation system. Town D4.1 and D7.16 with existing STP of design capacity 2 MLD each has been chosen along with ten other towns where STP has been proposed. The design capacity of the STPs have been mentioned in the Table 15.

Table 15: Towns selected for hybrid sanitation system with details of STPs

District	Code	Design year (2040)		Existing STP Capacity [MLD]	Proposed STP Capacity [MLD]
		Population	Wastewater generation [MLD]		
D2	D2.1	23,000	1.6		2.0
D4	D4.1	17,821	2.4	2.0	2.5
D4	D4.4	28,396	2.6		3.0
D4	D4.5	25,571	2.3		2.5
D5	D5.2	54,655	3.8		4.0
D5	D5.4	29,946	2.1		2.5
D5	D5.8	71,659	5.0		5.0
D6	D6.5	32,429	2.9		3.0
D6	D6.6	38,343	2.7		3.0
D7	D7.16	17,210	2.3	2.0	2.5
D8	D8.1	33,124	3.0		3.0
D9	D9.1	21,846	2.0		2.0

Interception & Diversion (I&D) System: Towns with water supply less than 135 LPCD and design population less than 1 lakh and low population density have been identified for I&D system. In this system, interception and diversion of surface drains will be done. The surface drains will be tapped at the outfall of the drain and with the help of pumping stations, will be pumped to the proposed STP with design capacity as mentioned in the Table 16.

Table 16: Towns selected for I&D system with details of STP

District	Code	Design year (2040)		Proposed STP Capacity [MLD]
		Design Population	Wastewater generation [MLD]	
D4	D4.6	20,280	1.8	2.0
D5	D5.3	17,042	1.2	1.5
D6	D6.2	20,087	1.4	1.5
D6	D6.10	18,720	1.3	1.5
D6	D6.13	25,063	2.3	2.5
D7	D7.15	9,514	1.3	1.5

Non-Sewered Sanitation System: The rest of the 35 towns are selected for practicing non sewered sanitation. In this system, wastewater will have to be safely disposed on site i.e., in the premise of the household. For this, municipal byelaws will be amended based on IS 2470 Part A and Part B which provides details of septic tank, soak pit and soak away. With this, there will not be requirement of any kind of collection and conveyance system for wastewater.

Along with this, municipal byelaw will also include byelaws for operationalising FSSM. The desludging frequency of 3 years will be achieved as per the May 2020 amendments of ODF++ Protocols.

1.5 Citywide Wastewater Infrastructure Status

The following Table 17 provides summary of the status of the infrastructure for wastewater management in the state.

Table 17: Citywide Wastewater Infrastructure Status

Sr. No.	District	Code	Households	Water Supply [LPCD]	Design year (2040)		Wastewater management Solution	Existing STP Capacity [MLD]	Desludging trucks [no.]	Proposed STP Capacity [MLD]
					Design Population	Wastewater generation {MLD}				
1	D1	D1.1	1,519	70	9,012	0.6	Non Sewered			
2	D2	D2.1	3,408	70	23,000	1.6	Hybrid		1	2.0
3	D3	D3.1	373	70	2,517	0.2	Non Sewered			
4	D3	D3.2	1,354	70	9,138	0.6	Non Sewered			
5	D3	D3.3	1,542	70	10,407	0.7	Non Sewered			
6	D4	D4.1	2,334	135	17,821	2.4	Hybrid	2.0	1	
7	D4	D4.2	1,851	70	14,133	1.0	Non Sewered			
8	D4	D4.3	1,287	70	9,827	0.7	Non Sewered			
9	D4	D4.4	3,719	90	28,396	2.6	Hybrid		1	3.0
10	D4	D4.5	3,349	90	25,571	2.3	Hybrid		1	2.5
11	D4	D4.6	2,656	90	20,280	1.8	I&D		1	2.0
12	D4	D4.7	1,548	90	11,820	1.1	Non Sewered			
13	D5	D5.1	637	70	4,864	0.3	Non Sewered			
14	D5	D5.2	7,158	70	54,655	3.8	Hybrid		1	4.0
15	D5	D5.3	2,232	70	17,042	1.2	I&D		1	1.5
16	D5	D5.4	3,922	70	29,946	2.1	Hybrid		1	2.5
17	D5	D5.5	1,024	70	7,819	0.5	Non Sewered			
18	D5	D5.6	1,533	70	11,705	0.8	Non Sewered			
19	D5	D5.7	1,095	70	8,361	0.6	Non Sewered			
20	D5	D5.8	9,385	70	71,659	5.0	Hybrid		2	5.0
21	D5	D5.9	1,745	90	13,324	1.2	Non Sewered			
22	D5	D5.10	1,911	70	14,591	1.0	Non Sewered			
23	D6	D6.1	43,558	135	3,74,386	50.5	Sewered	45.0	4	
24	D6	D6.2	2,337	70	20,087	1.4	I&D		1	1.5
25	D6	D6.3	1,792	70	15,402	1.1	Non Sewered			
26	D6	D6.4	788	70	6,773	0.5	Non Sewered			

Sr. No.	District	Code	Households	Water Supply [LPCD]	Design year (2040)		Wastewater management Solution	Existing STP Capacity [MLD]	Desludging trucks [no.]	Proposed STP Capacity [MLD]
					Design Population	Wastewater generation {MLD}				
27	D6	D6.5	3,773	90	32,429	2.9	Hybrid		1	3.0
28	D6	D6.6	4,461	70	38,343	2.7	Hybrid		1	3.0
29	D6	D6.7	1,210	70	10,400	0.7	Non Sewered			
30	D6	D6.8	1,612	70	13,855	1.0	Non Sewered			
31	D6	D6.9	1,143	90	9,824	0.9	Non Sewered			
32	D6	D6.10	2,178	70	18,720	1.3	I&D		1	1.5
33	D6	D6.11	1,136	90	9,764	0.9	Non Sewered			
34	D6	D6.12	1,152	90	9,902	0.9	Non Sewered			
35	D6	D6.13	2,916	90	25,063	2.3	I&D		1	2.5
36	D6	D6.14	1,825	90	15,686	1.4	Non Sewered			
37	D7	D7.1	1,663	70	12,698	0.9	Non Sewered			
38	D7	D7.2	991	90	7,567	0.7	Non Sewered			
39	D7	D7.3	1,320	70	10,079	0.7	Non Sewered			
40	D7	D7.4	17,457	135	1,33,293	18.0	Sewered	12.0	2	
41	D7	D7.5	1,355	70	10,346	0.7	Non Sewered			
42	D7	D7.6	1,421	70	10,850	0.8	Non Sewered			
43	D7	D7.7	1,583	70	12,087	0.8	Non Sewered			
44	D7	D7.8	1,155	70	8,819	0.6	Non Sewered			
45	D7	D7.9	1,901	70	14,515	1.0	Non Sewered			
46	D7	D7.10	1,135	90	8,666	0.8	Non Sewered			
47	D7	D7.11	1,028	90	7,849	0.7	Non Sewered			
48	D7	D7.12	913	70	6,971	0.5	Non Sewered			
49	D7	D7.13	394	70	3,008	0.2	Non Sewered			
50	D7	D7.14	732	70	5,589	0.4	Non Sewered			
51	D7	D7.15	1,246	135	9,514	1.3	I&D			1.5
52	D7	D7.16	2,254	135	17,210	2.3	Hybrid	2.0	1	
53	D7	D7.17	1,244	70	9,499	0.7	Non Sewered			
54	D8	D8.1	4,908	90	33,124	3.0	Hybrid		1	3.0
55	D9	D9.1	3,237	90	21,846	2.0	Hybrid		1	2.0

SECTION

02

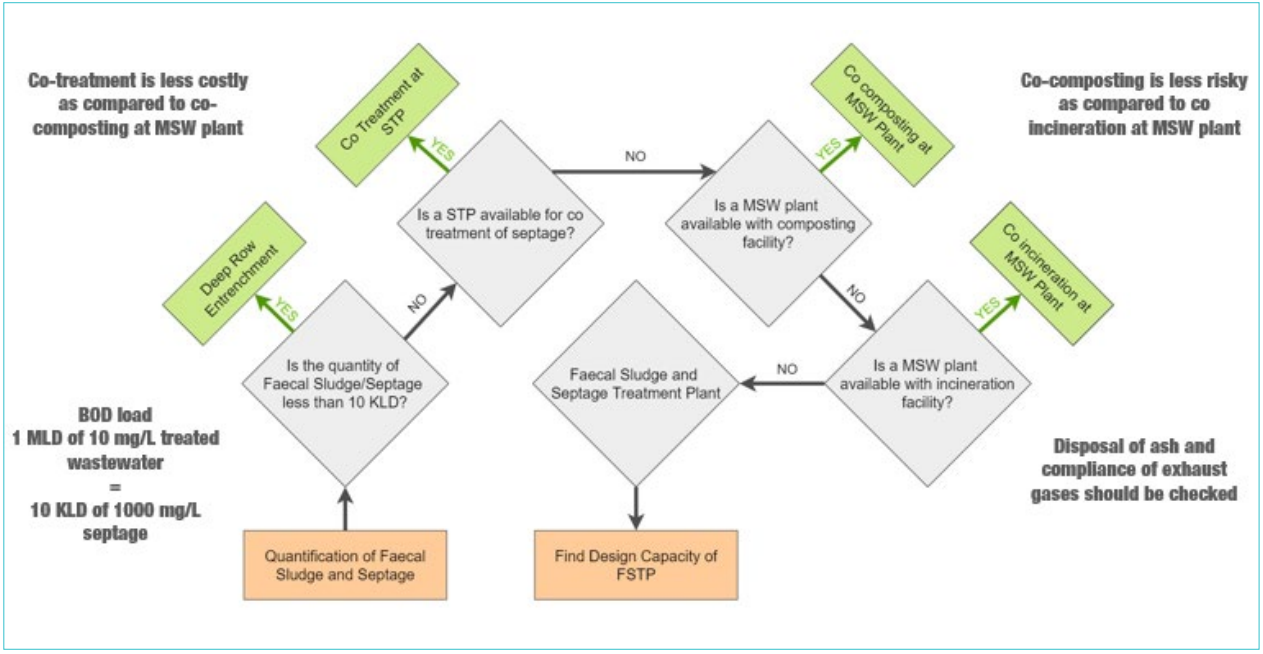
STATE IMPLEMENTATION PLAN

2. State Implementation Plan

The Ministry of Housing and Urban Affairs has asked the state to prepare a budget to provide safe sanitation for all. As a Chief Engineer of the parastatal body of the state responsible for facilitating sanitation infrastructure in all towns; you need to plan and prepare a budget required to provide FSSM services across the state.

2.1 FSSM Approach

The following decision-making algorithm will be used for deciding the FSSM approach for the towns in the State. However, in this case, we will not be considering co-treatment at the SWM facility due to lack of data.



If the septage collection in the design year is less than 10 KLD, then it is recommended to practice land application for following reasons:

1. The cost to benefit ratio is not favourable for small quantum of the septage. Once, the plant is implemented, the indirect expense towards establishment cost (salaries of the staff etc.) needs to be borne by the ULB even if the septage is not received at the plant regularly.

2. If the CAPEX of implementing of 10 KLD FSTP is invested in implementing decentralized STP, then it can potentially provide higher returns on investment as it will receive wastewater on a daily basis.

3. For practicing co-treatment, monitoring of the incoming sludge needs to be happen. Even a small quantity of non-domestic sludge can lead to failure of biological processes at the STP. Hence, co-treatment of smaller quantum of faecal sludge and septage at STP is recommended only if scientific safe land application is not possible due to non-availability of land, high ground water table etc.

This section will help to understand to make use of the existing assets with the ULB such as vacant land and STP for managing faecal sludge and septage with minimum investment possible before creating more assets which can be financially difficult to O&M and later.

2.1.1 Step 1 - Quantification of septage

Calculate the design population for each town and estimate the number of households. Using the desludging frequency of 3 years and 290 working days per year, calculate the daily collection of septage. The estimated daily collection of septage in the design year is provided in the Table 18.

2.1.2. Step 2 - Identify towns for Land Application

Select the towns with septage collection less than 10 KLD. The volume of the septage is relatively very small as compared to the septic effluent and grey water generated by the same population. Hence, the economic feasibility does not work to treat the septage to the discharge standards. Instead, scientific land application in the form of surface, sub surface or deep/shallow entrenchment is recommended. This is less cost intensive and easy to operate and maintain.

2.1.3 Step 3 - Identify the towns for Co-treatment

For the towns collecting more than 10 KLD of septage and in vicinity of 20 km if the town with STP, co-treatment of septage at STP is recommended. Co-treatment at STP is recommended when the STP is underutilized in terms of volumetric loading and solids loading and takes care of both solids and liquid stream of the septage.

2.1.4 Step 4 - Identify the towns for FSTP

Towns collecting more than 10 KLD of septage but not in vicinity of 20 km of the town with STP are selected for implementing FSTP.

2.2 Identification of the Towns

Table 18 provide details of the nearest town with STP and the distance to the STP. Using the criteria discussed in the Section 2.1, please fill the appropriate FSSM approach in the last column of the Table 18.

Table 18: Identification of FSSM approach for towns

Sr. No.	District	Code	Design year (2040) Septage Collection [KLD]	Solution	Existing STP Capacity	Proposed STP Capacity [MLD]	Nearest Town with STP	Distance to STP	FSSM Approach
1	D1	D1.1	8	Non Sewered					Land Application
2	D2	D2.1	20	Hybrid		2.0			Co-Treatment
3	D3	D3.1	3	Non Sewered					
4	D3	D3.2	8	Non Sewered					
5	D3	D3.3	9	Non Sewered					
6	D4	D4.1	15	Hybrid	2				Co-Treatment

7	D4	D4.2	12	Non Sewered			D4.4	25	FSTP
8	D4	D4.3	12	Non Sewered			D4.6	20	
9	D4	D4.4	24	Hybrid		3.0			
10	D4	D4.5	22	Hybrid		2.5			Co-Treatment
11	D4	D4.6	17	I&D		2.0			
12	D4	D4.7	12	Non Sewered			D4.5	20	
13	D5	D5.1	5	Non Sewered			D5.2	23	Land Application
14	D5	D5.2	46	Hybrid		4.0			Co-Treatment
15	D5	D5.3	15	I&D		1.5			
16	D5	D5.4	25	Hybrid		2.5			Co-Treatment
17	D5	D5.5	7	Non Sewered			D5.3	28	Land Application
18	D5	D5.6	12	Non Sewered			D5.8	20	Co-Treatment
19	D5	D5.7	7	Non Sewered			D5.2	24	Land Application
20	D5	D5.8	60	Hybrid		5.0			
21	D5	D5.9	12	Non Sewered			D5.8	20	
22	D5	D5.10	13	Non Sewered			D5.8	15	
23	D6	D6.1		Sewered	45				Co-Treatment
24	D6	D6.2	17	I&D		1.5			Co-Treatment
25	D6	D6.3	13	Non Sewered			D6.1	15	Co-Treatment
26	D6	D6.4	6	Non Sewered					Land Application
27	D6	D6.5	28	Hybrid		3.0			
28	D6	D6.6	32	Hybrid		3.0			
29	D6	D6.7	12	Non Sewered			D6.5	15	Co-Treatment
30	D6	D6.8	12	Non Sewered			D6.6	20	Co-Treatment
31	D6	D6.9	9	Non Sewered			D6.5	26	Land Application
32	D6	D6.10	16	I&D		1.5			Co-Treatment
33	D6	D6.11	12	Non Sewered			D6.10	15	Co-Treatment
34	D6	D6.12	9	Non Sewered					Land Application
35	D6	D6.13	21	I&D		2.5			
36	D6	D6.14	14	Non Sewered			D6.13	20	
37	D7	D7.1	11	Non Sewered			D7.16	15	Co-Treatment

38	D7	D7.2	7	Non Sewered			D7.16	22	Land Application
39	D7	D7.3	12	Non Sewered			D7.15	25	FSTP
40	D7	D7.4		Sewered	12				
41	D7	D7.5	12	Non Sewered			D7.16	15	Co-Treatment
42	D7	D7.6	10	Non Sewered					
43	D7	D7.7	11	Non Sewered			D7.4	20	
44	D7	D7.8	8	Non Sewered			D7.15	23	Land Application
45	D7	D7.9	13	Non Sewered			D7.16	25	FSTP
46	D7	D7.10	8	Non Sewered			D7.16	25	Land Application
47	D7	D7.11	7	Non Sewered			D7.4	27	Land Application
48	D7	D7.12	6	Non Sewered					
49	D7	D7.13	3	Non Sewered					
50	D7	D7.14	5	Non Sewered			D7.15	26	Land Application
51	D7	D7.15	8	I&D		1.5			Land Application
52	D7	D7.16	15	Hybrid	2				Co-Treatment
53	D7	D7.17	8	Non Sewered			D7.16	30	Land Application
54	D8	D8.1	28	Hybrid		3.0			
55	D9	D9.1	19	Hybrid		2.0			Co-Treatment

In the following table, kindly document the clusters for Co-treatment of faecal sludge and septage with sewage at the existing and proposed STP.

Sr. No.	Host ULB [ULB with STP]	Cluster ULBs
1	D4.6	D4.3
2	D4.5	D4. _
3	D5.8	D5. _, D5. _, D5. _ _
4	D6.1	D6.3
5	D6.5	D6.7
6	D6.6	D6. _
7	D6.10	D6.11
8	D6.13	D6.14
9	D7.4	D7.7
10	D7.16	D7. _, D7. _

2.3 Cost estimates

For arriving at cost estimates, we need to understand how many total treatment facilities need to be set up along with the treatment capacity. Refer to Table 18 and fill the following Table 19.

Table 19: FSSM approach-wise number of treatment facility and total capacity

Type of FSSM Approach	Land Application	Co-treatment	FSTP
Number of treatment facilities	2 _	3 _	3_
Total Capacity Proposed (in KLD)	1 _ 1	5_ 8	3_

Consider cost of Rs. 1 lakh per KLD for establishing a DRE site. Consider Rs.30,000 per annum (lumpsum) as operational expenditure for maintaining the DRE site.

Consider Rs 5 lakhs per KLD for capital cost for establishing co-treatment infrastructure at existing STPs which generally includes a solid and liquid separation unit, wherein liquid is treated with sewage and solid is handled with sewage sludge. The O&M cost for co-treatment is generally negligible and if in any case significant, can be tapped in from the O&M funds allocated for the operation of the STP.

Consider Rs 10 lakhs per KLD capital cost for establishing a FSTP. Consider Rs 80,000 per KLD cost for O&M for both nature-based system and mechanical based system.

Table 20: Cost estimates for FSSM across the State

Type of FSSM Approach	Land Application	Co-treatment	FSTP
CAPEX [lakh INR]	1 _ 1	2 _ 9 _	3 _ _
OPEX [lakh INR]	4 _ . _ 0	-	2 _ . _ 0

2.4 Phasing of the project

For phasing of the project, we choose the solution with least investment and highest impact first. Thus, land application and co-treatment at existing STPs is to be considered in the first phase which is from 2021 to 2025.

During this time, Detailed Project Reports will be made for proposed STP with co-treatment facility. Thus, the co-treatment in the proposed STPs will have to be considered in the second phase as the implementation of the STPs will take at least up to 2025 (base year) in this particular case.

Implementing FSTP can be considered as the third and the last phase as this solution has highest cost to benefit ratio. Until the FSTP is implemented, these towns can practice land application which is relatively easy to operate and significantly less costly.

SECTION

03

STAKEHOLDER ENGAGEMENT

3. STAKEHOLDER MANAGEMENT

Note: This exercise can be done individually as well as in a group. The instructions and steps remain the same.

Context
A Technical Support Unit has been set up at the state level. You are appointed as a project manager who has been assigned the task of planning FSSM for a cluster (D5 comprising D5.8, D5.9 and D5.10).

An STP of 5 MLD design capacity has been proposed in D5.8 and is expected to be commissioned within a period of 4 years. Along with the STP, solid free sewers are also planned in the city which are more cost effective for moderate to low population density. However, in order to keep the sewerage network functional, the septic tanks need to be desludged at a regular interval. Hence, FSSM will be required in the town in perpetuity.

D5.9 and D5.10 have relatively low population density and hence, the state has planned to practice non sewered sanitation in the city. However, to keep the soak away and pits from getting clogged, the households will be regularly desludging the septic tanks.

Introducing the activity
As with any public service project, there are a number of stakeholders involved in the planning and implementation of an FSSM project. These belong to the government as well as include non-government stakeholders. Due to the nature of FSSM, it involves a lot more people engagement as compared to centralised sanitation systems. This is the main reason why stakeholder engagement is a vital step in planning for FSSM.

Keeping in mind the context laid above, one of your tasks is to engage stakeholders so as to ensure smooth planning, implementation and operation of the project in the town.

As explained in the presentation, there are three steps in the entire process, namely:

1. Stakeholder identification
2. Stakeholder characterisation
3. Identifying engagement level and tools

In this activity, the entire class will be split into groups of 4-6 participants, who will discuss among their groups, before making a short presentation based on the discussions. Within each group, each person is to assume the role of the project manager and think accordingly from that perspective. Participants are encouraged to draw on experiences from their work in this entire activity. This will be followed by a discussion between the entire class to ensure cross-learning between groups and to ensure that different perspectives within the class are understood.

Part 1: Stakeholder identification
First part of the activity is to identify stakeholders for the planning of the project in the three towns, while keeping in mind post-planning aspects as well. Participants may, for simplicity, mention the stakeholders common to all towns on one side, and the unique stakeholders for each town on the other.

Hints to participants, the key hint being that thinking along each component of the sanitation service chain can help participants in breaking down the various stakeholders.

Please list the stakeholders in the below table, within each group. Please keep in mind to list all stakeholders you think should be part of the process in this table.

Stakeholders common to all towns	Stakeholders unique to each town

Suggested time: 5-7mins

Part 2: Stakeholder characterisation
Second part of the activity is stakeholder characterization. This can be done using the two parameters: (a) Interest and (b) Influence. Interest refers to the interest of the stakeholder in the project whereas Influence means the influence of the stakeholder on the project.

Each group must now classify the identified stakeholders in the following matrix, after thorough discussion. Depending on time available, the trainer can decide whether this has to be done for all towns separately, or just for stakeholders common to all towns.

	High Interest	Low Interest
High Influence		
Low Influence		

Suggested time: 5-7mins

Part 3: Identifying engagement level and tools

Stakeholder engagement can be carried out at different levels: (a) Information, (b) Consultation, (c) Collaboration and (d) Empowerment/Delegation. For engaging with the stakeholders, there are different tools such as Personal meetings, Workshops, Site visits, Media campaign, Advocacy, Focus Group Discussions, Household surveys, Trainings etc., which can be used. Each of these four levels and the different available tools have been explained in the presentations in Part A of this module.

The participants individually or discuss' within their groups on filling in the following table, selecting the engagement level and tools for each stakeholder identified and placed in the matrix. In this part, a further comment on the project stage has to be made and filled in, depending on which stage the stakeholder is to be engaged with. For reference and clarity, examples have been shared in the below table. The table further indicates that the stakeholders can be repeated.

Depending on the engagement level and project stage (planning, implementation, O&M or M&E), and for each difference, a separate entry must be made (refer to the example of desludging operators in the below table).

Identified Stakeholder	Engagement Level	Engagement Tool	Project Stage (planning/ implementation/ O&M/ M&E)
Desludging operator	Consultation	Personal meetings, advocacy material like videos, workshops, training etc.	Planning
Desludging operator	Collaboration	Personal meetings, advocacy material like videos, workshops, training etc.	M&E

Suggested time: 5-7mins

Once groups have discussed amongst themselves, a representative from each group presents the findings of the entire activity to the rest of the class, and a short discussion can be had.

SECTIONn

04

FSSM PLANNING FOR CLUSTER

4. FSSM Planning for a Cluster

After stakeholder characterization, data collection was done. In order to assess the service delivery and prepare FSSM plan on the CWIS principles, a comprehensive household survey was done. Information was collected through Key Informant Interviews (KIIs) with ULB officials, parastatal body officials, state pollution control board officials. Summary of the information collected from D7.9 town is given in the Table 26 below..

Table 21: Details collected from the surveys and KIIs

Description	D7.9
Population (2011)	8,935
Decadal growth rate (R)	18%
Person per household	4
No. of HH with IHHT	95%
No. of HH dependent on CT	5%
No. of HH connected to septic tanks	92%
No. of CT	3
No. of PT	6

In order to understand the requirements and needs of the desludging operators, Focus Group Discussions (FGDs) were held. The summary of the information collected is provided in the Table 27 below.

Table 22: Information collected through FGD

SIZE OF SEPTIC TANKS		
Households	3	KL
Community Toilet Blocks	7	KL
Public Toilet Blocks	4	KL

DESLUDGING FREQUENCY		
Households	3	years
Community Toilet Blocks	3	months
Public Toilet Blocks	6	months

TRUCK SIZES AVAILABLE		
3000 L and 8000 L		
TRIPS PER DAY		
3000 L	3	no.
8000 L	1	no.

Number of working days in a year = 290 days | Number of weeks in a month = 4

There are four stages in the FSSM planning process: (a) Foundation - Population projection, (b) Planning of emptying service - Estimating number and type septic tanks to be serviced, (c) Planning of conveyance service - Estimating type and number of conveyance units and (d) Quantification - Estimating quantity of faecal sludge and septage collected.

4.1 Foundation

Foundation stage is where population projection is done. Population projection is an important stage and should be based on the information collected from the ULB officials. The results of this stage should also be discussed with key stakeholders before proceeding for next stage. Any change in the projections will impact the rest of the calculations.

For population projection geometric increase method is taken in to consideration. Using the data provided in the Table 26 and the formula given below, estimate the population in the base year i.e., 2025 and design year i.e., 2040.

$$Future\ population = Past\ population \times (1+R)^n$$

Where; R: Decadal growth rate, n: number of decades

Table 23: Population Projection Based On The Information Collected From ULB

Description	D7.9
Population (2011)	8,935
Decadal growth rate (R)	18%
Population (2025)	11, _ _ _
Design population (2040)	14, _ _ _
Person per household	4
Projected no. of HH (2040)	3,6 _ _
No. of HH having septic tank	96%

4.2 Emptying Services

The first step of this stage is to estimate the number of households connected to the septic tank. For this, use the information provided in Table 28 and the formula below.

Households having septic tank [no.]

=Number of households [no.]
×Percent of households connected to septic tank [%]

Document the answer in the Table 29.

Next step is to estimate the number of septic tanks connected to the households. For this, use the information from Table 27, Table 29 and the formula given below.

$$HHs\ to\ be\ serviced\ per\ day = \frac{No.\ of\ HHs\ with\ septic\ tank}{desludging\ frequency \times no.\ of\ working\ days\ in\ a\ year}$$

Document the answer in the Table 29.

Next step is to estimate the number of septic tanks connected to CTs and PTs. For this, use the information from Table 26, Table 27 and formula given below.

$$\text{CT or PT to be serviced per week} = \frac{\text{No. of CT or PT with sepic tank}}{\text{desludging frequency x no. of weeks in a month}}$$

Document the answer in the Table 29.

Table 24: Details of planning of emptying services

Description	D7.9
No. of HH connected to septic tanks	3,4 _ _
No. of HH to be serviced per day	_
No. of CT to be serviced per week	1
No. of PT to be serviced per week	_

Calculate using the formula and the total number of households, CTs and PTs.

4.3 Conveyance Services

In this stage we estimate the number of vacuum trucks required for providing the service to the households, CTs and PTs. Use the information from Table 27, Table 29 and the formula given below to estimate VTs of 3 KL capacity for providing emptying services to the households.

$$\text{Number of trucks required} = \frac{\text{No. of HHs to be serviced in a day}}{\text{No. of trips per day for truck}}$$

Document the answers in Table 30.

The containment units connected to CTs and PTs have higher depth due to area constraints. Also, sometimes the location of these sanitation blocks is not adjacent to the main road and hence to desludge such containment unit higher capacity vacuum pump is required. The larger capacity trucks can carry higher capacity vacuum pump for operation.

Conveyance of sludge using higher capacity trucks as compared to doing multiple trips while using lower capacity trucks is economical and recommended. Use the information from Table 27, Table 29 and the formula given below to estimate VTs of 8 KL capacity for providing emptying services to the CTs and PTs.

$$\text{No. of trips required per day} = \frac{\text{Total units to be serviced per week}}{\text{Number of working days in a week}}$$

Assume number of working days in a week to be 6.

Document the answers in Table 30.

Table 25 Details of planning of conveyance service

Description	D7.9
No. of VTs required for HH	_
Existing number of VTs	0
No. of VTs required for CT & PT	1#

It is recommended that instead of having 3 KL truck doing multiple trips, servicing the larger septic tank with larger capacity vacuum truck is cheaper.

It needs to be noted that in some cases, the CTs might not be accessible to the trucks. In such cases, it is advisable to use vacu-tug to empty the sludge from the containment units and to transfer it to the truck parked on the nearest main road.

4.4 Quantification

Sludge emptied from the containment units can be classified as faecal sludge or septage depending upon the time period for which the sludge was contained in the unit. Longer the duration, the organic solids undergo digestion there by stabilising the sludge. The indicator of this is the colour and settleability of the solids. Septage is considered to have undergone higher degree of stabilization in the septic tank and is black in colour. The settleability of the digested solids is very high. On the contrary the faecal sludge is fresh, is yellow in colour and settleability of the solids is poor.

In case of desludging frequency more than 2 years, the sludge from such containment units will be classified as septage. The sludge coming from CTs and PTs will be classified as faecal sludge. Next step is to find the quantity of faecal sludge and septage to be handled at the treatment plant on a daily basis. Use the information from Table 27, Table 29 and the formula given below.

Quantity of sludge to be treated [KLD]
=Total no. of VTs x No.of trips per truck x Capacity of the truck

Units refer to no. of households to be serviced for calculating quantity of septage to be handled and no. of CT or PT to be serviced per week for calculating quantity of faecal sludge to be handled

Document the answers in Table 31.

Table 26: Quantification of faecal sludge and septage for the cluster

Description	D7.9
Quantity of septage to be handled	_ 2
Quantity of faecal sludge to be handled	_

It is important to understand the quantities of different sludge to be handled on a daily basis.

In case of co-treatment of sludge at the STP, this information is useful for design of the preliminary treatment and the septage receiving station. Further the information is also useful to identify the addition points in the STP where the sludge can be added to the sewage or sewage sludge. A separate module has been developed on “Co-Treatment of faecal sludge and septage with sewage at Sewage Treatment Plant” on the Sanitation Capacity Building Platform online portal.

In case of FSTP, this helps to decide the treatment units and their design capacities required at the treatment plant. For smaller quantities of faecal sludge, it can be blended with septage. In cases, where significant quantity of the faecal sludge needs to be handled, an anaerobic digester is recommended. In order to understand the design of faecal sludge and septage treatment plants, you may refer to advanced module “Faecal Sludge and Septage Management” on the Sanitation Capacity Building Platform online portal.

Desludging of the septic tank connected to public properties such as CTs and PTs can be scheduled so as to optimise the quantity of the faecal sludge to be handled.

SECTION

05

O&M COST OF FSSM

5. O&M Cost of FSSM

After completing the planning of emptying and conveyance stage of FSSM, you have selected an appropriate treatment scheme. The capital cost of the plant has been calculated. This capital cost will be catered to from the funds received by the ULB from the state government. However, the O&M cost of complete system needs to be borne by ULB.

5.1 Emptying and conveyance

Next step is to calculate the cost of emptying and conveyance stage of FSSM. As a project manager, you conducted a stakeholder consultation with the private desludging service providers in the city. Table 32 provides the important inferences from the consultation.

Table 27: Inferences drawn from stakeholder consultations for estimation of O&M cost of emptying and conveyance stage

Average Distance 18 km per trip	**Mileage of Truck** 4 km per Litre	**Human Resource** 2 persons per truck	**Protective Equipment** INR 8,000 per person-year
Fuel Price INR 92 per Litre	**O&M Equipment** INR 4500 per month	**Salary** INR 15,000 per person-month	**Overheads** 10% Total O&M cost

Calculate the cost of fuel

Use the information provided in the Table 27 and Table 32 to calculate the annual expenditure on fuel.

$$Fuel\ cost\ [\frac{INR}{trip}] = \frac{Average\ Distance\ [km]\ x\ Fuel\ Cost\ [\frac{INR}{L}]}{Mileage\ [\frac{km}{L}]}$$

$$Fuel\ cost\left[\frac{INR}{annum}\right] = Fuel\ cost\ \left[\frac{INR}{trip}\right] \times\ No.\ of\ trip\ \left[\frac{no.}{day}\right] \times\ No.\ working\ days\ [\frac{days}{annum}]$$

Fuel cost [INR/annum] =

Calculate the O&M cost of equipment

Use the information in Table 30 and Table 32 to calculate the annual expenditure towards O&M of equipment.

$$Equipment\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost\ of\ equipment\ \left[\frac{INR}{month}\right] \times\ No.\ of\ trucks\ [no.]$$

O&M cost of equipment [INR/annum] =

Calculate the human resource cost

Use the information in Table 30 and Table 32 to calculate the annual expenditure towards salaries of the staff.

$$HR\ cost\ \left[\frac{INR}{annum}\right]$$
$$= No.\ of\ trucks\ [no.]\ \times\ Human\ resource\ \left[\frac{persons}{truck}\right] \times\ Salary\ \left[\frac{INR}{person.month}\right]$$
$$\times 12\ [\frac{months}{annum}]$$

Human resource cost [INR/annum] =

Calculate protective equipment cost

Use the information in Table 30 and Table 32 to calculate the annual expenditure towards protective equipment.

$$PE\ cost\ \left[\frac{INR}{annum}\right] = No.\ of\ trucks\ [no.]\ \times\ Human\ resource\ \left[\frac{persons}{truck}\right] \times\ PE\ cost\ [\frac{INR}{person.annum}]$$

Protective equipment cost [INR/annum] =

Calculate O&M cost

$$O\&M\ cost\ \left[\frac{INR}{annum}\right] = Fuel\ cost + Equipment\ O\&M\ cost + \ HR\ cost + PE\ cost$$

O&M cost [INR/annum] =

Calculate overhead cost

$$Overhead\ cost\ \left[\frac{INR}{annum}\right] = Overheads\ [\%]\ \times\ O\&M\ cost\ [\frac{INR}{annum}]$$

Overhead cost [INR/annum] =

Calculate total O&M cost of emptying and conveyance

$$Total\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost + Overhead\ cost$$

Total O&M cost [INR/annum] =

Calculate the percentage contribution of different types of cost to the total O&M cost. Document your critical observations.

$$Percent\ contribution\ [\%] = \frac{Individual\ cost\ \left[\frac{INR}{annum}\right]}{Total\ O\&M\ cost\ [\frac{INR}{annum}]} \times 100$$

Table 28: Summary of O&M cost of emptying and conveyance

Type of cost	Cost [INR/annum]	Contribution [%]
Fuel cost	4, _ _, 240	
Equipment O&M cost	1, _ _, 000	
Human resource cost	10, _ _,000	
Protective equipment cost	_ _,000	
Total O&M Cost	19, _ _, 264	-

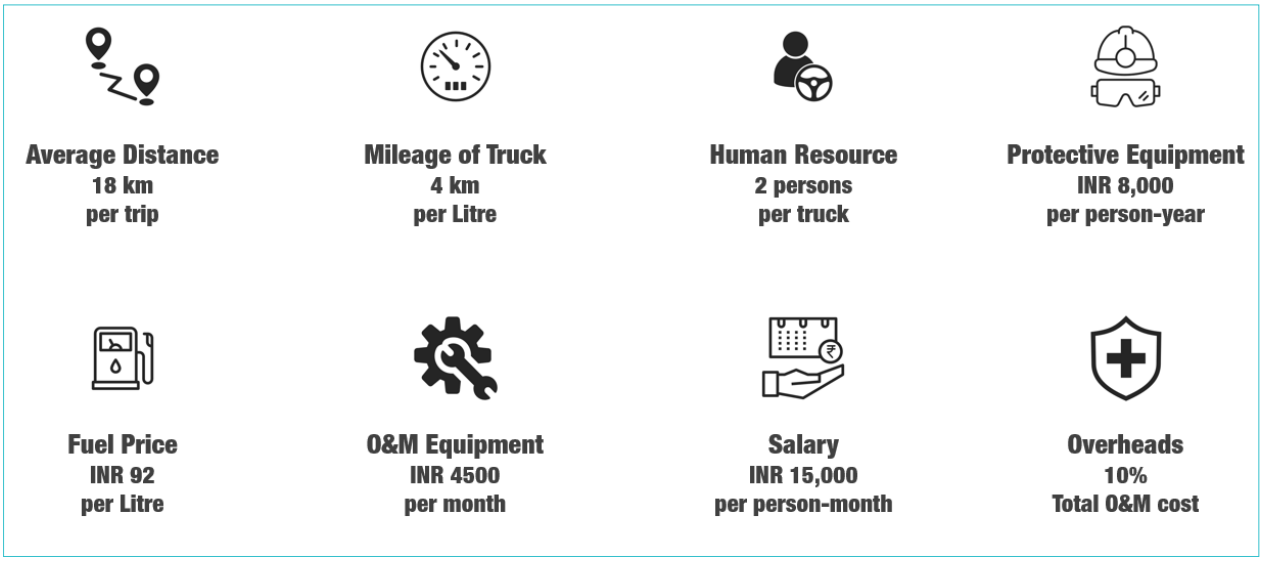
Observations:

5.2 Treatment

After calculating the cost of emptying and conveyance stage of FSSM, it is now time to calculate the cost of treatment stage. The treatment scheme you have chosen is a non-mechanized treatment scheme.

You have consulted the operator of the STP in the city for understanding the salaries of various human resources required at the treatment plant. Along with this, some assumptions were made. Table 34 gives all the data and assumption required for calculating the O&M cost of the treatment stage.

Table 29: Data and assumptions made for calculating O&M cost of treatment stage



Calculate the energy cost

Use the information provided in the Table 34 to calculate the expenditure towards energy bills for running the treatment facility.

$$Energy\ cost\ \left[\frac{INR}{annum}\right] = Energy\ cost\ \left[\frac{INR}{month}\right] \times 12\ [\frac{months}{annum}]$$

Energy cost [INR/annum] =

Calculate O&M cost of equipment

Use the information provided in the Table 34 to calculate the expenditure towards O&M of the equipment at the treatment facility.

$$Equipment\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = Equipment\ O\&M\ cost\ \left[\frac{INR}{month}\right] \times\ 12\ [\frac{months}{annum}]$$

O&M cost of equipment [INR/annum] =

Calculate protective equipment cost

Use the information provided in the Table 34 to calculate the expenditure towards protective equipment for the staff working at the treatment facility.

$$PE\ cost\ \left[\frac{INR}{annum}\right] = Total\ no.\ of\ human\ resources\ [no.] \times\ PE\ cost\ [\frac{INR}{person.annum}]$$

Protective equipment cost [INR/annum] =

Calculate human resource cost

Use the information provided in the Table 34 to calculate the expenditure towards human resources required for running the treatment facility.

$$Salary\ \left[\frac{INR}{annum}\right] = No.\ \times\ Salary\ \left[\frac{INR}{person.month}\right] x\ 12\ [\frac{months}{annum}]$$

Human Resource	Number	Salary [INR/person-month]	Salary [INR/annum]
Operator	1	35,000	
Chemist	1	30,000	
Skilled worker	4	20,000	
Unskilled worker	9	12,000	
Security guards	2	15,000	

Total human resource cost [INR/annum] =

Calculate O&M cost

$$O\&M\ cost\ \left[\frac{INR}{annum}\right] = Energy\ cost + Equipment\ O\&M\ cost + \ HR\ cost + PE\ cost$$

O&M cost [INR/annum] =

Calculate overhead cost

$$Overhead\ cost\ \left[\frac{INR}{annum}\right] = Overheads\ [\%]\ \times\ O\&M\ cost\ [\frac{INR}{annum}]$$

Overhead cost [INR/annum] =

Calculate total O&M cost of treatment

$$Total\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost + Overhead\ cost$$

Total O&M cost [INR/annum] =

Calculate the percentage contribution of different types of cost to the total O&M cost. Document your critical observations.

$$Percent\ contribution\ [\%] = \frac{Individual\ cost\ \left[\frac{INR}{annum}\right]}{Total\ O\&M\ cost\ \left[\frac{INR}{annum}\right]} \times 100$$

Table 30: Summary of the O&M cost of treatment facility

Type of cost	Cost [INR/annum]	Contribution [%]
Energy cost	9 _,000	
Equipment O&M cost	4 _,000	
Human resource cost	12, _ _,000	
Protective equipment cost	4 _,000	
Total O&M cost	16, _ _,800	

Observations:

5.3 Financial model

The financial models can be broadly classified into two: (a) tax model and (b) service fee model.

Calculate the total cost of O&M of FSSM

$$Total\ O\&M\ cost\ of\ FSSM\ \left[\frac{INR}{annum}\right]$$
$$= O\&M\ cost\ of\ desludging\ services\ \left[\frac{INR}{annum}\right]$$
$$+ O\&M\ cost\ of\ treatment\ plant\ \left[\frac{INR}{annum}\right]$$

Total O&M cost of FSSM [INR/annum] =

Tax model

In case of tax model, a fixed amount is collected from each registered property as a tax towards the FSSM service. The desludging service is then provided at a fixed, defined interval. In this case, it was 3 years. In case of scheduled desludging, the ULB will have to adopt tax model and provide a regular desludging service to the households and CTs and PTs. The advantage of the tax model is recommended as it makes the service more affordable to the households. However, the downfall is that the ULB needs to have a very good management information system linked to its tax revenue for structuring the services.

Assuming that the tax collection efficiency of the ULB is 62%, calculate the FSSM tariff.

$$FSSM\ Tariff\ \left[\frac{INR}{household.annum}\right] = \frac{Total\ O\&M\ cost\ of\ FSSM\ [\frac{INR}{annum}]}{Total\ no.\ of\ HH\ [no.]\ \times\ Tax\ collection\ efficiency\ [\%]}$$

FSSM Tariff [INR/ household/ annum] =

Service fee model

In case of service fee model, the customer pays the fees in one go upon receiving the service fee. The service fee model needs to be adopted in case of demand desludging.

$$FSSM\ service\ fee\ \left[\frac{INR}{service}\right] = \frac{Total\ O\&M\ cost\ of\ FSSM\ [\frac{INR}{annum}]}{Total\ no.\ of\ HH\ to\ be\ serviced\ \left[\frac{no.}{annum}\right]}$$

FSSM service fee [INR/service] =

In order to increase the affordability to the households, the service fee needs to be reduced. This can be achieved by increasing the time period of desludging. For example, the desludging frequency of 5 years will give less service fee as compared to the service fee calculated for 3 years. However, with variation in the size of the containment units such as septic tanks in a city, it is difficult to determine the optimum desludging frequency.

5.4 Summary

- The cost of desludging is significantly impacted by desludging frequency.
- Human resource cost contributes significantly to O&M cost of FSSM.
  - Selection technology is quite critical as mechanized treatment requires specialized and costly human resource.
- Fuel cost is second highest contributor in O&M cost of desludging services.
  - Treatment plant should be located as close as possible to the city.
- Cost of safety is negligible; however, provides larger benefits.
- Affordability of services determines the demand of desludging by the households.

Notes

Notes

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About NIUA

NIUA is a premier national institute for research, capacity building and dissemination of knowledge in the urban sector, including sanitation. Established in 1976, it is the apex research body for the Ministry of Housing and Urban Affairs (MoHUA), Government of India. NIUA is also the strategic partner of the MoHUA in capacity building for providing single window services to the MoHUA/states/ULBs.

About SCBP

The Sanitation Capacity Building Platform (SCBP) is an initiative of the National Institute of Urban Affairs (NIUA) to address urban sanitation challenges in India. SCBP, supported by Bill & Melinda Gates Foundation (BMGF) is an organic and growing collaboration of credible national and international organisations, universities, training centres, resource centres, non-governmental organisations, academia, consultants and experts. SCBP supports national urban sanitation missions, states and ULBs, by developing and sourcing the best capacity building, policy guidance, technological, institutional, financial and behaviour change advise for FSSM. SCBP provides a unique opportunity for:

- Sharing and cross learning among the partner organisations, to pool in their knowledge resources on all aspects of urban sanitation capacity building;
- Developing training modules, learning and advocacy material including key messages and content, assessment reports and collating knowledge products on FSSM. Through its website (scbp.niua.org), SCBP is striving to create a resource centre on learning and advocacy materials, relevant government reports, policy documents and case studies;
- Dissemination of FSSM research, advocacy and outreach to State governments and ULBs.

Its strength is its ability to bring together partners to contribute towards developing state sanitation policy, training of trainers and training content development, technical and social assessments, training programme delivery, research and documentation.

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FAECAL SLUDGE AND SEPTAGE MANAGEMENT—PLANNING MODULE

PART C: WORKBOOK