



सत्यमेव जयते

Ministry of Housing and Urban Affairs
Government of India

FAECAL SLUDGE AND SEPTAGE MANAGEMENT

TECHNOLOGY AND FINANCING MODULE

PART A: PRESENTATION SLIDES

TITLE

Faecal Sludge and Septage Management: Technology and Financing Module (Part A: Presentation Slides)

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CONTENT

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PART A: PRESENTATION SLIDES

Collaborative Effort Under Training Module Review Committee (TMRC)



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FOREWORD

Government of India launched Swachh Bharat Mission-Urban on 2nd October, 2014 to make country fully clean in five years and three other flagship Missions viz. Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart City Mission (SCM) and Pradhan Mantri Awas Yojana-Urban (PMAY-U) were also launched on 25th June, 2015. These Missions aimed to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a green and clean environment and application of 'Smart' Solutions to make optimum utilization of resources.

Indian cities are faced with the twin challenges of managing their water demand and reducing waste water footprint. A paradigm shift is needed in favor of decentralized solutions for treatment of waste water and its reuse, promoting water harvesting and protecting our ecology. Several Indian cities are taking concrete initiatives to address this challenge. Success of achieving Open Defecation Free cities under Swachh Bharat Mission, has provided impetus for addressing safe treatment and disposal of septage waste.

National Faecal Sludge and Septage Management Policy-2017 of Govt of India, provided the policy framework for a paradigm shift in favor of decentralized and non sewerage sanitation systems for urban India. Seventeen States have adopted the National FSSM Policy and put in place their own State specific FSSM Policy. More than 440 towns across 10 states are installing decentralized septage treatment plants.

I am happy to share this set of 3 Training Modules (Orientation Module, Technology & Financing Module and Septage Treatment Systems Design Module) prepared by the National Institute of Urban Affairs (NIUA) and the National Faecal Sludge and Septage Management Alliance that will be useful for Urban Local Bodies officials and all para-statal technical agencies in planning and designing decentralized solutions. I hope the National and State level nodal training institutes of MoHUA and all other Urban Resource Centres, Universities, Colleges and autonomous bodies will find them useful for imparting conceptual and practical skills trainings to address the challenges of waste water and septage management.

These modules are made available on the **NIUA website: scbp.niua.org** in downloadable PDF format for wide range and dissemination.

(Durga Shanker Mishra)

New Delhi
02 October, 2019



Acknowledgement

Increasing urbanization of India is putting significant pressure on the available water resources and the safe disposal of waste water. Most cities are facing increasing water stress and are breaching the limits to accessing drinking water from ground water, rivers and water bodies.

A paradigm shift is needed in the urban water and waste water sector, to move away from supply side to demand management and reducing the waste water footprint of cities. Septage management is one critical component of the urban sanitation challenge. With a grant from Gates Foundation, NIUA has rolled out a Sanitation Capacity Building Platform. Over the past 4 years, NIUA has promoted decentralized and non sewerred sanitation through capacity building, technical assistance, research and policy support to states and urban local bodies.

As member of the National Faecal Sludge and Septage Management Alliance(NFSSMA), NIUA has focused on capacity building of urban local body officials and engineers of para state technical agencies across 10 states of India. NIUA supported 8 nodal national training institutes of AMRUT for delivery of trainings and partnered with 9 universities to integrate concepts and technologies in their curriculum. NIUA supported the states of UP, Rajasthan and is currently working with Uttarakhand for appropriate urban sanitation solutions.

Through a collaborative engagement of the Training Modules Review Committee(TMRC) of NFSSM Alliance, anchored by NIUA, all training content developed so far on septage management, has been strategically revised updated into a 3 set learning Modules on Faecal Sludge and Septage Management :

- **One Day Orientation Module** provides an overview of septage management challenges, technology options and planning. Appropriate for all stakeholders.
- **Two Day Technology & Financing Options for FSSM Module** and exposure visit to a Septage Treatment Plant, is an excellent induction and orientation for Elected representatives, Urban Local Bodies officials and Engineers.
- **Three Day Faecal Sludge Treatment Systems Design Module** provides an in-depth training on twin aspects of Technology choice and Designing of Treatment Plants and Co Treatment of Septage with STPs. Appropriate for technical staff of ULBs, Para state agencies, consultants and private sector.

All the three Training Modules are in 2 parts : Presentations and Learning Notes. To serve as guidance for trainees as well as trainers. All the modules are also available on the NIUA website : scbp.niua.org

The modules are produced as a collaborative engagement of NIUA and NFSSM Alliance Partner Organisations. NIUA acknowledges the support provided by Ecosan Services Foundation (ESF), Pune, CEPT University and All India Institute of Local Self Government (AIILSG), Mumbai for developing the content for various modules. We acknowledge the support provided by Bill & Melinda Gates Foundation.

In the coming years, these modules will be developed into more innovative module formats including e learning and gamification, and new face to face training modules. Thereby addressing the next generation of septage management challenge of urban India.

Hitesh Vaidya
Director, NIUA

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:

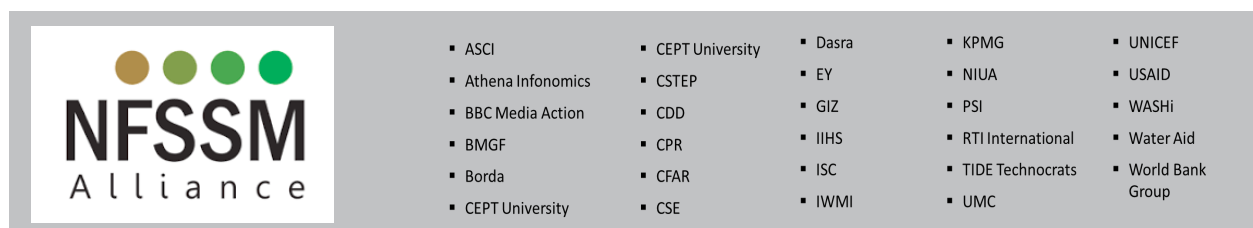
- Build consensus and drive the discourse on FSSM at a policy level, and
- Promote peer learning among members to achieve synergies for scaled implementation and reduce duplication of efforts

The Alliance currently comprises 28 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 a 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 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



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 Training Module

Title	Technology and Financing Options for FSSM: Exposure Visit Module
Purpose	<p>Given the fact that FSSM is different not just in terms of treatment of faecal sludge but integrating the stakeholders and addressing the entire sanitation service chain, it is necessary to strengthen the existing knowledge base and capacity for its planning and implementation.</p> <p>The objective of this training is to develop a comprehensive understanding of the various components of FSSM to implement effective and sustainable sanitation solutions in cities through hands-on experience of witnessing a case study.</p>
Target Audience	The module is designed for city and state officials, AMRUT nodal agencies and professionals associated with the government. Since the training is planned in participatory mode, a small group is generally ideal so that maximum interaction is achieved. The ideal number of participants per training is 30.
Learning Objectives	<p>By the end of the workshop through experience sharing participants are expected to achieve:</p> <ul style="list-style-type: none"> • Understanding the sanitation value chain with challenges and need for addressing septage management solutions for their cities. • Understanding of regulatory frame work, planning and financial options for Faecal Sludge Management initiatives in their cities and towns. • Understanding technology options for treatment of septage through site visit and interaction with engineers and city officials. • Understanding the importance of implementing small incremental Faecal Sludge and waste water Treatment measures in their cities and towns.
Format of the Module	<p>The Module has the following two parts:</p> <p>Part A – Presentation slides: Contains the PowerPoint presentations and practical exercises that trainees can refer to during the training sessions and exercise work</p> <p>Part B – Learning Note: Identifies the learning objectives and key learning outcomes that can guide trainers and trainees. Key learning outcomes are defined as specific points for each session, which need to be limited</p> <p>The content can be contextualised and adopted for conducting exposure visit to any state/ city depending on the profile of the participants, their areas of interest.</p>
Duration	<p>The training is proposed to be conducted in three days –</p> <p>Day-1: class room training,</p> <p>Day-2:field visit and interaction with stakeholders</p> <p>Day-3: Interaction with state/ ULB officials from the case study city and Preparation of action plan by participating officials</p> <p>The duration and content can be altered depending on the profile of the participants, their areas of interest and time available for the training</p>

List & Abbreviations

AIILSG	All India Institute of Local Self-Government
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BMGF	Bill & Melinda Gates Foundation
BIS	Bureau of Indian Standards
BMC	Bhubaneswar Municipal Corporation
BOD	Biological Oxygen Demand
CAPEX	Capital Expenditure
CEPT	Centre for Environmental Planning and Technology
CPHEEO	Central Public Health and Environmental Engineering Organization
CSR	Corporate Social Responsibility
CSTR	Continuously Stirred Reactors
CT	Community Toilet
Cu.m.	Cubic Metre
C-WAS	Centre for Water and Sanitation
DEWATS	Decentralized Wastewater Treatment System
ECOSAN	Ecological Sanitation
FC	Finance Commission
FSSM	Faecal Sludge and Septage Management
FSTP	Faecal Sludge Treatment Plant
GoI	Government of India
GoO	Government of Odisha
GPS	Global Positioning System
HH	Household
HRT	Hydraulic Retention Time
IEC	Information Education and Communication
IHHL	Individual Household Latrine
KLD	Kilo Litres per Day
LPCD	Litres Per Capita per Day
MIS	Management Information System
MLD	Million Litre per Day
MoHUA	Ministry of Housing and Urban Affairs
NGO	Non-governmental Organization
NBC	National Building Code
NIUA	National Institute of Urban Affairs
O&M	Operation and Maintenance
ODF	Open Defecation Free
OPEX	Operational Expenditure
OSS	On-site Sanitation
OWSSB	Orissa Water Supply and Sewerage Board
PDB	Planted Drying Beds
PFR	Plug Flow Reactor
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PT	Public Toilet
RCUES	Regional Centre for Urban and Environmental Studies

SBM	Swachh Bharat Mission
SCBP	Sanitation Capacity Building Platform
SeTP	Septage Treatment Plant
SFD	Shit Flow Diagram
SLR	Solids Loading Rate
SOP	Standard Operating Procedure
SPOC	Single Point Of Contact
SRT	Solids Retention time
SWM	Solid Waste Management
STP	Sewage Treatment Plant
TSU	Technical Support Unit
SLB	Service Level Benchmark
ULB	Urban Local Body
UHT	Underground Holding Tanks

Agenda

Day 1

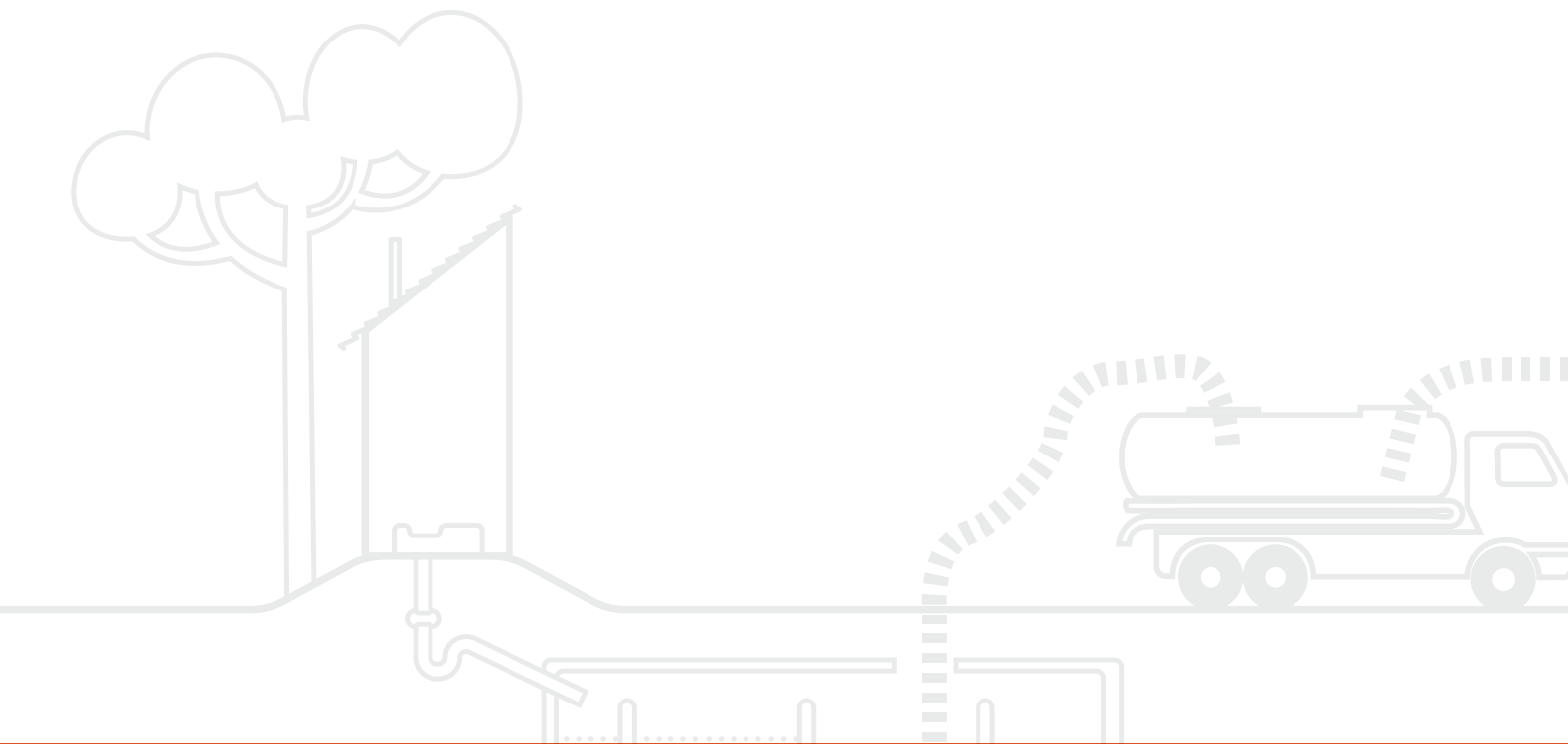
	Duration	Session	Content
	9.30 – 10.00	Introduction of participants and training expectations	
Session 1	10.00 - 10.45	Urbanization and Sanitation	Overview of sanitation systems and context of FSSM, policies and programmes.
Session 2 - A	10.45 - 11.30	Existing situation and challenges	Group exercise - Understanding Sanitation Systems and challenges in initiating FSSM systems
	11.30 – 11.45	Lunch break	
Session 2 - B	11.45 - 12.30	Existing situation and challenges	Shit Flow Diagram illustrations and discussion - Understanding flow of various types of waste water in different city context/ scenario
	12.30 - 13.30	Lunch break	
Session 3	13.30 - 15.00	Planning for emptying services	Overview on need, parameters, conveyance options and demand-schedule based desludging for planning of emptying services.
	15.00 - 15.15	Tea break	
Session 4	15.15 - 16.15	Technology options	Technology options for containment and conveyance, treatment and case studies, and selection criteria
	16.15 – 17.00	Briefing about site visits	Treatment technology details and learnings from implementation

Day 2

	Duration	Session	Content
Session 5	Full Day	Site Visit Discussion - Q and A with officials and staff	Visit to treatment plant to understand the process of treatment, interaction with engineer/ staff at plant/interaction with operator who undertakes desludging Discussion of on-ground implementation challenges and ways to overcome it

Day 3

	Duration	Session	Content
Session 6	9.30– 10.30	Financing and Contracting Options	Financing options, recovery of O&M - user fee, licensing, scheduled vs demand based, private sector participation
Session 7	9.30 - 10.00 10.00 – 10.30 10.30 - 11.00	Interaction with officials from state/city/TSU Follow up on site visit	Learnings from the state Q&A
	12.00 - 12.15	Tea break	
Session 8	12.15 – 13.30	Action Planning	Preparation of detailed action plan
Session 9	13.30 – 14.00	Closure and feed back	Follow up actions and support needed if any



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Day 1
Session
01

Urbanization and Sanitation

Objective:

To provide an overview of sanitation systems and context of FSSM, its need and national/state level policies and programmes.

Format:

Presentation followed by discussion

Duration:

45 minutes

Points to be covered:

- Sanitation situation in urban India, terminologies in FSSM, sanitation service chain and its components.
- Status of STPs in urban India, onsite sanitation systems, status of septage in small and medium towns in India, need for FSSM.
- Context for FSSM - centralized vs. decentralized, challenges and opportunities in FSSM.
- National/State level Policies and Programs, prohibition of employment under manual scavenging act, city level approach towards septage management.

1. Urbanization and sanitation

1. Sanitation Infrastructure in Urban India

Urbanizing India

- ✓ Decadal growth rate of urban population = 31.8%
- ✓ However, financial crunch for urban infrastructure for urban services

Study of SLB Data from **1564 cities**

Sanitation System	Percentage	Number of Cities
Fully sewage system	0.4%	5
Fully onsite sanitation system	76%	1190
Mixed sanitation system	23.6%	369

Source: CEPT, Based on the SLB data submitted to Government of India (2014)

Urban population has increased from 19.9% in 1971 to 31.2% in 2011. The decadal growth rate of urban population is 31.8%. With the increase in urban population, the needs for urban infrastructure and urban services have also increased. Comparative study of 1564 cities from SLB data shows that majority cities are fully dependent on onsite sanitation systems.

Sanitation Status

Table 4 List of States with STPs

Sr. No.	State/UT	Total No. of STPs	Sr. No.	State/UT	Total No. of STPs
1	Punjab	86	21	Kerala	10
2	Maharashtra	78	22	Andaman & Nicobar Islands	8
3	Tamil Nadu	73	23	Goa	7
4	Uttar Pradesh	73	24	Bihar	6
5	Himachal Pradesh	68	25	Puducherry	6
6	Rajasthan	64	26	Assam	5
7	Karnataka	57	27	Chandigarh	5
8	Gujarat	52	28	Tripura	2
9	Odisha	47	29	Meghalaya	1
10	Haryana	41	30	Mizoram	1
11	Chhattisgarh	36	31	Arunachal Pradesh	-
12	Delhi	35	32	Daman Diu and Dadra & Nagar Haveli	-
13	West Bengal	28	33	Lakshadweep	-
14	Jammu & Kashmir	25	34	Manipur	-
15	Jharkhand	24	35	Nagaland	-
16	Uttarakhand	24			
17	Telangana	18			
18	Madhya Pradesh	17			
19	Andhra Pradesh	12			
20	Sikkim	11			

920 STPs... How many are operational ??

- Capacities to maintain?
- High O & M Costs
- Unmanaged solid waste
- Water, power ?

Source: CPCB 2016

As per the current sanitation scenario in India, there are 30 States and Union Territories which have in total 920 STPs but not all of them are functional. This may be due to multiple reasons like limited capacity to maintain the STP, high operation and maintenance costs or limited supply of power and water.

Sanitation

Sanitation- Safe management of human excreta, including its safe confinement, treatment, disposal and associated hygiene related practices.

Sanitation component of SBM, 2014 –

- **ODF City-** A city where at any point of the day, not a single person is found defecating in open!

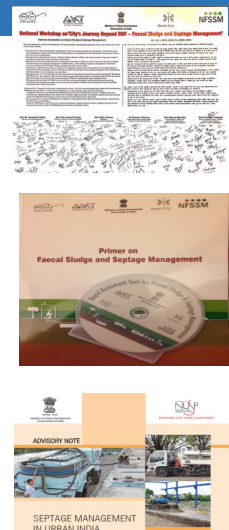
What about safe confinement, treatment, disposal of human excreta?

Sanitation is defined as the safe management of human excreta including its safe confinement, treatment, disposal and associated hygiene related practices. As per the SBM 2014 guidelines the definition of ODF city was limited to no single person being found defecating in the open which raises a question about the unaddressed needs for confinement, treatment and disposal

2. Emerging recognition of Faecal Sludge and Septage Management

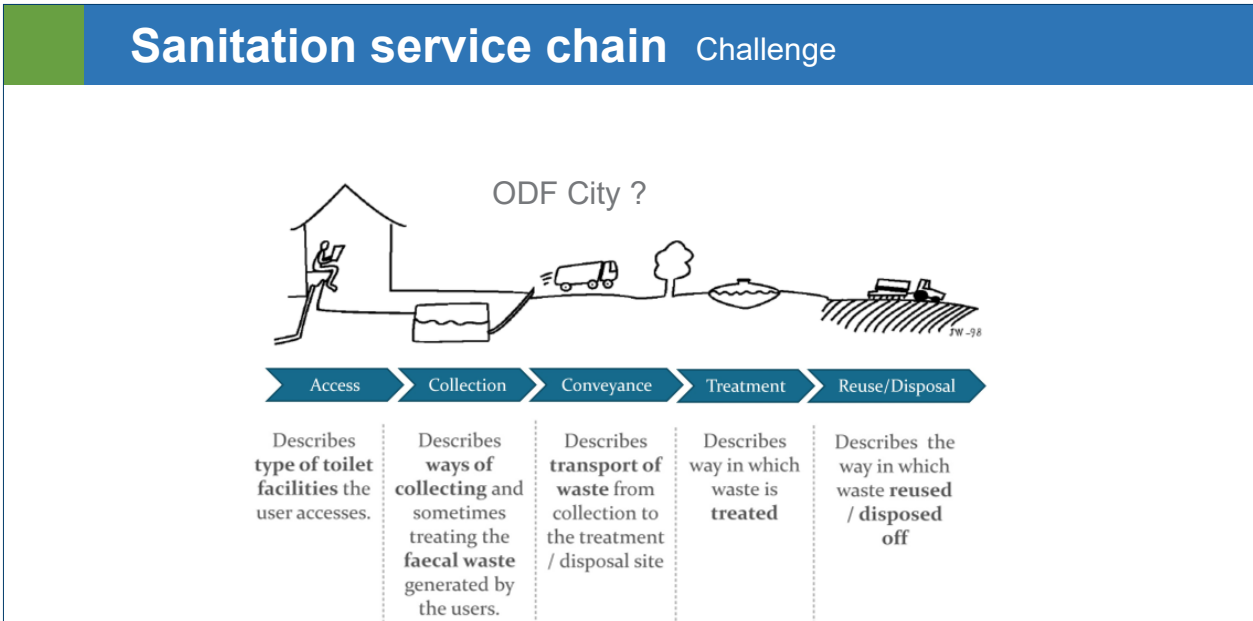
Emerging recognition of FSSM Challenge

- **Septage Management Advisory** of Government of India provides references to CPHEEO guidelines, BIS standards, and other resources for preparing SMP / FSSM plan. (Jan. 2013)
- **National declaration on Septage Management** by MoHUA, GoI (Sept. 2016)
- One of the major **thrust areas** of **AMRUT** is **Septage Management**
- **Primer on septage Management and Rapid Assessment tool** for estimating **budget requirements** for **FSSM** has been rolled out by MoHUA, GoI
- **National FSSM Policy -** by Ministry of housing and Urban Affairs, GoI to facilitate, nationwide implementation of FSSM services in all ULBs (Feb. 2017)

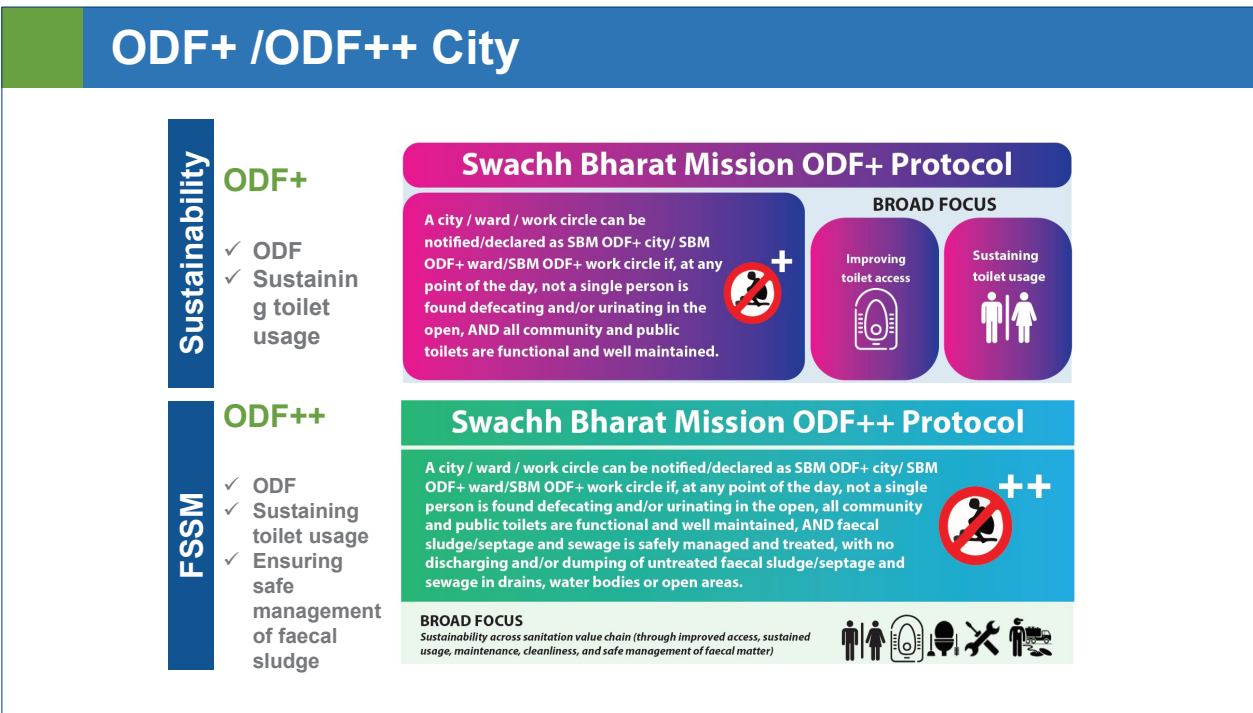


Over the last few years realising the emerging need for FSSM, the Government of India has recognised FSSM through various advisories and declarations. Under the flagship mission 'AMRUT' by GOI, Septage management was one the thrust areas. The National FSSM was released by GOI in February 2017 for nationwide implementation of FSSM in all ULBs has also emphasized on the need for implementation of septage management plans with proper faecal sludge and septage treatment facility.

3. Sanitation service chain



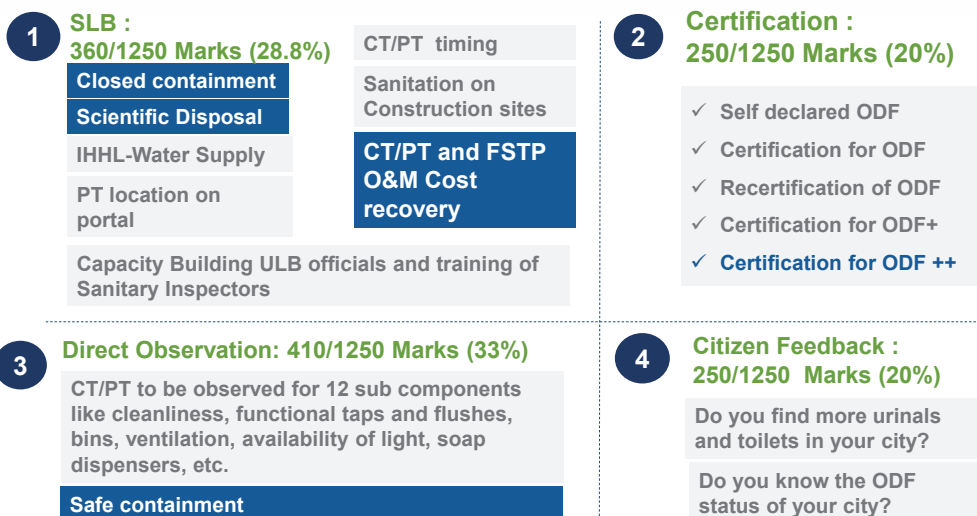
Sanitation chain comprises of the following components viz. access, collection, conveyance, treatment and reuse/disposal. As per ODF City definition the cities have addressed only the access component of the service chain by providing IHHL and access to CT/PT raising the need about what is to be done for collection conveyance treatment and disposal components of the service chain.



Under Swachh Survekshan 2019, MoHUA released the protocols for ODF+ and ODF++. ODF+ as per the protocol mainly focuses on improving toilet access and sustaining toilet usage by increasing IHHL coverage and providing well maintained functional CT/PT. ODF++ as per protocol broadly focuses on sustainability across the entire service chain ensuring safe management of faecal sludge with no discharge of untreated faecal waste in drains or water bodies or open areas in addition to ODF+ requirements.

Swachh Survekshan 2019

Components under Sustainable Sanitation – 1270/5000 Marks अँ(25.4%)



With the emerging need, sustainable sanitation was given about 25% weightage in the Swachh Survekshan 2019. Under all basic components of SLB, certification, direct observation and citizen feedback, sustainable sanitation was given at least 20% weightage. With the protocols for ODF+ and ODF++ released, certification for ODF++ was given 20% weightage of the certification component.

4. Faecal sludge and septage

What is faecal sludge?

“Faecal sludge is the solid or settled contents of pit latrines and septic tanks.

Faecal sludge comes from onsite sanitation systems such as pit latrines, non-sewered public ablution blocks, septic tanks, aqua privies and dry toilets.”

Source:
http://amrut.gov.in/writerreaddata/FSSM_Policy_Report_23Feb.pdf

As defined in the National Policy for FSSM, faecal sludge is the solid or settled contents of pit latrines and septic tanks. Faecal sludge comes from onsite sanitation system such as pit latrines, septic tanks, aqua privies and dry toilets etc.

What is septage?

“It is the liquid and solid material that is pumped from a septic tank, cesspool or such onsite treatment facility after it has accumulated over a period of time.

Septage is the combination of scum, sludge, and liquid that accumulates in septic tanks.”

Septage is defined in the National Policy for FSSM as the liquid & solid material that is pumped from an on-site sanitation system after it has accumulated over a period of time. It is the combination of scum, sludge and liquid that accumulates in septic tanks.

5. Need for Faecal Sludge and Septage Management

Why manage faecal sludge and septage?

1 truck of Faecal Sludge and Septage carelessly dumped
= 5,000 people shitting in the open!



Source : Chary, Srinivas, (2017), "City Wide Approach to Sanitation : Operationalizing FSM Regulations A Case study of Warangal City" at Ujjain Workshop by Water Aid, ASCI (mimeo)

1 Gram of Faeces may contain:

100 parasites eggs

1000 Protozoa

1,000,000 Bacteria

10,000,000 Virus

One gram of faeces contains multiple harmful microorganisms. Disposal of such untreated faecal sludge and septage can contaminate the surface water as well as ground water. The contamination of water leads to water borne diseases like Diarrhea, Cholera, and Typhoid etc.

Onsite sanitation and septage management

Challenge

Emerging questions!

>50% URBAN HHs TOILETS HAVE SEPTIC TANKS



Are septic tanks linked to soak pits

Are they built as per Codes / Specifications ?

How often are they cleaned ?

Where does the effluent flow ?

What happens to the SLUDGE?

In India, 50% urban HHs are connected to septic tanks which raised a question of safe disposal of sludge and effluent. Whether these tanks are linked to soak pits, Are they built as per codes and specifications, what is the desludging frequency, what happens to the sludge and where does the effluent flow, are the key questions to think.

6. Septage Management and sewerage systems

Status of conventional sewerage systems in India

Challenge

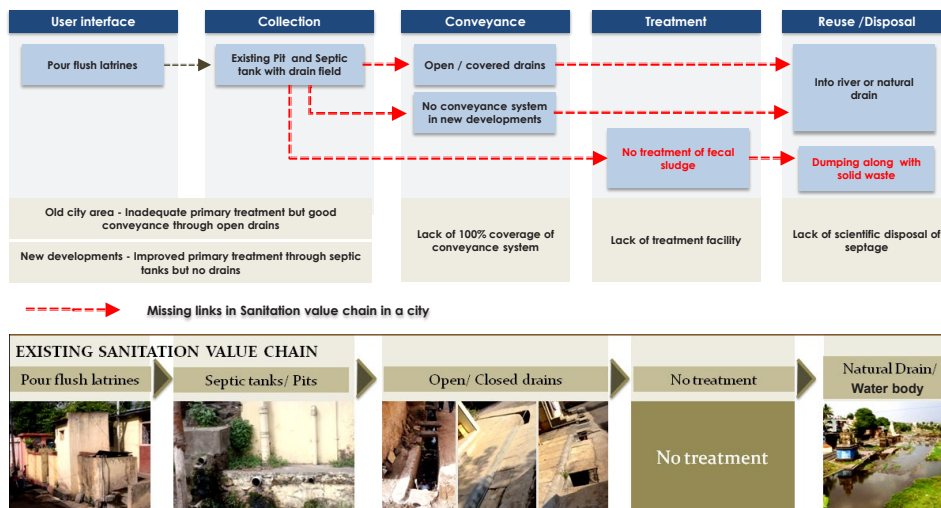
While the conventional sewerage may be an effective system for sewage collection and transportation and treatment, it also remains as a highly resource-inefficient technology.

- High capital cost and continuing significant costs for O&M
- No major effort to create community awareness either about the likely perils due to poor sewage management
- No awareness among citizens reducing sewage generation and promote effective management of its generation and treatment.
- Low degree of community sensitization and public awareness
- No system of segregation of black water (from toilets) and grey water (other liquid wastes) at household level.
- No proper service connections provided to the toilets connecting to the sewers in most cities and towns

Source: CPHEEO Manual; Part A: Engineering, Chapter 1

While the conventional sewerage may be an effective system for sewage collection and transportation and treatment, it also remains as a highly resource-inefficient technology. Consequentially, high capital cost and continuing significant costs for O&M of this system prohibit its widespread adoption in all sizes of urban areas in the country. In terms of capital cost and O&M cost, septage management may be comparatively economical than conventional sewerage system.

Septage in small and medium towns in India



In old city area, the primary treatment is inadequate but have good conveyance system. Due to absence of treatment facility, the septage is being dumped in to the open drains. In new developing areas, the primary treatment is good through septic tanks, but due the absence of treatment facility, the septage is being dumped in to the open drains. It is observed that lack of treatment and scientific disposal are major missing links in the sanitation service chain which need to be addressed along with safe containment and conveyance.

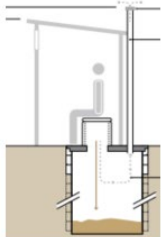
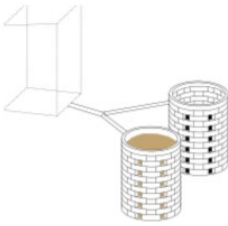
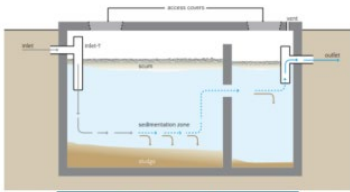
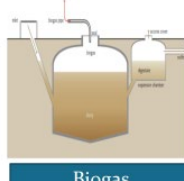


7. Components of sanitation value chain

Type of access

 <p>Individual toilet</p> <ul style="list-style-type: none"> - Toilets used by households at their home - On premise toilet 	 <p>Community toilet</p> <ul style="list-style-type: none"> - Toilets used by residents / community that do not have toilet at their home - Located near a community / slum area 	 <p>Public toilet</p> <ul style="list-style-type: none"> - Toilets used by floating population - Located in market area, bus stop, commercial area
---	--	---

The access component of sanitation service chain is the access to toilets. Toilet facility can be classified in to three type; Individual toilet, Community toilet and Public toilet. Individual House Hold Toilet (IHHL) are the one that are used by HHs at their home or called on premise toilet and the major thrust should be given to individual toilets. Toilets used by residents / HHs that do not have an IHHL are called Community Toilets. The toilets used by floating population located in commercial, market area etc. are called Public Toilets.

Type of collection systems Challenge

 <p>Single pit toilet</p>	 <p>Twin pit toilet</p>	 <p>Septic tank</p>
 <p>Biogas</p>	 <p>Composting toilet</p>	 <p>Bio-digester</p>

Single pit, twin pit, septic tank, biogas, composting toilet, bio-digester are some of the options of containment system. Construction of such collection systems should be done as per guidelines and specification as the primary treatment of sludge takes place in these systems. Construction of single pit should be avoided as it might pollute groundwater if they are not placed carefully.

Type of conveyance systems Challenge



Conventional Vacuum Tanker

For septic tanks which have proper access roads, a larger vehicle may be used



Mini-Vacuum Tanker (Vacutug)

For septic tanks located in narrow lanes or those that do not have proper access roads, smaller vehicles may be used



Gulper

Smaller mechanized tricycle/motorcycle mounted collection tanks of 20-40 litres capacity with gulper or smaller vacuum pumps at the primary level backed by a secondary transport system may work in the informal slum settlements.

Conventional vacuum tanker and Vacutug are commonly used for desludging service. Conventional trucks are used where there is long haul distance and are normally available in 3000-5000L capacity and used where road widths are broader. Vacutug are used in small haul distances and are available in 500-2000L capacity and can be used in areas where road widths are narrower. In densely populated areas with narrow lanes like informal slum settlements, Gulper/Auger can be used for desludging the containment system. It is smaller mechanized tricycle/ bike mounted tank with 20-40L capacity.

Type of treatment systems Challenge



Treating at an Existing Sewage Treatment plant



Treating at an Independent Faecal Sludge and Septage treatment plant (FSSTP)

There are two broad ways of treating septage generated in a city which does not have its own STP. Either at a nearby sewage treatment plant faecal sludge treatment plant. A faecal sludge treatment plant is a facility where sludge is generally received by vacuum emptier trucks or likewise and is treated to allow for safe disposal or reuse. Septage can also be co-treated at an existing sewage treatment plant with available spare capacity. This should be done cautiously to avoid any negative impact on the functioning of the STP.

Type of reuses/disposal Challenge



Once the solids undergo treatment at the FSTPs, they can be reused in certain ways depending on the nature and characteristics of the by-product. The most common option of reuse is as a fertilizer and soil conditioner by farmers. It can also be used as a backfilling material or can be added in biogas plants.

Challenges and opportunities in FSSM

Challenges in Access



While implementing FSSM in cities, multiple challenges are faced across the sanitation service chain. For constructing individual toilets, the major challenges are lack of awareness/willingness, availability of space to build the structure and access to money above the subsidy provided by government. Inadequate water supply, compromise in quality, existing dilapidated or insanitary toilets also pose major challenges. In community/public toilets, lack of adequate toilet blocks to cater to the target population, low maintenance, inadequate water and electric supply and safety are the common challenges faced.

Challenges and opportunities in FSSM

Challenges in Collection

Septic tanks are below the toilets and don't have access covers



Inaccessible septic tanks with sealed tops



Septic tanks located near drains and sealed from the top



Single pit toilets



Oversized septic tanks



Toilets directly connected to drains



Inaccessible septic tanks, absence of septic tank covers are some of the challenges in collection system. In many cases, due to lack of space, the superstructure is built right above the septic tank rendering it difficult to desludge without breaking the slab. Single pit toilets, insanitary toilets, unlined septic tanks, outlet of septic tank directly to drains are also challenges in the collection system which pose a high risk to environment.

Challenges and opportunities in FSSM

Challenges in Conveyance



Services mainly provided by city governments



Unsafe handling of septage



Informal Private sector



Emptying when the tank is full

- No monitoring mechanism for informal sector
- Cleaning cycle greater than 8-10 years against recommended cycle of 2-3 years
- Due to infrequent cleaning, septage begins to solidify in tanks and septic tank fills up, faecal matter along with effluents is released into the drains

Very low desludging frequency against the recommended cycle, unsafe handling of septage by desludging operators and lack of monitoring mechanism for informal sector are the major challenges in conveyance system. Lack of awareness about environmental hazards leads to desludging of septic tanks on when they are full. Due to such infrequent cleaning of septic tanks, overflow of effluent mixed with sludge is often witnessed in drains. The septage in the septic tank also solidifies over time making it difficult to desludge.

Challenges and opportunities in FSSM

Challenges in disposal



Disposal of septage at dump site



NO TREATMENT OF FAECAL SLUDGE & SEPTAGE



Disposal of septage in open land



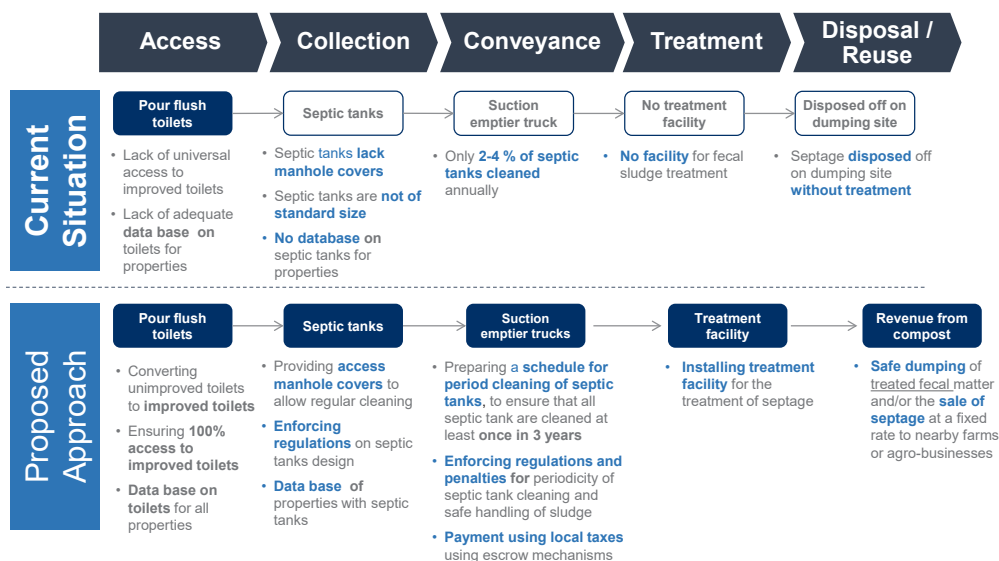
Disposal of septage in water bodies

Source: Chary, Srinivas, (2007), "City Wide Approach to Sanitation - Operationalizing FSM Regulations A Case study of Warangal City" at Ujjain Workshop by Water Aid, ASCI (mimeo)

Due to lack of treatment facilities for septage, it is disposed in hazardous manner in open in the city. After desludging, septage is generally disposed at the solid waste dumping site of the city, or in open land or water bodies in the city outskirts.

8. Approach to septage management in cities

End-to-end IFSM solution – From red to green



Apart from addressing the access component in the sanitation service chain, the current situation in most cities is poor as shown in the 1st part of the diagram. The septic tanks do not have access covers and are larger than the standard sizes so that the desludging period is more. Only 2-4% of total septic tanks are cleaned annually and due to less demand, the cities have poor infrastructure to cater to the same. There is no treatment provision for septage and it is disposed off haphazardly without treatment into the environment. Thus, there is a need to address the entire sanitation service chain in the cities. This includes ensuring access to toilets, enforcing regulations for appropriate collection systems, moving towards periodic cleaning of septic tanks as per norms and treatment and reuse of collected septage.

Step by Step approach to operationalize septage management plan

A. Preparation and implementation of plan for Septage management

- **Assessment** of existing toilets and septic tanks through surveys and creation of database
- Design and construction / **refurbishment** of septic tanks
- **Desludging** of septic tanks
- Scheduled septic tank emptying services
- **Treatment** of faecal sludge / septage

B. Institutional and governance aspects in Septage Management

- **Regulations** for septage management systems
- **Awareness generation** and capacity building activities
- Record-keeping , **reporting (MIS), monitoring** and feedback systems
- Sources of **revenues** for septage management

A step by step approach towards end to end septage management is crucial starting from preparation and implementation of septage management plan to its governance aspects.

Planning and implementation for septage management includes assessment of existing toilets and septic tanks, construction and refurbishment of septic tanks, scheduling of septic tanks and their periodic cleaning and treatment of septage. The governance aspects include regulations, awareness generation and capacity building, record keeping, monitoring and identifying sources of revenue.

Assessment of existing toilets and septic tanks through surveys and creation of database (1/2)

Present system

- No database of toilets, septic tanks for HHs
- No ready database to show how often a septic tank is being cleaned and at which location in the city

Creating database and improving monitoring :

- Create database for each HHs / property depicting details on Toilets, septic tanks, soak pits details
- Update of HHs / property on server through mobile application or reporting systems once the septic tank is cleaned
 - Automatic reminder sent to the HHs after 3 years to clean the septic tank



At present very few cities have database on number of septic tanks, their spatial location and their frequency of cleaning. For effective planning of septage management, creation of HH/property level database is beneficial for accuracy in designing.

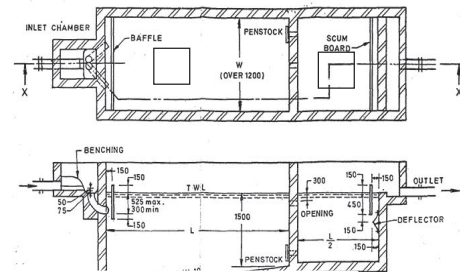
Design and construction / refurbishment of septic tanks

Note : A provision of 300 mm should be made for free board.

- The **septic tanks** need to be **designed and constructed** as per the **norms suggested** in:
 - **Swachh Bharat Mission Guidelines, 2014**
 - **Manual on Sewerage and sewage treatment systems , CPHEEO, 2013**
 - **National Building Code of India, 2005**
 - **IS: 2470 - Code of practice for installation of septic tanks - Part 1: Design and Construction and Part 2: Secondary treatment and disposal of septic tank effluent 1985 (Reaffirmed 1996).**
- **Notices** should be issued to all **property owners** whose **septic tanks do not meet the standard septic tank design.**
- All **insanitary toilets** need to be **converted to sanitary toilets** with twin pits or septic tanks

No. of Users	Length(M)	Breadth(M)	Liquid Depth (Cleaning interval of)	
			2 Years	3 Years
Recommended size of septic tank up to 20 users				
5	1.50	0.75	1.00	1.05
10	2.00	0.90	1.00	1.40
15	2.00	0.90	1.30	2.00
20	2.30	1.10	1.30	1.80
Recommended size of septic tank for housing colony upto 300 users				
50	5.00	2.00	1.00	1.2
100	7.50	2.65	1.00	1.2
150	10.00	3.00	1.00	1.2
200	12.00	3.30	1.00	1.24
300	15.00	4.00	1.00	1.24

Typical sizes of septic tanks for various user sizes



Typical two compartment septic tank

Septic tanks are generally over designed beyond the standards by people for their own convenience to reduce the frequency of desludging. Septic tanks need to be designed and constructed as per norms mentioned in NBC and CPHEEO manual for them to function efficiently. Strict regulations and monitoring for this should be followed and non-complying parties should be penalized. Similarly, existing septic tanks which are not as per the norms should be refurbished.

Desludging of septic tanks

As per **Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013** , desludging / emptying of septic tanks will be **undertaken by mechanical devices** like suction emptier trucks / vacuum tankers

For septic tanks which have proper access roads, a larger vehicle maybe used

For septic tanks located in narrow lanes or those that do not have proper access roads, smaller vehicles maybe used

As per **CPHEEO Manual** on Sewerage and Sewage Treatment , 2013 **IS : 2470 (Part I & II), 1985** on Code of Practice for Installation of Septic tank

“Yearly desludging of septic tank is desirable, but if it is not feasible or economical, then septic tanks should be cleaned at least once in two - three years, provided the tank is not overloaded due to use by more than the number of persons for which it is designed”

Pg 9-22, CPHEEO Manual



As per the CPHEEO manual on sewerage and sewage treatment 2013, it is expected that septic tanks should be cleaned at least once in two to three years. Desludging should be undertaken by mechanical devices as per prohibition of Employment as Manual Scavengers and their Rehabilitation Act 2013.

Recommendations for desludging as per MoUD Advisory

Desludging of Septic tanks

- **De-sludging** of septic tanks - using **mechanical devices**
- **De-sludging frequencies** of septic tanks once every **2 to 3 years**, or when the tank becomes one third full
- Periodical desludging will help **reduce the pollution levels in the effluent**
- **1-2 inch of sludge** should be **left in tank** to **facilitate** future **decomposition**
- **Regular desludging** activities will **require well-organized** community and **public/private service providers**
- **Tanks should not be scrub** cleaned or **washed with detergent**

Transportation

- **Vehicles** are available in different **capacities** from **2,000 to 12,000 litres**.
- Small scale vacuum trucks called **Vacutug** are recommended for **areas inaccessible** to large vehicles
- The **no. of cleaning machines** - based on frequency of **cleaning**, **distance** of location of **treatment facility** and local conditions
- A **Transportation Plan** should be formulated which **should include**:
 - **Scheduling** and routing for trucks
 - **Customer service protocols**
 - **Locating** tanks and cleanouts with **proper pumping** equipment operation and worker safety
 - **Transportation requirements**, including rules of the road
 - **Disposal procedures** at the treatment facility
 - **Routine service** of equipment
 - **Recordkeeping** for all tanks pumped and wastes discharged at the disposal facility

The Advisory Note on 'Septage Management in Urban India' published in January 2013 by the Ministry of Housing and Urban Affairs (<http://cpheeo.gov.in/upload/uploadfiles/files/Advisory%20Note%20on%20Septage%20Management%20in%20Urban%20India.pdf>) gives recommendations for desludging of septic tanks and conveyance of the desludged septage.

Desludging of septic tanks:

It states that the septic tanks should be desludged once every 2-3 years or when the tank becomes full. The most satisfactory method of sludge removal is by vacuum tankers. Periodical desludging also helps reduce the pollution levels in the effluent, which normally enters waterways untreated. However, a small amount of sludge should be left in the tank to ensure that a minimum level of the necessary microorganisms responsible for anaerobic digestion remain in the tank. To do this, well organized public and private sector providers should be in place. The sludge after removal should be transported in a controlled manner to avoid leakage or spillage en-route.

Transportation of septage:

The following norms are suggested to work out the requirement of septic tank cleaning machines.

- The vehicles are available in different capacities from 2,000 up to 12,000 litres.
- Total number of machines depends on the frequency of cleaning of septic tanks (once in 2–3 years) and also the distance from the location of septic tanks to the septage treatment facility.
- It is to be noted that the requirement of machines also varies depending upon the capacity of vehicles, road width etc. In case of bigger cities having sufficient width of roads, vehicles having larger capacities may be adopted.
- However, the number of septic tank cleaning machines will have to be decided based on local conditions and in consultations with the community and traffic police regarding movement of vehicle.
- Small scale vacuum trucks called Vacutug (from 200 up to 2,000 litres capacity) are also recommended for use in areas inaccessible to large desludging vehicles.

It would be desirable to develop standard operating procedures for pumping, and transportation of septage as part of a manual of practice for septage.

Licensing of septage transporters for providing scheduled services

- **ULBs** should either **provide the emptying services themselves** or enter into appropriate **management contracts** with **private agencies**.
- In case of private sector contract, **ULBs should certify and license private septage transporters to de-sludge and transport waste** to the designated **treatment facility**.

Septage Transporter Permit for _____ Municipality

In accordance with all the terms and conditions of the current _____ Municipality's Rates, Rules and Regulations, the special permit conditions accompanying this permit, and all applicable rules, laws or regulations of Government of Maharashtra, permission is hereby granted to:

NAME OF PERMITTEE: _____

ADDRESS: _____

For the disposal of septage from domestic septic tank or commercial holding tank at the _____ treatment facility.

This Permit is based on information provided in the Septage Transporter Permit application which constitutes the Septage Management Hauled Permit.

This Permit is effective for the period set forth below, may be suspended or revoked for Permit Condition Non Compliance and is not transferable. The original permit shall be kept on file in the Permittee's office. A copy of this Permit shall be carried in every registered vehicle used by the permittee.

EFFECTIVE DATE: _____

EXPIRATION DATE: _____

___ CHECK IF RENEWED PERMIT

Permit is liable to be cancelled in case of violations of any Acts, Rules and Regulations relating to the operation of Septage System or in cases of safety protocols not being adhered to or in case of non-permitted disposals.

Sample licensing format¹

1: Source: Operative guidelines for septage management for urban and rural local bodies in Tamil Nadu.(2014)

If desludging services are outsourced to private sector, appropriate contract documents stating all the necessary terms and conditions should be developed. ULBs should certify and license private septage transporters to desludge and transport waste only to the designated treatment facility.

Amrut Sub-Mission on FSSM - An opportunity for States and Cities.

- All Amrut Cities are eligible
- 48 cities on the main stem of river Ganga shall mandatorily undertake FSSM projects for areas not covered by sewerage
- State must have notified the State FSSM Policy in line with the National FSSM Policy issues by MoHUA in 2017
- State shall adopt and notify the Standard Operating Procedure (SOP) for cleaning of sewer and septic tanks released MoHUA in November, 2018.
- ULBs shall adopt FSSM Policy and SOPs for cleaning of sewer/septic tanks by passing a resolution

Over the past two years FSSM has received increasing attention and a national FSSM policy has been adopted. Government of India has undertaken several policy and programme initiatives like FSSM sub-mission under AMRUT which is eligible for all AMRUT cities. As per this, states must have notified their state FSSM policies in line with national FSSM policies issued by MoHUA in 2017. (http://amrut.gov.in/writereaddata/FSSM_Policy_Report_23Feb.pdf)

Gender and sanitation

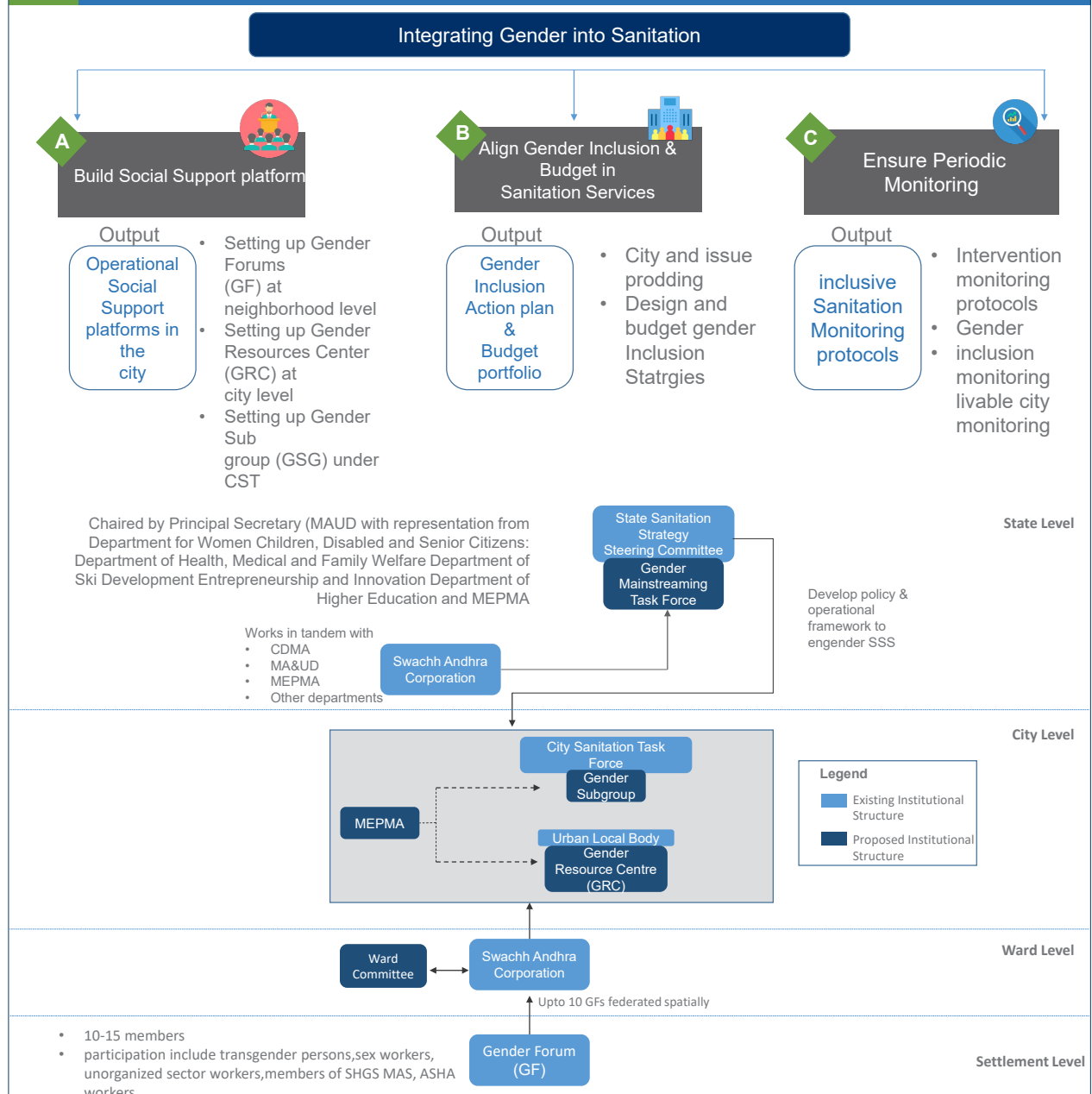
In the context of sanitation in urban areas, exclusion is rampant and all pervasive

Women, children , adolescent girls, Persons with Disabilities (PWD), Elderly, People living with HIV and Leprosy, Fisher folk, Shikaris, Yerukulas, , Rag pickers and Transgender

Exclusion can be addressed through Gender Integrated Sanitation Interventions

Gender Integration in Sanitation aims at increasing women’s voice, agency, empowerment and participation in sanitation as beneficiaries and also as providers of services.

A case study of Andhra Pradesh



Source: ASCI, Hyderabad

The Centre for Study of Science, Technology and Policy (CSTEP), the Administrative Staff College of India (ASCI) and Centre for Advocacy and Research (CFAR) is at present engaged in a collaborative project titled Intersectionality-Informed Framework for Implementation of Effective Gender Mainstreaming in WSH: Andhra Pradesh. The project aims to strengthen agencies and advance policies, regulations, and processes for increased accessibility to sanitation services. This framework is being piloted in three towns of Andhra Pradesh (Anantapur, Kovvur and Narsapur). The framework has been designed operate along three tracks to ensure extensive reach and impact. These tracks have been described below:

- Build social mobilisation/support platforms
- Gender Sub-Group (GSG)
- Gender Resource Centre (GRC)

The experience from the three cities has shown demonstration of implementing gender mainstreaming strategies by institutionalizing social mobilization platforms at neighbourhood and city level GFs at urban poor settlements and GRC at the Urban Local Body. Reports from these cities show a positive and encouraging impact in access to sanitation for marginalised and disadvantaged communities residing in the cities. GFs have been constituted in the highly vulnerable slums in the three cities with participation from transgender persons, sex workers, unorganised sector workers, members of Self-Help Groups (SHGs), Slum Level Federations (SLFs), Area Level Federations (ALF), town Level Federations, ASHA workers etc. A GRC Forum has been federated at the city level for each city involving the ULB, MEPMA and frontline leaders and volunteers from GFs. Efforts are being made at state to institutionalise the framework through a policy framework and capacity development of state departments. The figure in the slide describes the proposed and existing institutional structures for implementing gender mainstreaming in urban sanitation in Andhra Pradesh

Social Entrepreneurship in FSSM: Berhampur, Odisha

A Case Study of Berhampur, Odisha

Best Practices: Under Odisha National Urban Livelihoods Mission engagement of women SHGs in the O&M of community toilets



- Berhampur city - Engaged **26 Self Help Groups (SHGs)** for O&M of **36 community toilets**.
- SHGs also engaged in motivating households for **mechanised cleaning of septic tanks** for which they are given incentives based on every desludging service.
- Balasore, Bhadrak, Bhubaneswar and Cuttack adopted similar concept.

Source: EY, Odisha

Social Entrepreneurship in FSSM - The Case Study of Berhampur, Odisha

Mainstreaming vulnerable populations through livelihood opportunities within the sanitation sector is crucial for their empowerment and progress. Among the successful social entrepreneurial activities undertaken under the Odisha National Urban Livelihoods Mission are engagement of women SHGs in the O&M of community toilets.

- Berhampur has taken a lead by engaging 26 Self Help Groups (SHGs) engaged in the O&M of 36 community toilets.
- SHGs in Berhampur are also engaged in motivating households for mechanised cleaning of septic tanks for which they are given incentives based on every desludging service.
- Other towns such as Balasore, Bhadrak, Bhubaneswar and Cuttack have adopted similar interventio

Session

02

Existing Situation and challenges

Objective:

To understand sanitation systems and challenges through hands-on work and understanding the concept of shit flow diagram

Format:

Presentation followed by group exercise

Duration:

90 minutes

45 minutes – presentation

45 minutes – group exercise

Points to be covered:**Presentation: Shit Flow Diagram tool**

- Understanding the concept of shit flow diagram and its applicability as a visual graphic to portray sanitation situation across the service chain.
- Understanding flow of various types of waste water in different city context/ scenario.

Group exercise: Understanding sanitation systems

- Mapping out existing sanitation systems in city – access to basic vs. access to improved – to understand gaps and their impact on the performance of the system.
- Identification of components of sanitation service chain and systems under each component.
- Outlining the blackwater and greywater path across the sanitation service chain.
- Drawing the envisaged sanitation system which might serve the city in safe and adequate manner.

2. Existing situation and challenges

1. Group exercise – Understanding sanitation systems

Understanding Sanitation

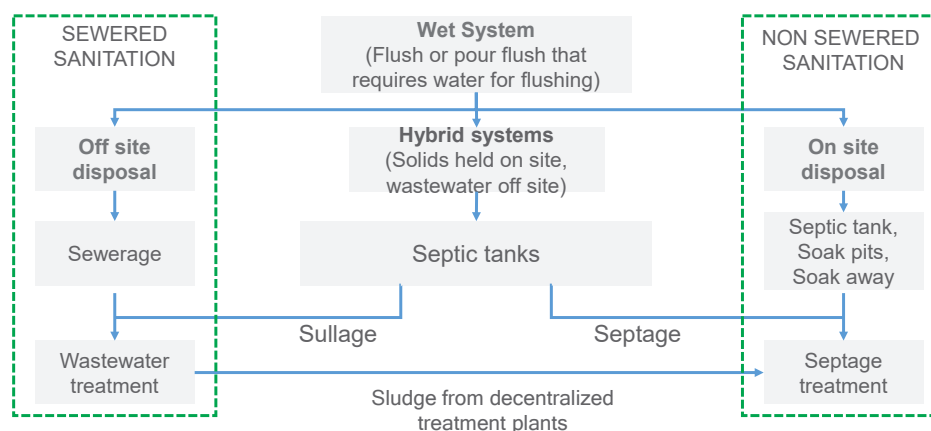
- An intervention involving behaviour and facilities aiming at interrupting the disease cycle (faecal-oral disease transmission).
- Safe management of excreta.
- Hardware (toilets & sewers)
- Software (regulations & hygiene promotion)
- Access to basic vs. access to improved

Objectives of Sanitation

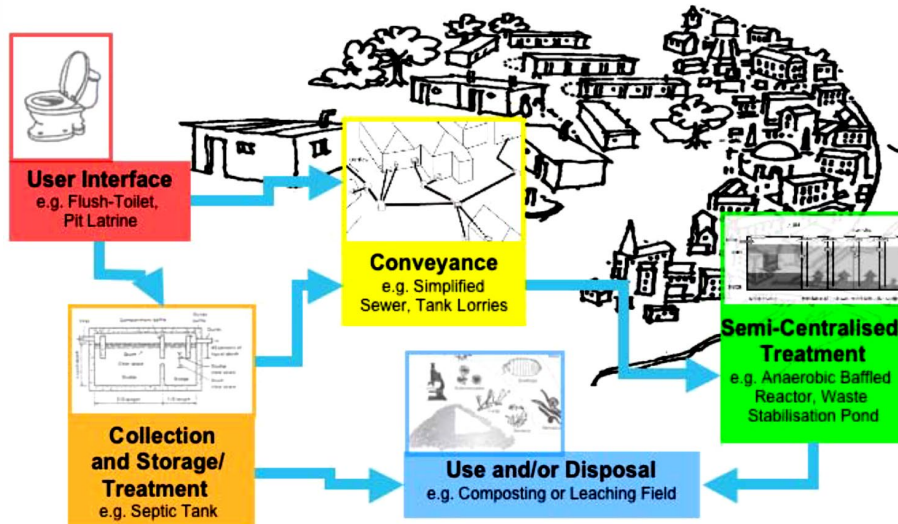
- Protect and promote health
- Protect the environment
- Be simple
- Be affordable
- Be culturally acceptable
- Works for everyone

Sewered and non-sewered sanitation

Sanitation systems around us!


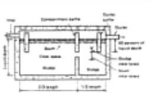

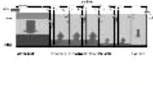



Sanitation Systems- Functional Groups



Source: Sandec Training Tool

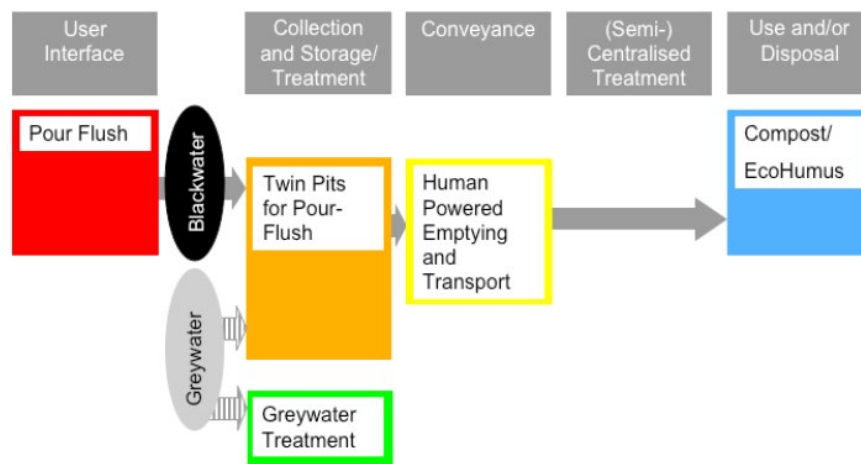
Sanitation Systems- Functional Groups

User Interface	Collection and Storage/Treatment	Conveyance	(Semi-) Centralised Treatment	Use and/or Disposal
 <ul style="list-style-type: none"> • Dry Toilet • Urine Diverting Dry Toilet • Urinal • Pour-Flush Toilet • Flush Toilet • Urine Diverting Flush Toilet 	 <ul style="list-style-type: none"> • Single Pit • Single VIP • Dehydration Vaults • Septic Tank • Composting Chamber • Anaerobic Baffled Reactor • Anaerobic Filter etc. 	 <ul style="list-style-type: none"> • Human-Powered Emptying and Transport • Motorized Emptying and Transport • Simplified Sewers • Small-Bore Sewer • Conventional Gravity Sewer • Jerry Can/Tank etc. 	 <ul style="list-style-type: none"> • Anaerobic Baffled Reactor • Anaerobic Filter • Trickling Filter • Waste Stabilisation Ponds • Activated Sludge • Constructed Wetland • Co-composting etc. 	 <ul style="list-style-type: none"> • Application of Urine • Application of Dehydr. Faeces • Compost • Irrigation • Aquaculture • Soak Pit • Leach Field • Land Application • Surface Disposal etc.

Source: Sandec Training Tool

There are various subsystems or components under each functional group based on its type, technology etc. The User Interfaces can be dry toilets, urinal, pour-flush toilets, flush toilets, urine diverting dry toilet, urine diverting flush toilet etc. Different types of collection and storage are single pit, twin pit, single VIP, dehydrating vaults, septic tanks, composting chamber etc. Types of conveyance systems are human powered emptying and transport, motorised emptying and transport, simplified sewers, conventional gravity sewers etc. The treatment plants can be anaerobic filter, anaerobic baffle reactor, constructed wetland, cocomposting etc. The end product can be reused in irrigation, leech fields, aquaculture, surface disposal etc.

Sanitation System- Twin pit toilet



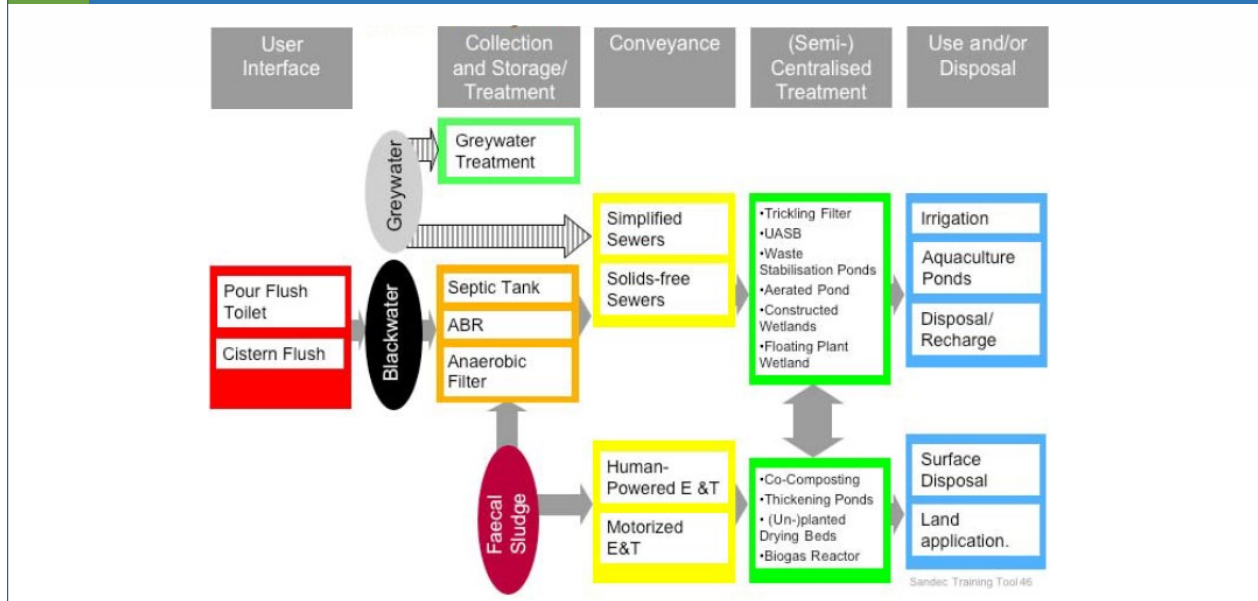
The complete service chain for a HH in a city in case of a regular twin pit toilet is described. The user interface is a pour flush toilet where black water goes into the twin pit toilet for storage. The grey water then flows through drains for treatment the solids are emptying by human powered emptying and transport. There is no treatment facility and it is directly reused as compost.

Understanding Sanitation Systems

- Divide the flip chart into two parts.
- Top part: Draw the sanitation system which serves majority of your city.
 - Observe the gaps in the systems and their impact on the performance of the system.
 - Identify potential solutions for completing the sanitation system.
- Bottom part: Draw the envisaged sanitation system which might serve the city in safe and adequate manner.

The participants are expected to divide their sheets in two sections and draw the current sanitation system that exists in the majority of their cities and observe gaps in the same in the top section of the sheet through brainstorming in a group. After this, an envisaged system which will serve the city in safe and adequate manner should be drawn in the second half of the sheet. All groups are expected to present their systems after completion.

Sanitation System- Small Bore System

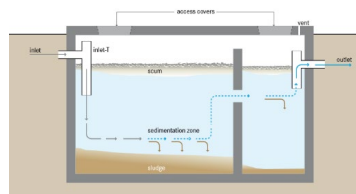
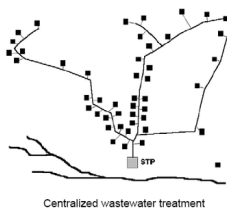


- The user Interface could be pour flush toilets and cistern flush toilets
- From the User Interface the blackwater shall be collected in the septic tank, ABR or or anaerobic filter. The solids shall settle and the grey water shall flow out. The grey water from the user interface shall be collected in the grey water tank.
- This grey water from the tanks shall be conveyed via small bore system or solids free sewers to the treatment plant. The faecal sludge shall be conveyed via human or motorised emptying and transport to a treatment facility.
- Treatment option like UASB, waste stabilization pond, floating plant wetland etc could be adopted for liquids and co composting , bio gas reactor, drying beds etc could be adopted for solids
- The end products may be used for surface disposal, irrigation, aquaculture ponds etc as per market demand in the city.

2. Shit flow diagram illustration

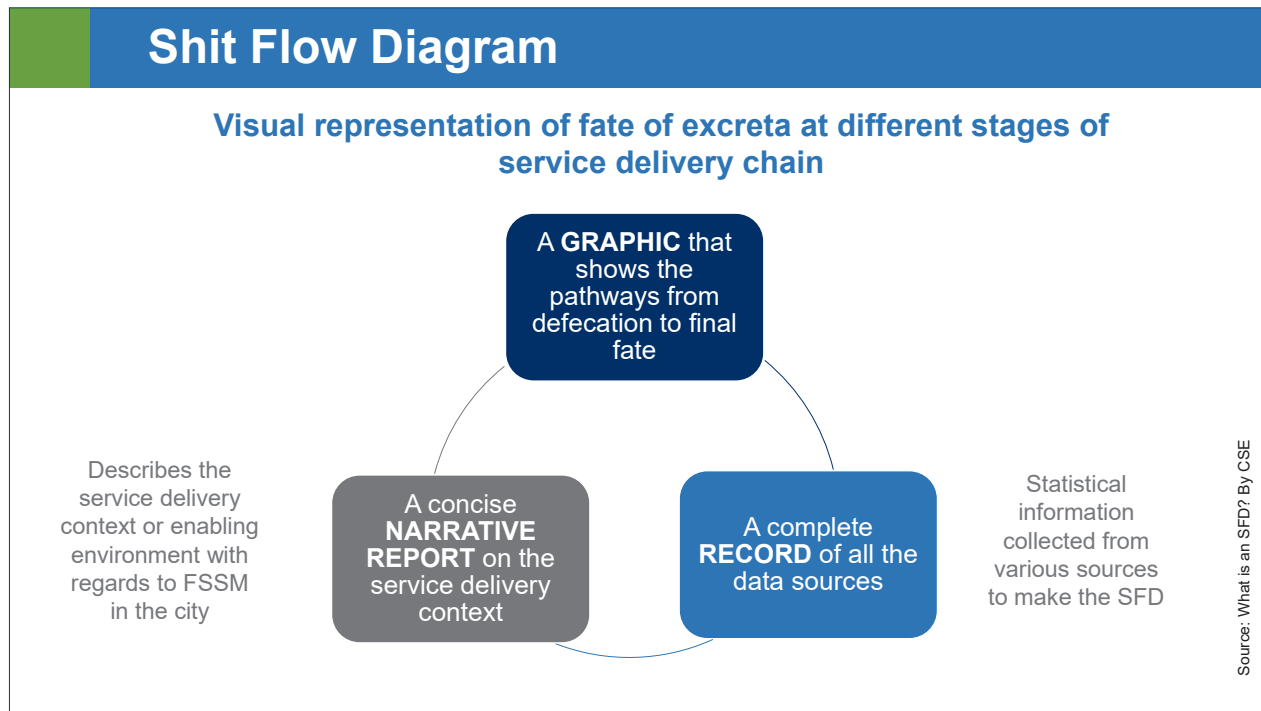
The status quo

- Strong focus on centralized wastewater management systems.
- Most urban dwellers with sanitation access use on site sanitation systems.
- On site sanitation systems are seen as temporary solutions and hence neglected.
- Data on the sanitation is not collected city wide.
- Failure to manage the sanitation systems



Source: What is an SFD? By CSE

The current approach to sanitation in India is largely focused on centralized waste water management systems which are challenging to plan, execute and manage due to various factors like cost, land availability, execution time etc. Most urban cities lack centralized sanitation systems and are dependent on on-site sanitation systems such as septic tanks, twin pits etc. As per Census 2011, on-site pit latrines and septic tanks account for a substantial proportion of toilets in urban India – over 47% of urban Indian households depend on onsite facilities and this proportion is increasing with increase in toilets under SBM. Such systems are seen as temporary solutions and are hence neglected. There is absence of city-wide database related to sanitation. Thus sanitation systems in most urban Indian cities are unmanaged.



A shit flow diagram is a tool to readily understand and communicate how excreta physically flows through a city or town. An SFD presents a clear picture of how wastewater and FSSM services are delivered in a city.

Shit Flow Diagram

- An information - communication – advocacy tool for engaging stakeholders to focus on excreta management at a city level.
- A tool for engineers, planners and decision-makers to inform urban sanitation programming.
- Based on contributing populations, it gives an indication of where their excreta goes
- A representation of public health hazard
- An overview from which to develop sanitation priorities

Source: What is an SFD? By CSE

A shit flow diagram is essentially an advocacy tool for engaging stakeholders by showcasing the current situation of excreta in the city and the urgent need to focus on its management. The SFD is a diagnostic tool that helps to identify the aspects of service delivery where improvements are needed. An SFD summarizes service outcomes in terms of the flow and fate of excreta in urban areas. It includes a qualitative assessment of the context in which service delivery takes place and a complete record of data sources. The graphical representation can be linked to infrastructure considerations, and indicate where to prioritize investment into urban sanitation.

(Refer: <https://www.cseindia.org/introduction-to-sfd-8609>)

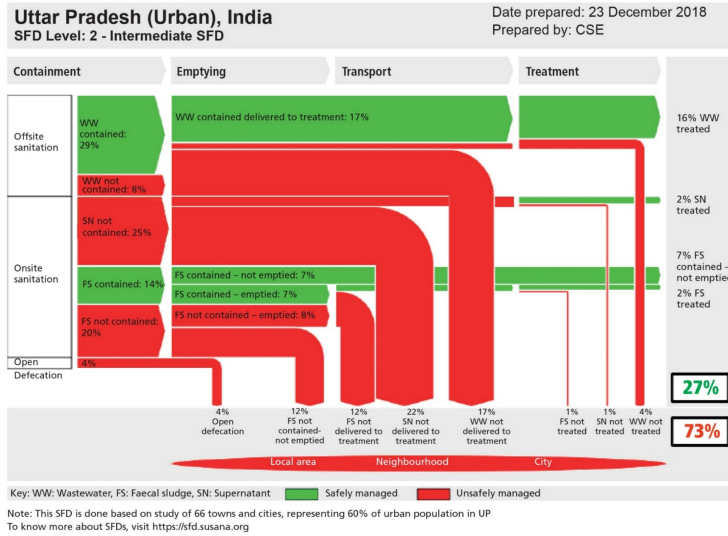
SFD Report

Service Delivery Context Assessment



Source: What is an SFD? By CSE

SFD Graphic for UP



Source: CSE, Delhi

SFD Graphic for UP

KEY OBSERVATIONS

More than **60%** of the total population is dependent on onsite sanitation systems like septic tank and pit latrine. Out of which, the faecal sludge and septage of 4% of the population is treated

Septic tank effluent (overflow) of **50%** of the population is discharged in open drains, of which, 2% is treated by tapping of nullahs and drains

29% of the population is connected to sewerage network. Of which, sewage of 16% of the population is treated

More than **80%** of the sewerage network in state is found in 7 cities (out of 635)

Sanitation provision through sewer system increases with the increase in population of cities

Excreta of **8%** of the population is discharged directly in open drains

4% of the population still defecates in the open

Excreta of **27%** of the total population is safely managed. 7% of which is safely stored in containment systems

No city is **100%** sewered

NOTE: This study is done based on data collected by CSE in October, 2018

Source: CSE, Delhi

For detailed information, visit:

<https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/3453>

Session

03

Option 1:

Role of Stakeholders in FSSM Planning Process

Option 2:

Planning for Emptying Services

Option 1: Role of stakeholders in FSSM planning process

Option 2: Planning for emptying services

Session 3 can either be 'Role of stakeholders in FSSM planning process' which outlines the role of each stakeholder through a group activity or 'Planning for emptying services' outlining demand based and schedule based emptying in detail. Based on the target audience, the trainer can conduct the session that is more apt and suitable for the participants.

Option 1 - Role of stakeholders in FSSM planning process

Objective:

To understand the role of various stakeholders in the process of planning and implementation of FSSM services

Format:

Group exercise followed by discussion and hands-on exercise

Duration:

90 minutes

45 minutes – Group exercise

45 minutes – Discussion

Points to be covered:

- Identify the stakeholders across the service chain of FSSM
- Understand the role and responsibility of each stakeholder for activities across the service chain
- Deliberate on the efforts each stakeholder takes for effective planning and implementation of FSSM activities
- Cross learning of expectations each stakeholder has from other stakeholders in the system

3. Role of stakeholders in FSSM planning process

1. Group Exercise

Option 1- Role of stakeholders in FSSM planning process

IDENTIFY STAKEHOLDERS



The participants are expected to identify and list various important stakeholders involved in the process of planning and implementation of FSSM.

Group Exercise

STAKEHOLDERS

1. State Government
2. ULB – Municipal Officials
3. ULB – Elected Representatives
4. NGOs
5. Private Sector
6. Citizens
7. Media

WHAT IS MY
RESPONSIBILITY ?

WHAT DO I EXPECT
FROM OTHER
STAKEHOLDERS ?

Each group is allotted one stake holder from the above list of identified stakeholders and are expected to list what are their responsibilities and what do they expect from the other stakeholders. After the activities are listed, each group presents their listed responsibilities and expectations in the role of the particular stakeholder.

A comprehensive list for each stakeholder is thus prepared to make everyone understand the tasks and efforts required in the process and the outcome expected by other stakeholders.

OPTION 2 – Planning for emptying services

Objective:

To understand existing practices of desludging in cities and planning for emptying services for a city.

Format:

Presentation followed by discussion and hands-on exercise

Duration:

90 minutes

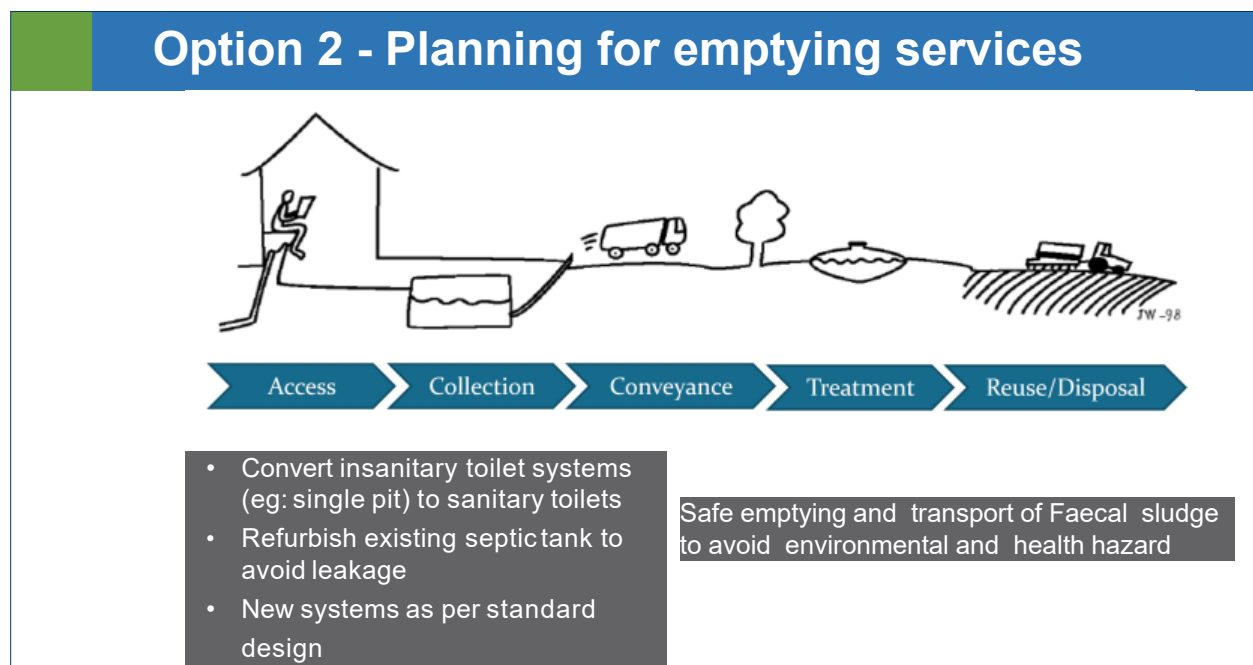
70 minutes – presentation

20 minutes – hands-on exercise

Points to be covered:

- Understanding current practices of emptying services in urban India.
- Need for record keeping/creation of database of collection systems in the city.
- Need for periodic cleaning of septic tanks as per CPHEEO norms.
- Demand vs. scheduled desludging – pros and cons.
- Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013
- Types of conveyance systems.
- Parameters for assessing and deciding conveyance options.
- Involvement of private sector in desludging and their monitoring.
- Hands-on exercise for calculating infrastructure requirements for conveyance in a city.

1. Current status of emptying services



Collection refers to the collection systems of septage like septic tanks, twin pits etc. Addressing collection systems include converting insanitary toilets to sanitary toilets, refurbishing septic tanks if needed and designing new septic tanks as per norms. Conveyance refers to safe emptying and transportation of sludge collected from the septic tanks and its emptying at a dedicated treatment facility

Emptying Services

- Facilities like septic tanks, dry latrines, community toilets, or other types accumulate faecal sludge
- Septage needs to be removed periodically.
- If this septage is not properly managed, negative impacts on the urban environment and on public health may result
- Environmental pollution is caused by effluents of not regularly de-sludged septic tanks or community toilets
- Improper handling of septage regenerates the risks of faecal matter re-entering the domestic environment

Table 3: Pollutants in the effluent of on-site treatment Systems

Pollutant	Reason for concern
Total suspended solids	In surface waters, suspended solids can settle and form sludge deposits that smother benthic invertebrates, fish eggs and can contribute to benthic enrichment, toxicity and sediment oxygen demand. Colloidal solids can block sunlight, affect aquatic life and lower the ability of aquatic plants to increase the dissolved oxygen in the water.
Biodegradable organics (BOD)	Biological degradation of organics can deplete the dissolved oxygen in surface waters resulting in anoxic conditions, harmful to aquatic life.
Nitrogen	Nitrogen could lead to eutrophication and dissolved oxygen loss in surface waters. High levels of nitrate nitrogen in drinking water can cause methemoglobinemia in infants and pregnancy complications for women. Livestock can also suffer from drinking water high in nitrogen.
Phosphorus	Phosphorus would also lead to eutrophication and reduction of dissolved oxygen in surface waters.
Pathogens	Parasites, bacteria and viruses can cause communicable diseases through body contact, ingestion of contaminated water or shellfish. Transport distances of some pathogens (bacteria and viruses) can be quite significant.

Effluent and septage from septic tank systems impacts ground and surface water resources

Source : Advisory note on septage management in urban India, MoUD January 2013

Septic tank effluent and septage, with appreciable levels of organics, nitrogen and pathogens, disposed without proper treatment are a cause of concern on account of the organic carbon (as measured as BOD), nitrogen, phosphorus and pathogens in the effluent. The pollutants in the effluent and septage from septic tanks systems and their potential impacts on ground and surface water resources are summarized in table in the slide.

2. Need for periodic cleaning of septic tanks

Need for Periodic Cleaning

When Pit is Full !

- Often a tank is emptied when it is full.
- There is a tendency to use/build oversized septic tanks to avoid frequent emptying.
- It is important to assess how often a septic tank is emptied. Such information will need to be gathered through a household surveys.

As per **CPHEEO Manual** on Sewerage and Sewage Treatment , 2013

IS : 2470 (Part I & II), 1985 on Code of Practice for Installation of Septic tank

Planning Decision

Demand desludging v/s Scheduled desludging



Sketch adopted from compendium of sanitation systems and technologies, Eawag


“Yearly desludging of septic tank is desirable, but if it is not feasible or economical, then septic tanks should be cleaned at least once in two - three years, provided the tank is not overloaded due to use by more than the number of persons for which it is designed”

Pg 9-22, CPHEEO Manual

It is commonly observed in cities that septic tanks are often cleaned only when they become full and start to overflow. People build oversized septic tanks to avoid frequent cleaning. As per CPHEEO Manual, septic tanks should be cleaned atleast once in two to three years. Such period cleaning of tanks is essential. The city needs to assess how often the septic tanks are emptied and what are the average sizes of septic tanks. A decision to either continue with demand based desludging or adopt scheduled desludging need to be undertaken by the city.

3. Prohibition of employment as manual scavengers and their rehabilitation act 2013

Manual Scavenging Act



Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013
Came into force on Dec 6, 2013

"Prohibition of Insanitary Latrines and Employment and Engagement for cleaning of Sewers or Septic Tanks as Manual Scavenger"

Prohibition of Activity		
Local authorities to survey Insanitary latrines and provide Sanitary <u>community</u> latrines.	Survey of manual scavengers in urban areas by Municipalities	Duty of local authorities and other agencies to use modern mechanical technology for cleaning of sewers and onsite systems, etc.

Rehabilitation

Rehabilitation of persons identified as Manual Scavengers by a Municipality. Housing and Financial Assistance to be given.

The prohibition of employment as manual scavengers and their rehabilitation act 2013 came into force on December 6th 2013. As per this act, employment of manual scavengers, the manual cleaning of sewers and septic tanks and the construction of insanitary latrines is prohibited. Local authorities should survey insanitary latrines in the city and convert them into sanitary latrines. The emptying of tanks should be undertaken only by mechanical devices like vacuum emptier trucks. Manual scavengers should be identified through surveys and their rehabilitation through housing and financial assistance should be provided.

4. Technologies for desludging

Technology options for emptying



Conventional Vacuum Tanker

For septic tanks which have proper **access roads**, a **larger vehicle** maybe used



Mini-Vacuum Tanker (Vacutug)

For septic tanks located in **narrow lanes** or those that do not have proper access roads, **smaller vehicles** maybe used



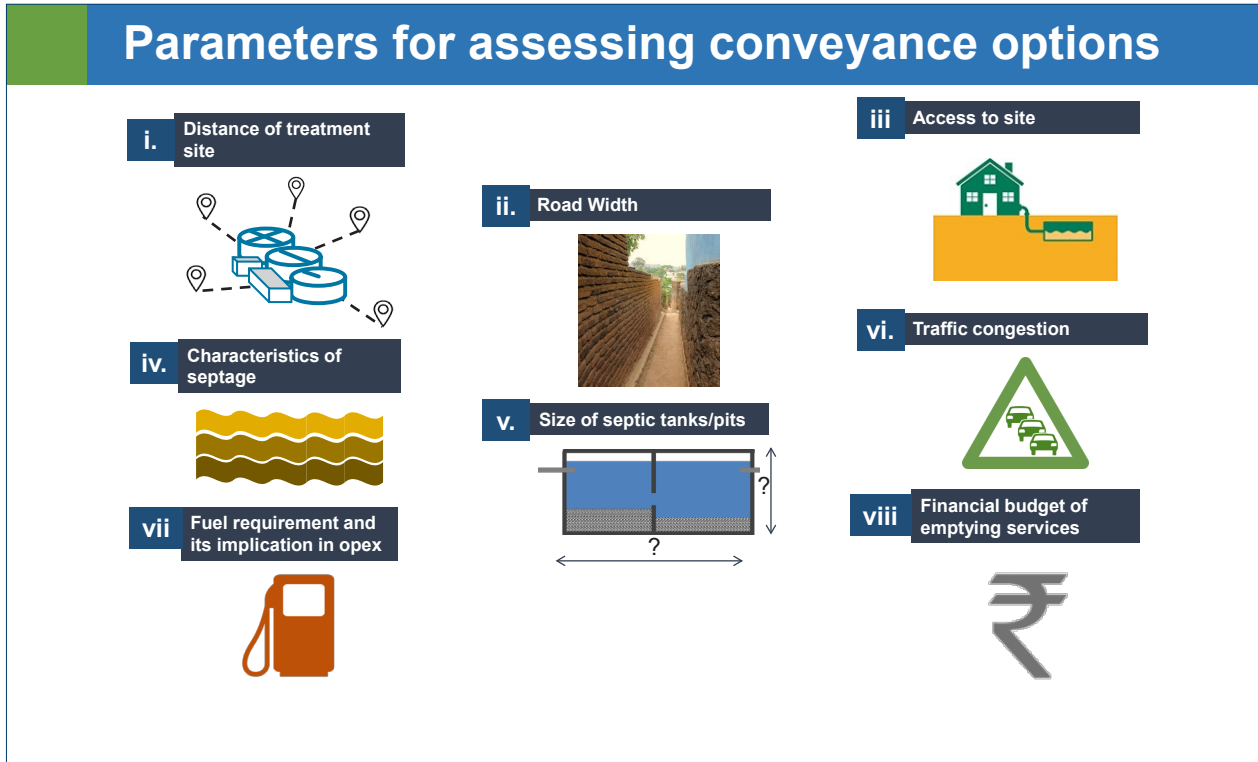
Gulper

Smaller mechanized tricycle/ motorcycle mounted collection tanks of 20-40 litres capacity with gulper or smaller vacuum pumps at the primary level backed by a secondary transport system may work in the informal slum settlements.

The type of conveyance trucks should be purchased based on assessment of local conditions in the city.

- Conventional vacuum tanker: For appropriate access roads, conventional vacuum trucks can be used. These are generally of capacity starting from 3000 liters upto 10000 liters or more depending on market availability.
- Mini vacuum tanker/ vacutugs: For narrow lanes in the city, smaller vehicles called vacutugs may be used. These are generally 1000 to 2000 liters.
- Gulper: Smaller mechanized tricycles called gulpers with 20 -40 liters capacity may work in slum settlements.

5. Parameters for assessing conveyance options



For deciding the conveyance systems following parameters need to be taken into consideration: Distance of treatment site, access to site, traffic congestion: to comprehend the number of trips that can be made in a day.

- **Road with:** to understand the size of vehicles that need to be purchased.
- **Characteristics of septage and size of septic tanks:** to assess the amount of septage that can be desludged at a time which will consequently affect the number of trips.
- **Fuel requirement:** to understand its implications on OPEX.
- **Financial budget of emptying services:** to assess feasibility before planning for conveyance system.

Parameters for assessing conveyance options

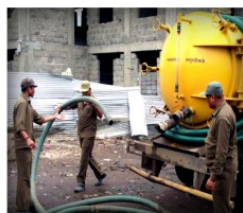
Parameters	Mini Vacuum Truck (Vacutug)	Conventional vacuum truck	Gulper
Distance of treatment plant from emptying point	Small Haul distance	Long Haul distance	No means of disposing the sludge off site
Road width	To be used where road widths are narrower	To be used where road widths are broader	Can be used in narrower road widths
Access to site	To be used where site access is difficult for large vehicles	To be used where site access is easy for large vehicles	Can access most locations
Type of on site sanitation system (septic tank/pits) and characteristics of septage	Difficulty emptying high viscosity sludge	Can handle emptying high viscosity sludge	Hand pumps can be used for liquid and to a certain degree, viscous sludge
Size of septic tanks/ pits	Applicable for smaller volume (500- 2000 litres)	Applicable for larger size (3000 - 5000 litres)	Cannot empty entire pit (if pit is deep), Slow emptying times
Traffic congestion	To be used in areas with high traffic congestion	Difficulty in moving in areas with high traffic congestion	Not affected by traffic
Fuel requirement and its implication in opex	Requires less fuel and low opex	Requires more fuel and high opex	No fuel requirements, very low opex
Financial budget of emptying services	Not financially viable for long haul transport	Proves to be financially viable for long haul transport	Not financially viable for large septic tanks/pit size and for long haul distance

The above slide summarizes the type of conveyance options that can be used by the city and parameters across which the conveyance options can be assessed as discussed in the previous two slides.

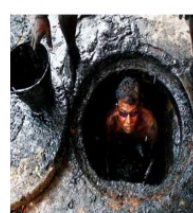
Technology options for emptying



Services mainly provided by city governments



Unsafe handling of septage



Informal Private sector



Emptying when the tank is full

- No monitoring mechanism for informal sector
- Cleaning cycle greater than 8 -10 years against recommended cycle of **2-3 years** by GoI advisory on Septage Management
- Due to infrequent cleaning, septage begins to solidify in tanks and septic tank fills up, faecal matter along with effluents is released into the drains

Very low desludging frequency against the recommended cycle, emptying only when the tanks are full, unsafe handling of septage by desludging operators and lack of monitoring mechanism for informal sector are the major challenges in conveyance system. Distance of treatment site, access to site, traffic congestion: to comprehend the number of trips that can be made in a day.

Current Practice of desludging in India

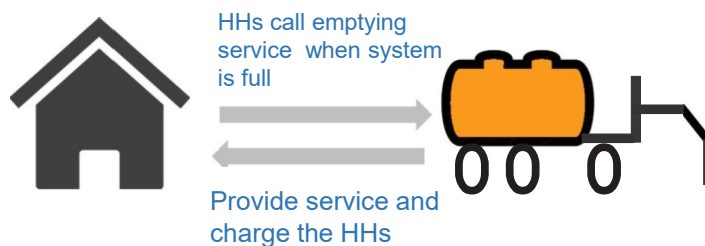
Current practice is of complaint redressal mechanism and NOT a public service like sewerage and SWM

<p>Low frequency of desludging</p> <p>On-demand desludging = only done when septic tanks overflow = frequency of 8-10 year+s CPHEEO norm is 2-3years</p>	<p>Environmental impacts of poor quality effluent</p> <p>Low desludging frequency = poor efficiency of septic tank = poor quality of supernatant / effluent overflow being released in rivers</p>	<p>Increased chances of Manual Scavenging</p> <p>Low desludging frequency = sludge hardens in the tank = requirement of manual labour to remove it</p>
<p>High cost per desludging</p> <p>Emptiers need to achieve economies of scale. Cann of optimize trips or have assured amount of business in on-demand service</p>	<p>Small towns paying still higher prices</p>	<p>High desludging charges discouraging HHs from actually using their toilets Adversely affecting ODF sustainability</p>

Currently desludging in India works as a demand based system wherein the HHs calls the ULB or the private operator to desludge the septage once the septic tank is full and overflowing. This is essentially a complaint redressal system with almost no cities providing desludging as a public service to the citizens like sewerage and SWM. The frequency of desludging is very low with more than 10 years as against the norm of 2-3 years. Due to this, the efficiencies of septic tanks are also low with poor quality effluent overflow being released in rivers causing negative environmental impact. Due to low desludging, the septage hardens in the tank which becomes difficult to remove leading to manual labour to remove it thereby increasing chances of illegal manual scavenging. On-demand desludging is unreliable and not optimal as a business which increases cost per desludging with small towns paying higher prices per trip. Since HHs have to pay higher charges, they either build oversized septic tanks or avoid using the toilets thereby adversely affecting ODF sustainability of the city.

6. Demand based desludging

Demand based emptying



If non-regulated,

- No regular cleaning
- Overflowing system pose enviromental and health risk
- Private emptier may charge higher
- No safety precautions
- No monitoring of septage disposal

Plan for Regulated Demand based emptying services

- Awareness and regulations to HHs for regular desludging
- Empanelment and training of desludging operators
- Monitoring of emptying services through GPS enabled trucks
- Mandatory safety measures during desludging
- Regulations for emptying charge/tax system

Dakar Model



Demand based desludging is when a HH called an emptying service when the collection system is full. The emptying service provides a one-time service and takes certain charges from the HH. If the city wants to adopt/continue with demand based desludging, it should be regulated suitably. HHs should be made aware to desludge their tanks periodically and regulations should be made and followed for the same. Desludging operators should be emplaned and trained. They should be allow to empty their tankers only at designated places. Regular monitoring of private operators should be done by installing GPS systems on the trucks. Use of personal protective equipment should be made mandatory for drivers and helpers. Emptying charges should also be regulated.

7. Schedule based desludging

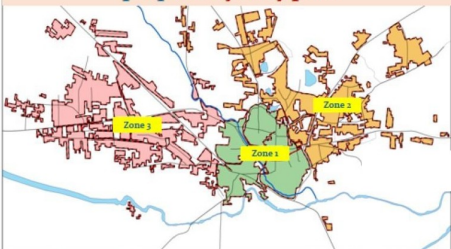
Schedule based emptying

Septic tank cleaning cycle of 3 years All onsite system de-sludged in a fixed cycle according to a schedule

- To maintain a cycle of 3 years, **roughly 2800 septic tanks** need to be cleaned annually
- Each vehicle needs to make **4 to 5 trips daily**
- Roughly **300 Working Days** are required
- To clean 2800 septic tanks, **2-3 nos of suction emptier trucks of 5000 l capacity** would be required

2-3 nos of trucks of 5000 litre capacity are required for cleaning HHs and non-residenti al septic tanks

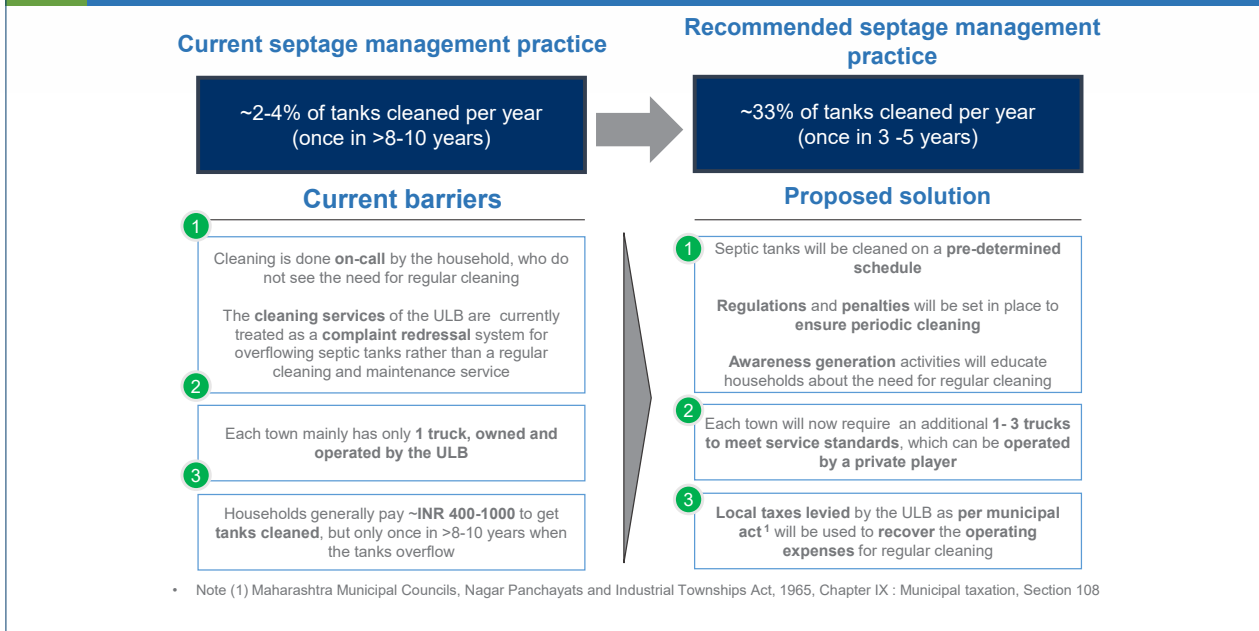
Divide the city into zones and prepare a yearly plan



Year	Zones	No. of septic tanks to be cleaned annually (no)	No. of Days required
Year 1	Zone 1	1889	201
	Zone 2	947	101
	Total	2836	302
Year 2	Zone 2	1262	135
	Zone 3	1582	169
	Total	2844	303
Year 3	Zone 3	2762	294
	Total	2762	294

Schedule based desludging refers to scheduled emptying of septic tanks or other containment systems at an interval of 2-3 years as recommended by CPHEEO Sewerage & Sewage Treatment Manual and the MoHUA Advisory on Septage Management (2013). In this, the city is divided into 3 zones (since each septic tank needs to be cleaned once in 3 years). Based on the total number of septic tanks in the city, septic tanks that need to be cleaned annually is calculated. Based on total number of septic tanks to be cleaned daily, the total number of trucks and their capacities is determined.

Demand vs Schedule Emptying



Benefits of Schedule Emptying

- **Equitable services** - all households / properties are covered by services
- **Pricing** - Services are offered at lower prices, due to efficiency gains
- **Behavior change** – Contribution to ODF sustainability as toilet usage can increase
- **Manual scavenging** - Removal of need for manual scavenging due to regular emptying
- **Infrastructure optimization** - More predictable loads for treatment facility and route optimization of trucks
- **Environmental benefits** - Likely reduction of BOD and coliform in septic tank effluent, as well as lower likelihood of septic tank overflows

Since schedule emptying is provided as a public service, all households are covered in the three year plan/schedule. Due to efficiency gains and optimal business structure, the prices for desludging become more affordable. Regular cleaning also ensures that manual scavenging does not take place. The amount of septage that will be received for treatment is pre-determined hence optimal infrastructure can be planned accordingly. Regular cleaning of tanks will reduce overflows thereby reducing the release of pollutants into the environment. Regular desludging will also contribute to sustaining ODF status of the city as toilet usage may increase.

Preparing for implementation/IEC

Household visits



Banners/Hoarding/Mob Videos



Circulating small videos

Intimation through SMS



Awareness material should focus on importance of emptying, details of scheme, precautions to be taken etc.

- Distribution of pamphlets
- Share video over whatsapp and local cable channel
- Auto rickshaw announcements
- Ward wise gatherings can be planned with a detailed schedule using different material

For periodic desludging to succeed, it is necessary to make citizens aware of its importance and benefits. Effective IEC methods can be adopted by the city such as creating and sharing videos on whatsapp or social media, auto rickshaw announcements, banners/hoardings and SMSs etc. The city of Wai in Maharashtra has started the implementation of schedule desludging and has created a whatsapp video with a message from the chief officer urging the citizens to cooperate during desludging. An SMS is sent to the citizens one day prior intimating them that their tank will be cleaned tomorrow. Such effective techniques help in smooth implementation of schedule planned by the city.

8. Private sector participation

Regulating private sector through licensing/contracting

Licensing of septage transporters

Emptying services by ULB or by private agencies management contracts. In case of private sector contract, ULBs should certify and license private septage transporters to de-sludge and transport waste to the designated treatment facility.

Septage Transporter Permit for _____ Municipality

In accordance with all the terms and conditions of the current _____ Municipality's Rates, Rules and Regulations, the special permit conditions accompanying this permit, and all applicable rules, laws or regulations of Government of Maharashtra, permission is hereby granted to:

NAME OF PERMITTEE: _____

ADDRESS: _____

For the disposal of septage from domestic septic tank or commercial holding tank at the _____ treatment facility.

This Permit is based on information provided in the Septage Transporter Permit application which constitutes the Septage Management Hauled Permit.

This Permit is effective for the period set forth below, may be suspended or revoked for Permit Condition Non Compliance and is not transferable. The original permit shall be kept on file in the Permittee's office. A copy of this Permit shall be carried in every registered vehicle used by the permittee.

EFFECTIVE DATE: _____

EXPIRATION DATE: _____

CHECK IF RENEWED PERMIT

Permit is liable to be cancelled in case of violations of any Acts, Rules and Regulations relating to the operation of Septage System or in cases of safety protocols not being adhered to or in case of non-permitted disposals.

Contracting the service to private sector

The service for de-sludging and transport of septage can be contracted out to private sector for a predefined period of time and cost of the service. A detailed tender document should be made detailing out all the necessary terms and conditions

Sinnar Municipal Council, Sinnar

TENDER DOCUMENT

Name of Work
"Scheduled cleaning of septic tanks, Sinnar"

Estimated Cost: To be given by the bidder

E.M.D. : 48,000/-

Office of the
Chief Officer,
Sinnar Municipal Council, Sinnar

Savitri S. Patil Municipal Engineer Vyanktesh R. Duvvas Chief Officer Sanjay Narve Vice President Ashvini Deshmukh President

In case of private sector involved in transportation services, ULBs should certify and license them to desludge and transport waste to the designated treatment facility. A monitoring system should also be adopted for these licensed operators to keep a track of the desludging activities happening in the city. Desludging services can also be contracted for a limited time period and cost. A detailed tender document should be drafted with all necessary terms and conditions.

Occupational Safety

- Municipalities should provide workers with safety gear.
- Each worker should be made aware of the risks of the work through trainings.
- Workers should be held liable for not using available protective gear



ULBs should provide the workers with personal protective equipment or if private operators are involved, ensure through contract that the private operator provides the same to the persons on duty. Basic PPE includes helmet, goggles, mask, boots and torch. Use of PPE should be made mandatory and should be strictly monitored by the city and appropriate action should be taken for noncompliance. Workers primarily handling septage should be made aware of health hazards if PPE is not used.

Monitoring emptying services

Monitoring of emptying service is required:

- Use of GPS enabled trucks to monitor emptying services
- Keep a check on operations of private service provider and regulate the payment
- Build a data base of toilets and septic tanks in the city
- Develop records on when septic tanks are emptied
- Monitor the quality of septage etc.

Different stakeholders such as Municipal Council, private service provider, citizens, treatment plant operator etc. can benefit from a robust monitoring process

Source: Operative guidelines for septage management for urban and rural local bodies in Tamil Nadu.(20 14)

It is essential to monitor the emptying service to improve its functioning as well as to establish a robust database of toilets and septic tanks in the city. Some good examples are in setting up call centers, and formalizing associations of desludgers and ensuring that households are regularly desludged. GPS enabled trucks can be used which will help keep a check on operations and regulate the payment accordingly.

Formats for emptying services

Daily Report formats



Municipal Council's copy



Property holder's copy



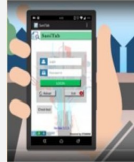
Emptying service provider's copy



Treatment plant's copy

These records can be linked to the payment of private emptying service provider

Use of mobile based applications for monitoring the emptying process



Template of Manifest form

Collection and transport records form / manifest forms

Sample Form to be filled by Operator / Transporter of Septage

I. Identification of Waste:

a) Volume _____
 b) Type: _____ Septic Tank _____ Others _____
 c) Source: _____ Residential _____ Commercial _____ Restaurant _____ Portable Toilet _____ Others _____

II. Details of Waste Generator

a) Name: _____
 b) Phone Number: _____
 c) Address: _____
 d) Pin: _____
 e) Any kind of deficiencies, missing pipes or fittings, improper manholes or access covers, any other cracks or damage observed: _____

The undersigned being duly authorized does hereby certify to the accuracy of the source and type of wastewater collected and transported.

Signature: _____

III. Details of Transporter / Operator

a) Company Name: _____
 b) Permit: _____
 c) Vehicle License: _____
 d) Pump out date: _____

The above described wastewater was picked up and hauled by me to the disposal facility name below and was discharged. I certify that the foregoing is true and correct.

Signature of authorized agent and title: _____

IV. Acceptance by _____ Municipality's authorized STP

The above transporter delivered the described wastewater to this disposal facility and it was accepted.

Disposal date: _____ Amount collected from transporter (if any): _____

Signature of authorized signatory and title: _____

NOTE: SUBJECT TO THE TERMS AND CONDITIONS OF _____ MUNICIPALITY.

¹ Adapted from operative guidelines for septage management for urban and rural local bodies in Tamil Nadu (2014)

A template to keep track of information of septic tanks that are desludged needs to be developed by the city to ensure record keeping which will further help in improving the desludging process. This can be done either by manual formats or developing mobile based applications that the service provider can fill up while visiting the HH. These records can they be linked to payment of the service provider. The city of Sinnar in Maharashtra has developed mobile based formats for scheduled desludging. The city of Wai is also in the process of doing the same.

Design emptying and transport plan

Awareness for regular emptying

Determine emptying frequency

Determine number of septic tanks/pit to be emptied per day

Volume of septage to be collected per day

Type and size of emptying vehicles based on local conditions

Number of emptying trucks required

Implementation and monitoring of emptying services

Proper Regulation for regular emptying

Formulation of emptying and transportation plan should be holistic and focus on these aspects: awareness for regular emptying, implementation and monitoring of emptying services and proper regulation for regular emptying. The planning includes decision of scheduled or demand based desludging, frequency of desludging, number of tanks to be emptied daily. This will determine the volume of septage to be collected and treated per day. Based on this, the number of trucks that will be needed can be estimated.

Case study: Behrampur, Odisha

Referral system for increasing demand generation

Objective: Increased mechanized emptying, reducing instances of manual scavenging, and generating alternate sources of income for SHGs through CLC on incentive mechanism.

A three step approach focusing on orienting and training was considered for onboarding stakeholders – SHG, CLC and cesspool operator:

Step 1: The first step was to conduct a training for SHGs on the importance of FSSM, frequent desludging and monetary benefits for SHGs.

Step 2: The second step was to build a consensus between SHG and cesspool operator for sharing the referral fee.

Step 3: The third step was to orient SHGs on the action plan for convincing households to desludge septic tank frequently.



Figure 1: Orientation for SHG on referral initiative

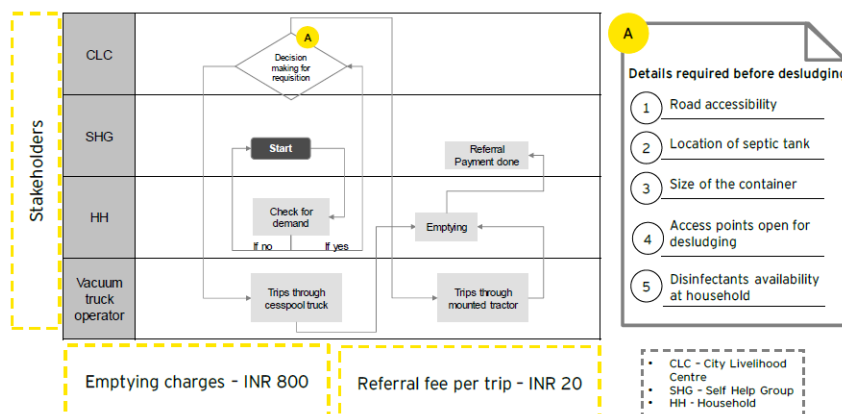


Figure 2: Interaction between cesspool operator and SHG

Source: Report on Referral system for increasing demand generation, May 2019, EY

Case study: Behrampur, Odisha

Operating procedure



The referral system is replicable in places where SHGs have been working in sanitation sector or are inclined towards working in this sector. The incentive can be negotiated with the ULB based on the scenario in each city.

Source: Report on Referral system for increasing demand generation, May 2019, EY

BeMC has taken an innovative step of introducing a revenue generating model for increasing requests for mechanized cesspool emptying operations through referrals received from SHGs. This is in line with the SBM model of toilet construction wherein the Swachhagrahis are provided an incentives, referral model for cesspool demand generation is based on the similar concept wherein the SHGs are provided an incentive of INR 20 per request generated from each household. To ensure the sustainability of this initiative, BeMC has signed a contract with the private operator (valid for a year), wherein, the vacuum truck operator agrees to provide trips per the agreed ULB rate and pay the referral amount to SHG post completion of the services. The operator will also maintain database of the trips undertaken in a month. The referral system has been designed to reach out to urban poor and areas within a city that are inaccessible by Corporation's effort of generating demand. Involving SHGs in this initiative has helped Corporation reach out to 60% of the population in Behrampur. This has also helped in providing them alternate source of income.

9. Group exercise: Calculation for infrastructure requirements for conveyance in a city

Prepare FSSM plan for your city

Participants will plan for infrastructure that is required for implementing a FSSM plan for a city.

FSSM PLAN		
Sr.No	Description	No.
Input details		
A	Population	65251
B	Total households (HHs)	13112
C	HHs having toilets with septic tanks	9900
D	No. of community/ public toilets having septic tanks	21
E	Average volume of household and community toilet septic tanks (cum)	5
F	Septic tank cleaning cycle for HHs (Years)	3
G	Septic tank cleaning cycle for CT/PT (Days)	7
H	No. of working days in an year	300
I	No. of trips possible per emptying vehicle per day (trip/day/vehicle)	4

An example of a city is given with its profile mentioning input details like population, HHs, HHs with septic tanks, number of CT/PTs, and average volume of septic tanks etc. Based on these figures, participants are expected to calculate number of septic tanks to be emptied daily, number of trucks required and volume of septage to be treated in that city. With such a hands-on exercise, participants understand the requirements for planning of conveyance systems and can gauge the current status and requirements to regularize conveyance in their cities.

Key outputs

- **Number of tanks to be emptied daily = 14 daily**
 - HHs toilets connected to septic tank / cleaning cycle for HHs = 3300 annually
 - HHs toilets to be cleaned daily = annual cleaning / number of working days = 11 daily
 - CTs connected to septic tank / cleaning cycle for CTs = 3 daily
- **Number of trucks required = 3.5~4 nos**
 - Number of tanks to be emptied daily / Number of trips per day = 3.5 nos
- **Volume of septage to be treated = 70 cum/day**
 - Average volume of HHs and CTs septic tanks x Number trips per day = 70 cum/day

Based on the formulae mentioned in the slides, the three outputs: number of septic tanks to be emptied daily, number of trucks required and volume of septage to be treated can be calculated.

Session

04

Technology Options for Conveyance and Treatment of Septage

Objective:

To give an overview of technology options for conveyance and treatment and selection criteria for the same.

Format:

- Presentation followed by discussion
- Discussion with state/city officials on technology used, its rationale and implementation in treatment plants to be visited on day 2

Duration:

105 minutes

60 minutes – presentation and discussion

45 minutes – Discussion with state/city officials


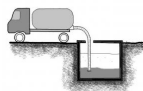
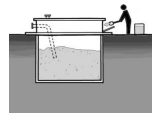
Points to be covered:

- Type of conveyance systems – human powered/motorized – and their appropriate use.
- Co-treatment of septage at sewage treatment plants
- FSS treatment chain – solid liquid separation, stabilization, dewatering, pathogen reduction, end products.
- Selection criteria - parameters to choose technology options.
- Types of treatment systems and their combinations with their advantages and limitations.
- Case studies of existing co-treatment options/FSTPs.

4. Technology options for conveyance and treatment of septage

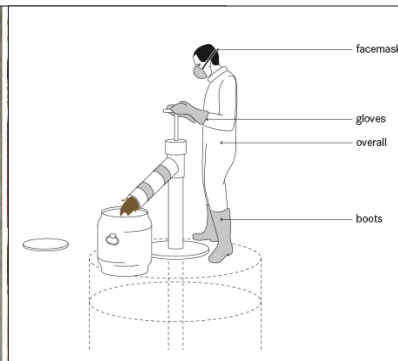


1. Technology options for conveyance

Conveyance

		
Human powered Emptying & transport	Motorised Emptying & transport	Transfer stations
<ul style="list-style-type: none">• Sludge Gulper• Manual Diaphragm Pump• MAPET	<ul style="list-style-type: none">• Pit Screw Auger• Vacuum Trucks• Vacu tug	<ul style="list-style-type: none">• Fixed transfer station• Mobile transfer station• Network Connected station

The technical and physical criteria for choosing appropriate conveyance technology/system are as follows; 1. Water availability, 2. Ground condition, 3. Ground water level and contamination. Human-powered emptying and transport refers to the different ways in which people can manually empty and/or transport sludge and solid products generated in on-site sanitation facilities. Motorized emptying and transport refer to a vehicle equipped with a motorized pump and a storage tank for emptying and transporting faecal sludge septage and urine. Sludge and septage emptied from on-site sanitation systems need to be transferred to (semi-)centralised infrastructures for further treatment. Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility.

Sludge Gulper



Source: Faecal Sludge Management System and Approaches

Manual sludge pumps like the Pooh Pump or the Gulper are relatively new inventions and have shown promise as being low-cost, effective solutions for sludge emptying where, because of access, safety or economics, other sludge emptying techniques are not possible. Sludge hand pumps work on the same concept as water hand pumps: the bottom of the pipe is lowered into the pit/tank

while the operator remains at the surface. As the operator pushes and pulls the handle, the sludge is pumped up and is then discharged through the discharge spout. The sludge can be collected in barrels, bags or carts, and removed from the site with little danger to the operator. Hand pumps can be locally made with steel rods and valves in a PVC casing.

Manual diaphragm pump

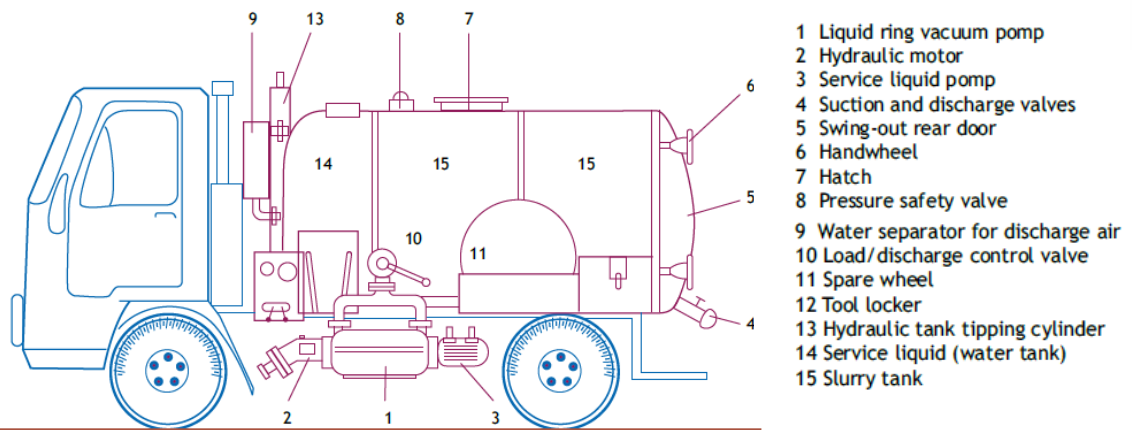


Source: Faecal Sludge Management System and Approaches

Manually operated diaphragm pumps are simple low-cost pumps capable of extracting low viscosity faecal sludge that contains little non-biodegradable materials. They typically consist of a rigid, disc shaped body clamped to a flexible rubber membrane called a diaphragm. An airtight seal between the diaphragm and the disc forms a cavity. To operate the pump, the diaphragm is alternately pushed and pulled causing it to deform into concave and convex shapes in the same way a rubber plunger is used to unblock a toilet. A strainer and non-returning foot valve fitted to the end of the inlet pipe prevents non-biodegradable material from entering the pump and stops backflow of sludge during operation respectively.

Performance	Purchase/Operating Cost	Challenges
<ul style="list-style-type: none"> • Suitable for pumping low viscosity sludges • Average flow rates of 100 L/min • Maximum pumping head of 3.5m – 4.5m 	<ul style="list-style-type: none"> • Capital Cost: INR 20,000 – INR 60,000 (depending on manufacturer and model) • Operating Cost: Unknown 	<ul style="list-style-type: none"> • Clogging at high non-biodegradable content • Difficult to seal fittings at the pump inlet resulting in entrainment of air • Pumps and spare parts currently not locally available

Vacuum Trucks



Motorized emptying and transport refer to a vehicle equipped with a motorized pump and a storage tank for emptying and transporting faecal sludge septage and urine. Humans are required to operate the pump and manoeuvre the hose, but sludge is not manually lifted or transported. Motorised emptying and transport, is fast and generally efficient.

The typical volume of trucks used for the collection of FS ranges from 4,000 litres to 12,000 litres. Various factors influence the selection of a vacuum truck by a service provider, including:

- typical volume of the tanks or vaults that will be serviced;
- road widths and weight constraints;
- distance to the treatment plant;
- availability;
- budget; and
- Skill level of the operators.

Conventional vacuum tankers are typically fitted with either a relatively low cost, low-volume sliding vane pump or a more expensive liquid ring pump. The former is more appropriate for low-capacity vacuum tankers where high vacuum and low airflow sludge removal techniques are used. Vacuum conveyance techniques work best for removing low-viscosity sludge such as that found in septic tanks.

Vacutug



Source: Faecal Sludge Management System and Approaches

The storage tank mounted on a cart which can be manually or pulled by smaller vehicles. It is equipped with a vacuum pump with smaller capacity. It is useful to access the smaller lanes. It is also suitable for densely populated area and slums.

Type	Capacity (Litres)	Relative Width	Travel Distance	Mounting & Propulsion	Cost (INR)
I & II	500	Very Narrow	Short-Haul	Mounted on self-propelled chassis	6,50,250
III	1900	Average	Long-Haul	Mounted on trailer chassis and propelled by tractor or pick-up	13,00,500
IV	700	Narrow	Medium-Haul	Mounted on chassis of motorized tricycle	9,75,375
V	1000	Narrow	Medium Haul	Mounted on chassis of motorized tricycle	9,75,375

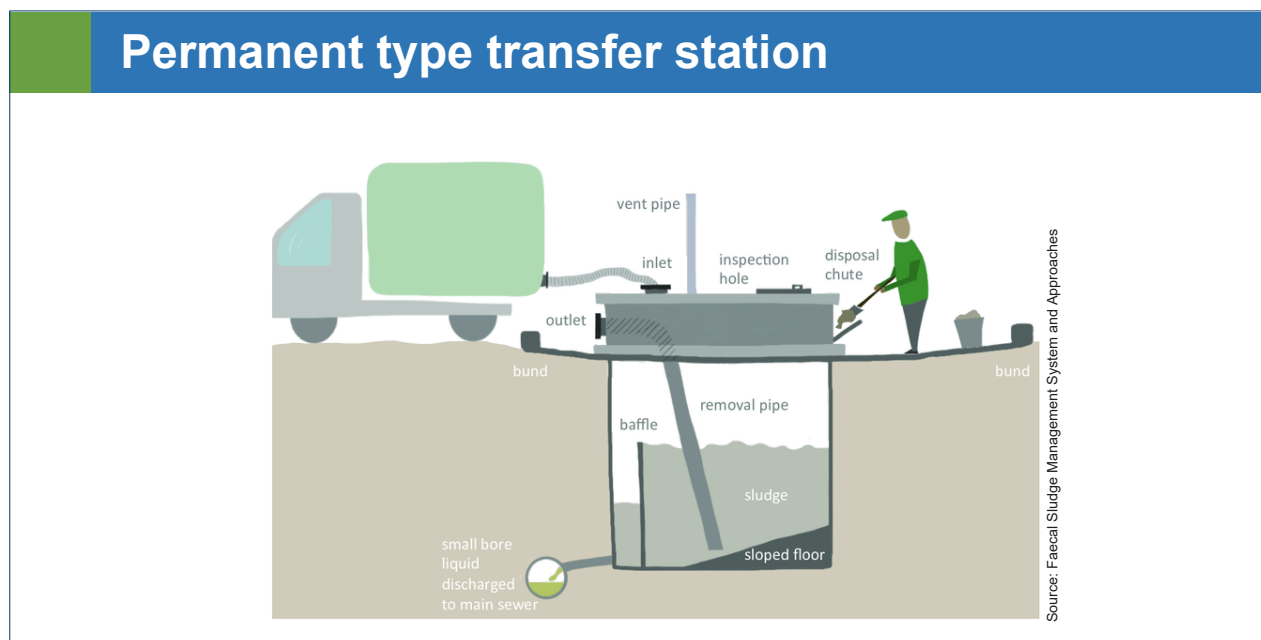
Mobile Faecal Sludge Treatment Unit (MTU)

Mobile Faecal Sludge Treatment Unit by WASH Institute



The Mobile Treatment Unit (MTU) is an onsite faecal sludge treatment technology developed by the Water, Sanitation and Hygiene Institute (WASH Institute). It is a treatment system mounted on the bed of a small truck and treats the effluent of septic tanks on-site. The on-site Mobile septage Treatment Unit works with the concept of solid-liquid separation, sludge thickening and effluent treatment processes. While the liquid is separated from the solid, the effluent passes through the treatment process and disposes the treated effluent. The sludge thickening process helps to further reduce the moisture content in the sludge. The operational capacity of the MTU varies from 3000 to 6000 lits/hr.

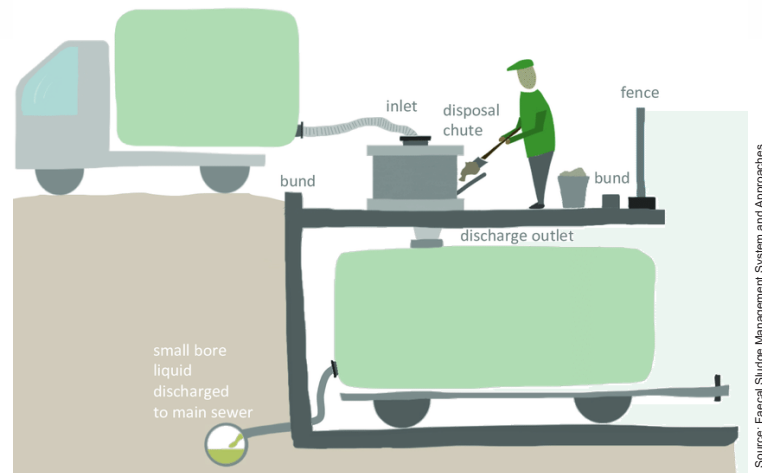
The MTU attempts to address several barriers to achieving safely managed septic waste and is designed in such a way that it is replicable across geography and is financially scalable. In general, the septage consists of higher volumes of liquid than solids and most of the truck operators carry the septage (solid & liquid) to the treatment/disposal sites, adding an extra burden on the transportation cost. The higher flow rate of MTU therefore helps in emptying & treating a greater number of septic tanks per day, bringing down the operational cost of the truck, especially its fuel cost, maximizing the profit. If the truck operators pass on this benefit to the Households/customers, then customers will get to pay less for desludging services. Secondly, the treatment facilities will also benefit due to less volumetric load



Permanent Storage Type Station

Permanent storage tanks are constructed as vault-like concrete structures, these tanks are designed to provide storage capacity for FS over a short period of time without capacity for treatment. An example of such tanks are the underground holding tank (UHT) in Ghana with capacities of approximately 23 m³, the UHTs were designed to provide access to pan latrine collectors (primary transport) and vacuum trucks (secondary transport). However, the natural solid-liquid separation and Siltation that takes place when FS is stored over relatively long periods soon became an operational issue for local authorities. As a result, many UHTs fell into disuse as de-silting became a prohibitively costly and time-consuming process.

Mobile type transfer station

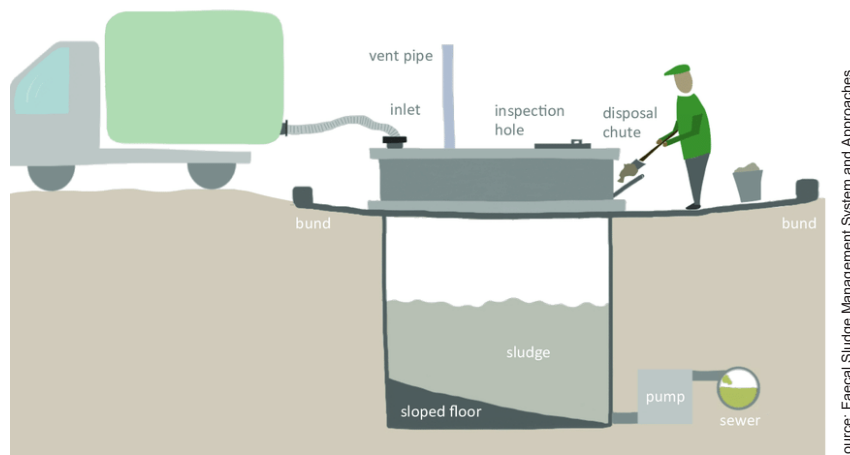


Mobile Transfer Station

Modular transfer station has been developed using portable containers to replace the concrete vault. These come in various sizes such as:

- small sized (e.g. 200-litre metal drums, McBride, 2012);
- medium-sized (e.g. Intermediate Bulk Containers (IBCs) made of plastic liner and metallic frame, 500 – 3,000 litres);
- large-sized (e.g. customised metallic tanks or skips, >2,000 m³ (Macleod, 2005; Strauss and Montangero, 2002)

Network connected transfer station



Co treatment in STP

Limiting factor:

Organic & hydraulic loading

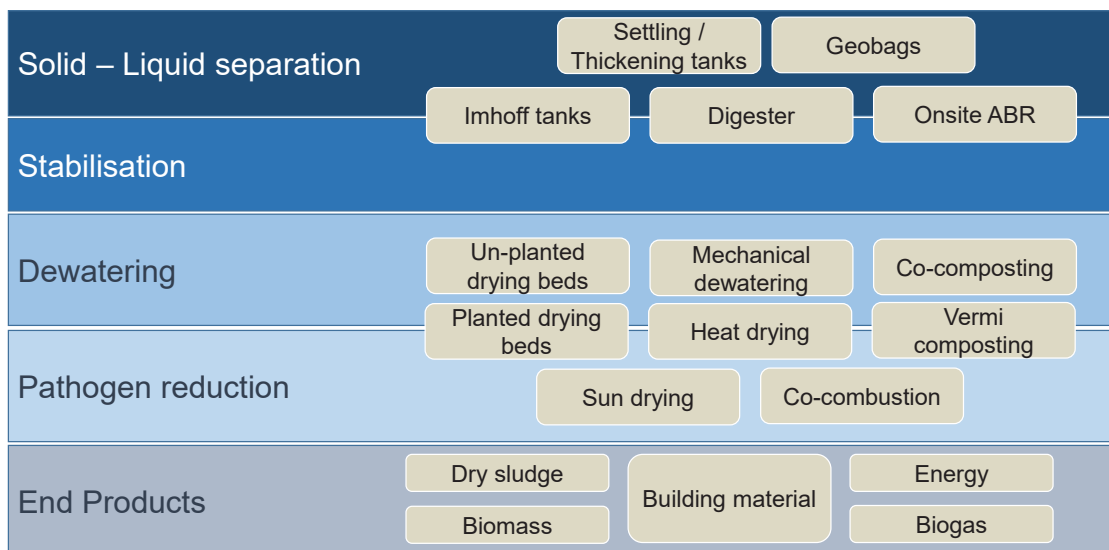
Application

- At the Manhole Chamber before the inlet of STP
- At the inlet of Screens of the STP
- At the Sludge Management Process of the STP



2. Technology options for treatment

FSS Treatment Chain



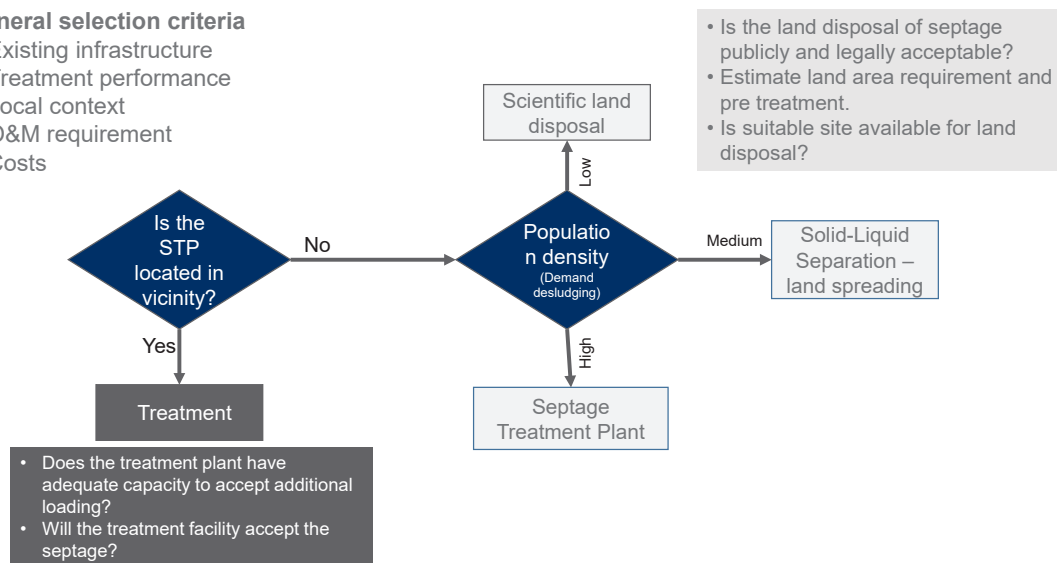
The faecal sludge and septage contain more than 95% water, hence as the first step of treatment, the easily settleable solids are removed using sedimentation process. These solids are then treated biologically to digest and stabilize. In case of well digested septage, the solids can be directly sent to dewatering or drying stage, where the bound water and moisture is removed and the solids are completely dried. The pathogen reduction happens after that and is usually carried out by further sun drying the sludge or co combustion. The end product thus obtained can have various uses

2.1 Selection criteria for technology

Approach for FSS Treatment Technology

General selection criteria

- Existing infrastructure
- Treatment performance
- Local context
- O&M requirement
- Costs



Parameters to choose technology

- **Local context**
 - Characteristics of sludge
 - Quantity and frequency of sludge discharged
 - Climate
 - Land availability and cost
 - Interest in end use
- **O&M requirement**
 - Skills needed for O&M and monitoring
 - Availability of spares
- **Costs**
 - Investment costs covered
 - O&M costs covered
 - Affordability for households
- **Technical performance**
 - Effluent and sludge quality according to the standards.

Co treatment in STP

Limiting factor:

Organic & hydraulic loading

Application

- At the Manhole Chamber before the inlet of STP
- At the inlet of Screens of the STP
- At the Sludge Management Process of the STP



Source: ES&F/Dhawal Patel



Source: ES&F/Dhawal Patel



Source: Faecal Sludge Management, IWA

Deep row entrenchment

- Deep trenches, filled with sludge and covered with soil.
- **Advantages:**
Simple, low cost, limited O&M, no visible or olfactory nuisance.
- **Limiting factor:**
Land and groundwater table, legislation.



Source: Faecal Sludge Management, IWA

Deep row entrenchment consists of digging deep trenches, filling them with sludge and covering them with soil. Trees are then planted on top, which benefit from the organic matter and nutrients that are slowly released from the FS. In areas where there is adequate land available, deep row entrenchment can present a solution that is simple, low cost, has limited O&M issues and produces no visible or olfactory nuisances. Benefits are also gained from the increased production of trees. However, the availability of land is a major constraint with deep row entrenchment, as is the distance/depth to clean groundwater bodies. Deep row entrenchment is considered most feasible in areas where the water supply is not directly obtained from the groundwater source and where sufficient land is available, which means the sludge would have to be transportable to rural and peri-urban areas. In many countries' legislation is still lacking for this option.

Advantages and Constraints

The main advantage of deep row entrenchment is that very little is needed for it: no expensive infrastructure or pumps that are very susceptible to poor maintenance. In addition, growing trees has many benefits such as extra CO₂ fixation, erosion protection, or potential economic benefits. Constraints are that sufficient land has to be available in an area with a low enough groundwater table and, moreover, legislation still needs to catch up in many countries to allow for this technology.

Case Study: Deep row entrenchment in Odisha



Notification from Government of Odisha for Deep Row Entrenchment (DRE) as an interim measures in the ULBs where still Faecal Sludge or Septage Treatment Plants (SeTP) are not placed.

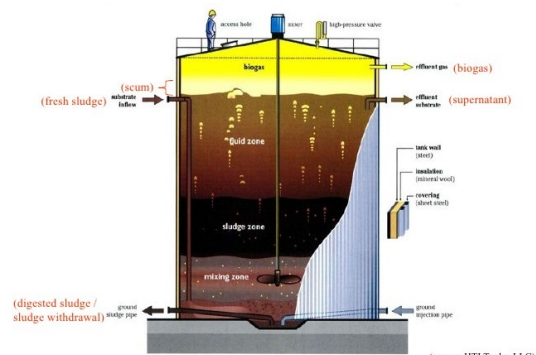


Anaerobic digestion treats organic waste in airtight chambers to ensure anaerobic conditions. Anaerobic digestion has been widely applied in centralized wastewater treatment facilities for the digestion of primary sludge and waste activated sludge, typically with plug flow (PFR) or continuously stirred reactors (CSTRs). The main design parameters for anaerobic digesters are the hydraulic retention time (HRT), the temperature and the loading pattern. Operating conditions that play an important role in the design and operation of anaerobic digesters include:

- solids retention time (SRT);
- HRT;
- temperature;
- alkalinity;
- pH;
- toxic / inhibiting substances; and
- Bioavailability of nutrients and trace elements.

Anaerobic digestion

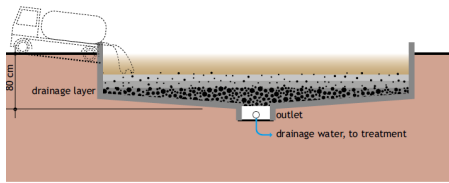
- Organic matter- Biogas (methane and CO_2) and digestate.
- **Advantages:**
Production of biogas, reduction of sludge volume and odours.
- **Limiting factor:**
High level of skilled operation and monitoring.



Advantages and Constraints

Anaerobic digestion has the potential to produce biogas while stabilizing FS, reducing sludge volume and odours. However, operation and maintenance (O&M) of anaerobic digesters requires a relatively high level of skilled operation. Inhibition of digestion needs to be considered due to the inconsistent nature of FS, and also detergents and heavy metals should be addressed at the household level.

Unplanted drying beds



Source: Tilley et al. 2014



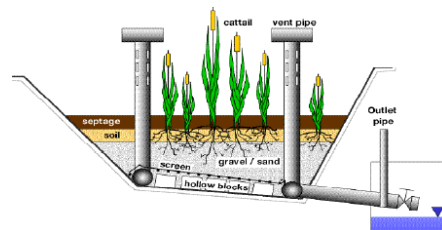
Source: Faecal Sludge Management, IWA

- Shallow filters with sand and gravels with under drain to collect filtrate.
- **Application:**
Climatic factor and types of sludge
- **Advantages:**
Low cost and ease of operation.
- **Limitation:**
Large footprint and odour potential

Unplanted sludge drying beds are shallow filters filled with sand and gravel with an under-drain at the bottom to collect leachate. Sludge is discharged onto the surface for dewatering. The drying process in a drying bed is based on drainage of liquid through the sand and gravel to the bottom of the bed, and evaporation of water from the surface of the sludge to the air. Depending on the faecal sludge (FS) characteristics, a variable fraction of approximately 50-80% of the sludge volume drains off as a liquid (or leachate), which needs to be collected and treated prior to discharge. After reaching the desired dryness, the sludge is removed from the bed manually or mechanically. Further processing for stabilization and pathogen reduction may be required depending on the intended end use option. When considering the installation of a drying bed, the ease of operation and low cost needs to be considered against the relatively large footprint and odour potential.

Planted drying beds

- Unplanted drying bed with emergent macrophyte.
- **Application:**
Climatic factor
- **Advantages:**
Low cost and ease of operation.
- **Limitation:**
Large footprint and odour potential



Source: AIT, Thailand



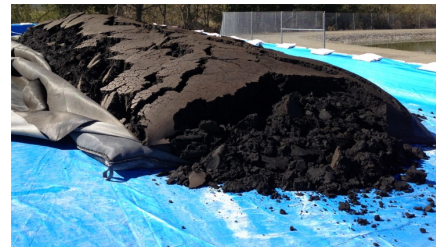
Source: Faecal Sludge Management, IWA

Planted drying beds (PDBs), also sometimes referred to as planted dewatering beds, vertical-flow constructed wetlands and sludge drying reed beds, are beds of porous media (e.g. sand and gravel) that are planted with emergent macrophytes. PDBs are loaded with layers of sludge that

are subsequently dewatered and stabilized through multiple physical and biological mechanisms. The dewatering, organic stabilization and mineralization performance of the PDB depends on a variety of factors such as the media type and size, the type of plants, the maturity of the beds, climatic factors, and the sludge characteristics, as well as operational factors such as the hydraulic loading rate (HLR), the solids loading rate (SLR), and the loading frequency.

Geotubes

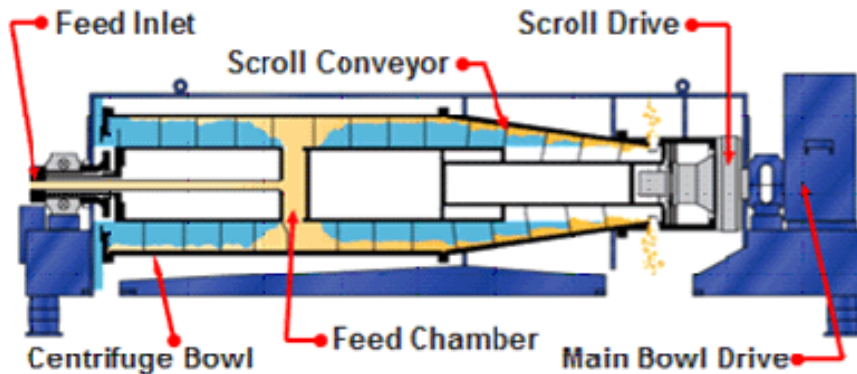
- Non woven geotextile is used to create long tubes.
- **Application:** fully digested sludge, increasing efficiency of SDB.
- **Advantages:** Low cost and ease of operation.
- **Limitation:** One time use



Mechanical sludge treatment

- Belt filter, Centrifuge, Frame filter press and the Screw press.
- Mostly used for sludge generated in STP, transferable to FS and septage.
- **Advantages:** Compactness, speed of the process.
- **Limiting factors:** investment costs, O&M costs, dependency on electricity, skilled operator.

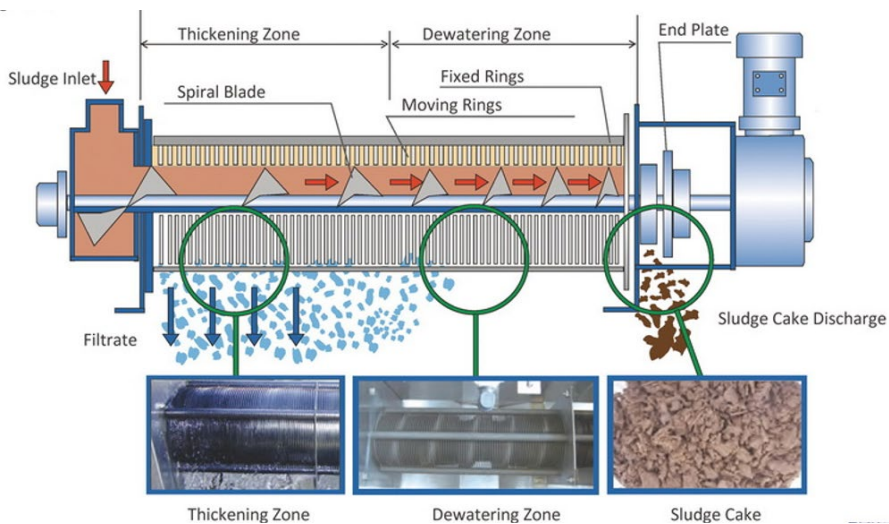
Centrifuge



Source: www.hiler-us.com

This technology dries the FS as it is squeezed outwards on the surface of a cylinder rotating around its horizontal axis, due to the centrifugal force. The flocculated sludge is injected into the middle of this cylinder, and the particles are pushed outward against the surface. An Archimedean screw transports the released liquid to the side where the sludge entered, while another transports the sludge to the other end. The main disadvantage of the centrifuge is the high energy requirements.

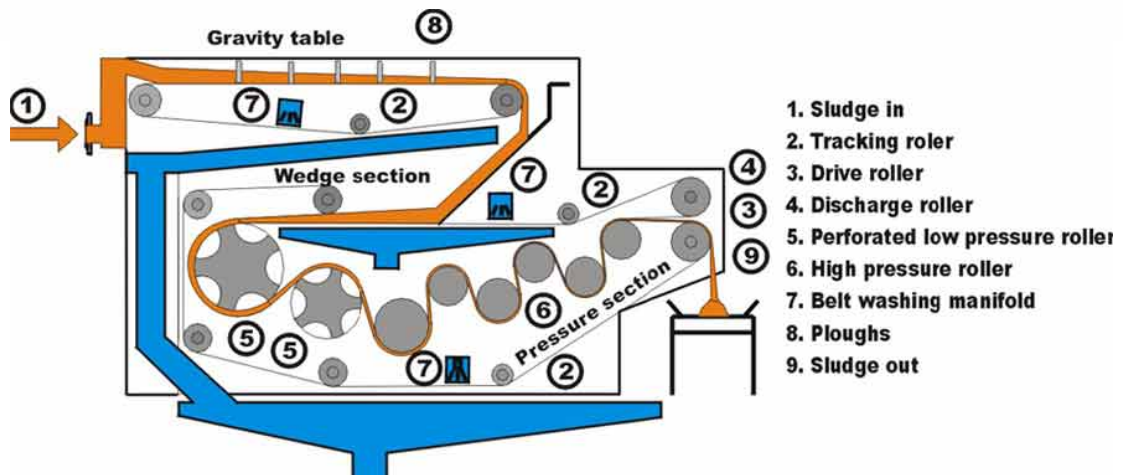
Screw press



Source: www.ecologysystems.com

A screw press consists of a rotational screw placed in a perforated cylinder. The sludge is loaded at one end, it is pressurised due to a diminishing distance between the screw and the cylinder, and the liquid that is squeezed out is removed through the pores in the cylinder. The dewatered sludge is discharged at the other end. Screw presses provide dewatering at relatively low equipment and operational costs, and minimal maintenance skills are required. However, the dewatering is comparatively lower than other mechanical dewatering technologies.

Belt filter



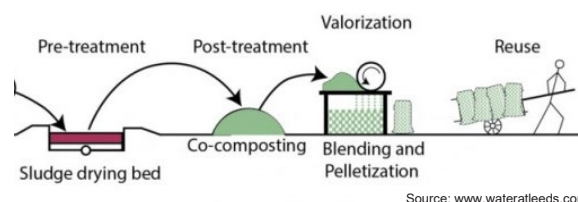
Source: Krofta Engineering

Belt filter press: This allows the water to be squeezed out of the sludge as it is compressed between two belts. The main disadvantages of a belt filter press compared to other mechanical dewatering techniques are the need for skilled maintenance and the difficulty in controlling odours. The system consists of:

- A gravity drainage zone where the flocculated sludge is deposited and conveyed on a porous and mobile belt;
- A compression zone where a second belt is applied on the upper layer of the sludge, and compresses it to a pressure that can reach 7 bars; and
- A zone where the belts are separated and the dewatered sludge is released.

Co composting

- C:N Ratio = 20-30:1, Oxygen concentration: 40-60%, Particle diameter < 5 cm
- **Advantages:**
Thermophilic condition- Pathogen inactivation
- **Limiting factors:**
Technical and managerial skills



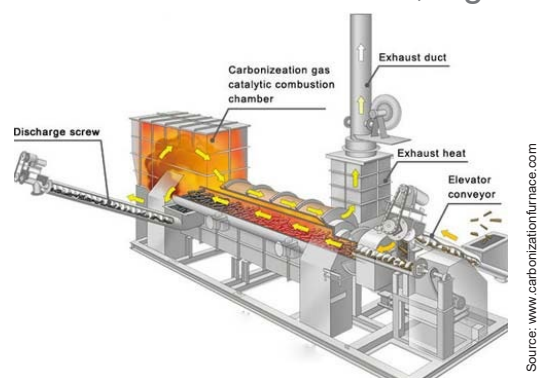
Composting is a biological process that involves microorganisms that decompose organic matter under controlled predominantly aerobic conditions. The resulting end product is stabilized organic matter that can be used as a soil conditioner. It also contains nutrients which can have a benefit as a long-term organic fertilizer. Co-composting of FS with MSW is best implemented with sludge that has undergone dewatering (e.g. settling-thickening tanks or drying beds).

Advantages and Constraints

The main advantage of co-composting is formed by the thermophilic conditions and the resulting pathogen inactivation. The output of co-composting is a good soil conditioner which provides potential for income generation depending on the demand for compost. However, operating a co-composting plant and generating a safe product with value requires technical and managerial skills, which can be limiting if not available.

Sludge incineration

- Burning of sludge at temperature 850-900°C.
- **Advantages:** Volume and pathogen reduction.
- **Limiting factors:** emission of pollutants, high skilled operator and maintenance staff, high capital and O& cost.



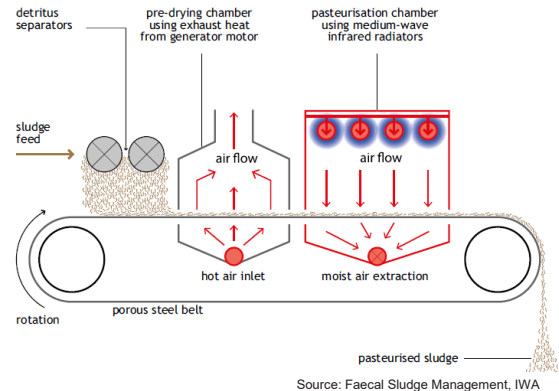
Incineration of sludge is a form of disposal which involves the burning of sludge at temperatures between 850-900°C. It does not typically take advantage of the potential for resource recovery, however, energy can be captured from the incineration of sludge, for example in cement kilns. The ash that is produced from incineration could potentially be used, for example as a cover material for urine diversion dry toilets or in construction, or it can be disposed of in landfill sites. Sludge needs to be dewatered prior to combustion, but stabilization treatment is not necessary as it decreases the volatile content of the sludge. Commonly used incineration systems are multiple-hearth incineration, fluidized-bed incineration and co-incineration with municipal solid waste.

Advantages and Constraints

Disadvantages include: the potential emission of pollutants; the need for highly skilled operating and maintenance staff, high capital and O&M costs; and residual ashes. Advantages are that the sludge volume is substantially reduced and all pathogens are removed.

Thermal drying and pelletising

- Direct (hot air or gas) or indirect thermal driers (hot water or oil).
- **Advantages:**
Reduction in volume and pathogen content.
- **Limiting factors:**
high energy requirements, risk of fire and explosion, high maintenance.



These systems require preliminary dewatering if used for sludge that is high in water content. In direct thermal driers, the hot air or gases are mixed with the dewatered sludge, as they pass through it, or are transported with it. In indirect thermal driers, a heat exchanger is used, which allows the heat convection to the sludge. In this case, the heat carrying media is often steam or oil, and does not come in direct contact with the sludge, which reduces the operational need to separate the sludge from the heat carrier. In both cases, the vapor produced by the evaporated water needs to be collected and transported out of the dryer. Gas treatment can be an issue depending on environmental requirements and the odours produced. Indirect thermal driers produce less contaminated vapor.

Advantages and Constraints

Thermal drying results in a significant reduction in volume as well as pathogen content. Dried sludge is easy to handle and to market, and can be used in agriculture. The main constraints are the expense, high energy requirements, the potential risks of fire or explosion due to the gas and dust in the system, and the high maintenance requirements.

Pelletizing combines mechanical dewatering and thermal drying technologies. The dried pellets can then be used as an energy source or soil conditioner, and are relatively easy to transport and to market.

Day 2

Session

05

Site Visit to Treatment Plants



Septage Treatment plant, Bhubaneswar

The treatment plant in Bhubaneswar is first of its kind septage treatment plant in India which treats both solids and liquids parts of septage in an integrated manner. The capacity of the plant is 75 KLD constructed by Odisha Water Supply and Sewerage Board under the AMRUT programme at a cost of 3.54 crore.

The SeTP is designed to treat the liquid part of the septage using DEWATS technology. The technology requires least mechanical and electrical interventions to run the process and is cost effective as compared to other technologies. Solar plant of 10 KW capacity installed at the SeTP as a special feature.

1. Introduction

Bhubaneswar treatment plant treats both solid and liquid parts of septage in integrated way. The low cost technology, easy operation and maintenance demonstrates a scalable and sustainable model for septage management in India.

2. City overview

Bhubaneswar, the capital of Odisha, is located in the eastern coastal plains along the Eastern Ghats. The area under the jurisdiction of the Bhubaneswar Municipal Corporation covers 186 square kilometer.

Name of the city and state	Bhubaneswar, Odisha
Population (census 2011)	8,46,402
Existing sanitation situation	<ul style="list-style-type: none">• Connectivity to sewer network is 26%• Majority of the population of the city are dependent upon Onsite Sanitation

3. Approach

a. Planning

FSSM approach in Odisha is a state centric strategy. The Septage Treatment Plant (SeTP) of Bhubaneswar has been constructed under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) programme by Odisha Water Supply and Sewerage Board (OWSSB). The operation and maintenance of the plant is also by OWSSB. The criteria for technology selection was for it to be low cost and non-mechanized so that operation and maintenance can be done by the local staff.

b. Conveyance

FSSM approach in Odisha is a state centric strategy. The Septage Treatment Plant (SeTP) of Bhubaneswar has been constructed under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) programme by Odisha Water Supply and Sewerage Board (OWSSB). The operation and maintenance of the plant is also by OWSSB. The criteria for technology selection was for it to be low cost and non-mechanized so that operation and maintenance can be done by the local staff.

Figure 1 Cesspool emptier vehicle procured by the State of Odisha



ULBs in Odisha are using technology as an enabler to integrate and improve FSSM service delivery. Under Smart City Mission, Bhubaneswar Municipal Corporation (BMC) is implementing the smart FSSM system, which enables the components of FSSM, to be remotely monitored using wireless sensors installed inside the tank of cesspool emptier vehicles.

Figure 2 Integrated command center in Bhubaneswar



c. Technology

Septage treatment plant at Bhubaneswar is of 75KLD capacity spread over the area of 1 Ha. There is a receiving/inlet chamber for the sludge where it is screened and goes into the settler cum thickener tank. Settler cum thickening tanks are constructed for separation of solid and liquid components of the faecal sludge.

The SeTP is designed to treat the liquid part of the septage using DEWATS technology. DEWATS is chosen as a preferred technology, given the comparative advantage of technology, in terms of its minimum electricity requirement and ease of operations through semi-skilled personnel. The solids from the settler tank go to the sludge drying bed with movable sheds. After drying the sludge goes to the compost shed. After composting the sludge is reused.

The SeTP covers an area of 2.47 acres out of which 1.3 acres have been utilized for landscaping and plantation which not only enhances the aesthetics of the plant but it also helps in garner citizens support and raise awareness on importance of treating faecal sludge and septage.



Sludge drying beds with movable sheds



Planted gravel filter



Anaerobic Baffled Reactor + AF

d. Financing

The project has been constructed under AMRUT by 50:50 cost sharing basis. The total project cost is 3.5 crores which includes O&M cost of 5 years.

Sources:

- Odisha's Journey of Faecal Sludge and Septage Management, towards sustainable sanitation goals by Ernst & Young LLP.
- Septage Treatment Facility in Bhubaneswar & Puri, Design Approach and overview of SeTP- Presentation by Binod Kumar Sahoo, Project Director, OWSSB



Co-treatment of septage at Puri, STP

The holy town of Puri is the first in Odisha to have a Sewerage and Septage Management Project. As per mandate under AMRUT programme, Orissa Water Supply & Sewerage Board (OWSSB) has constructed a 50 KLD capacity Septage Treatment Plant (SeTP) at Mangalaghat, Puri in October, 2017 and is one of its kind in the nation as it uses Cotreatment technology for the treatment of sludge being unloaded.

The SeTP employs co-treatment method for treatment of septage where the liquid fraction is treated in a Sewerage Treatment Plant (STP) located adjacent to the SeTP. The solids are dried at sludge drying bed of existing STP which was initially utilized only biannually when the sludge from STP was removed. This has reduced the cost of the project thus making it sustainable for the ULB.

1. Introduction

Puri SeTP employs co-treatment method for treatment of septage where solids are treated through drying beds and the liquid fraction is treated in Sewerage Treatment Plant (STP) co-located with SeTP.

2. City overview

Puri is a city in the state of Odisha in eastern India. It is situated on the Bay of Bengal, 60 kilometers south of the state capital of Bhubaneswar. With the 12th-century Jagannatha Temple located in its heart, Puri is a pilgrimage town with high floating population.

Name of the city and state	Puri, Odisha
Population (census 2011)	2,00,564
Existing sanitation situation	• Majority of the population of the city are dependent upon onsite sanitation

3. Approach

a. Planning

The approach for FSSM in Odisha is state centric. The SeTP of Puri has been constructed under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) programme by Odisha Water Supply and Sewerage Board (OWSSB). The plant in Puri employs co-treatment for septage management.

b. Conveyance

In October 2017, Puri Municipality appointed a private contractor to provide emptying services Rs. 790/- per trip. As a result of lower price and in time services, the Municipality saw an increase in the number of trips being emptied at the plant.

Figure 1 Cesspool emptier vehicle procured by the State of Odisha



Cesspool vehicles

Odisha Government purchased cesspool vehicles for ULBs using state funds in early 2015 and ensured availability of cesspool vehicles with all the ULBs for safe collection and transport of faecal sludge/septage. The Puri Municipality has 6 numbers of cesspool vehicles out of which 4 were procured by the OWSSB and handed over to the ULB while the

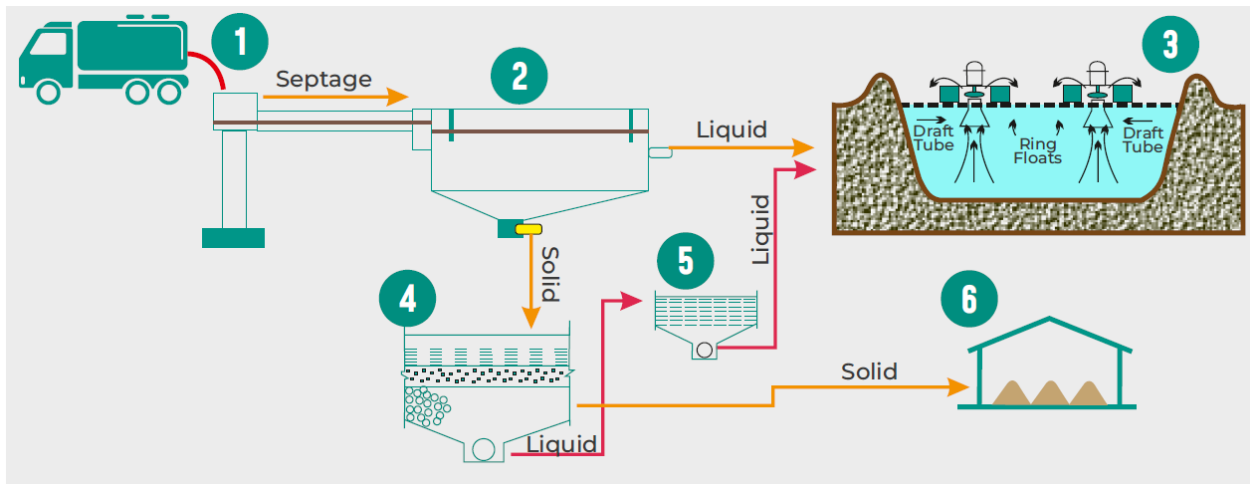
other two were procured by the ULB. The 4 newly procured vehicles are of 3000 L capacity and have been handed over to the private agency under the contract.

c. Technology

An SeTP of 50 KLD capacity was constructed by Orissa Water Supply and Sewerage Board (OWSSB) in October 2017. The treatment plant was constructed under AMRUT scheme. The septage at this

treatment plant is co-treated by treating solids in SeTP and the liquid in the co-located STP. The septage is emptied at the receiving chamber. It then goes to the settling cum thickener tank of SeTP which allows heavier particles of the unloaded septage to settle down to the bottom of tank while the lighter part of septage (i.e. water and oil) remains above. The sludge (settled soils) gets thickened in the settling-cum-thickener tank and removed by pumping at regular interval to the sludge drying bed for removal of moisture content. These sludge drying beds are the underutilized drying beds of STP which have been modified for treating septage to save infrastructure cost. The leachate from sludge drying bed is collected in the leachate sump which is pumped to the pre-treatment unit of Sewage Treatment Plant (STP) which is co-located with the SeTP for further treatment and disposal.

Figure2 Treatment process flow diagram



d. Financing

The project has been constructed under AMRUT by 50:50 cost sharing basis. The total project cost is 1.75 crores.

Sources:

- Odisha's Journey of Faecal Sludge and Septage Management, towards sustainable sanitation goals by Ernst & Young LLP.
- Septage Treatment Facility in Bhubaneswar & Puri, Design Approach and overview of SeTP- Presentation by Binod Kumar Sahoo, Project Director, OWSSB



Faecal Sludge Treatment Plant, Wai (Maharashtra)

The journey of Wai towards improvement of sanitation in 2013 started with making of a City Sanitation Plan with an innovative approach to adopt non sewerred options for waste water management. The city through its city-wide septage management plan, planned and implemented Regularly desludging the septic tanks of all the properties once in every 3 years and treating the septage in a scientific and safe manner prior to disposal. This city is one of the first cities in India to implement a schedule septic tank emptying service.

Various innovative tools have been used for assessment and implementation of sanitation related activities such as performance-based contract for emptying, financing models such as sanitation tax and opening of escrow account, mobile based applications for monitoring the service, etc. The learnings of Wai has also been adopted in the NFSSM policy and FSSM primer that GoI has rolled out.

1. Introduction

Wai city have moved from a demand based emptying system to a regular service oriented emptying system by implementing scheduled desludging.

2. City overview

Name of the city and state	Wai, Maharashtra
Population (census 2011)	~ 43,000 (census - 36,025)
Existing sanitation situation	<ul style="list-style-type: none">• More than 80% of households have individual household toilets. The rest have access to well-maintained community toilets.• The city does not have any underground drainage system and toilets in city are connected to septic tanks and pit latrines.

3. Approach

a. Planning

The journey of Wai towards improvement of sanitation in 2013 started with making of a City Sanitation Plan with an innovative approach to adopt non sewerred options for waste water management. After achieving the ODF status, city aimed at sustaining the ODF status which focused on increasing the individual toilet coverage and achieving ODF++ status as per MoHUA's protocol which deals with safe collection and disposal of fecal matter. The city through its city-wide septage management plan, planned and implemented:

- Regularly desludging the septic tanks of all the properties once in every 3 years
- Treating the septage in a scientific and safe manner prior to disposal

This city is one of the first cities in India to implement a schedule septic tank emptying service.

b. Conveyance



The city formulated a scheduled emptying plan wherein all the septic tanks in the city would be emptied once in 3 years and the collected septage will be treated at a dedicated septage treatment facility. To achieve the same, the entire city is divided in 3 zones and the city aims to empty the septic tanks of 1 zone per year. Initially, around 2% (~100) septic tanks were cleaned annually in Wai and these services were being provided by two WMC operated truck against a charge. However, Wai is now going to empty 33% i.e. 2000 septic tanks annually. This service is being provided by a private contractor which was selected through competitive tendering process. A service based contract for 3 years has been signed.

Impact of scheduled desludging

In Wai, scheduled desludging is operational since 30th May 2018. Since the implementation of scheduled emptying of septic tanks 7-8 tanks septic tanks are desludged every day as compared to 7-8 tanks being emptied every month. Within 5 months 350+ tanks have been desludged.

c. Technology

Wai Municipal Council allocated land near the solid waste management processing site for an FSTP of capacity 70 cu.m/day. The FSTP and schedule emptying service in Wai was inaugurated in May 2018. It is a thermal FSTP with engineered pasteurization, dewatering and waste water treatment unit. The reuse of energy produced during the pyrolysis of fecal sludge makes the setup more efficient and saves valuable energy. Reuse of treated septage and water is being explored and discussions are going on with local famers, government officials and agro based industries for reuse.

Figure 5 The Thermal Faecal Sludge and Septage treatment process

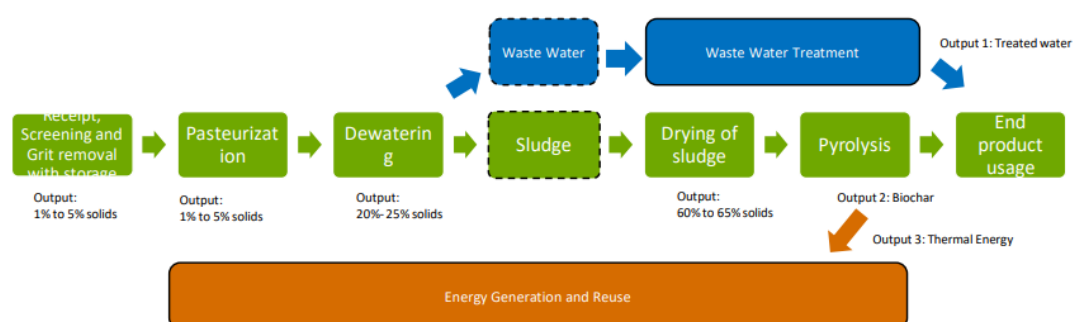


Figure 6 Site pictures of treatment plant



d. Financing

The FSTP at Wai was initiated as a pilot project wherein capital cost was funded by BMGF. Wai Municipal Council opened an independent escrow account for payment of private contractor for emptying service which protected it against payment delay. The scheduled desludging service is financed through the city governments' own funds. A sanitation tax is levied on the citizens which amounts to much less than what each family needed to pay for emergency desludging. This tax, along with surplus from property tax collection, funds the O&M of emptying and treatment.

Sources:

- Wai Municipal Council
- www.pas.org.in

Day 3

Session

06

Financing and Contracting Options



Objective:

To discuss the financing aspects of FSSM for conveyance and treatment of septage

Format:

Presentation followed by hands-on exercise

Duration:

60 minutes

40 minutes – presentation and discussion

20 minutes – hands-on exercise

Points to be covered:

- Identifying the potential financial sources for CAPEX and OPEX for FSSM.
- Recovery of O&M - user fee/ licensing for scheduled vs. demand based conveyance system.
- Stakeholders involved in financial transfers
- Financial models - Discrete collection and treatment model/integrated model/Parallel tax and discharge fee model etc.
- Contracts and their implications.
- Calculation of tariff requirement for O&M for conveyance and treatment of septage.

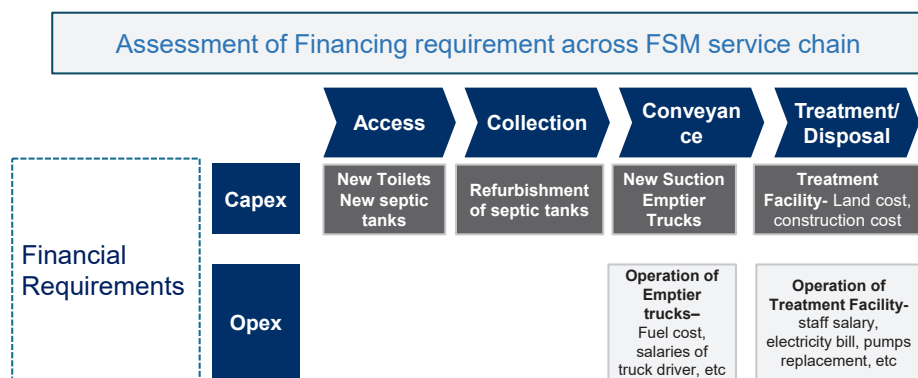
6. Financing and contracting options

Objective of the session

- This session will highlight that to ensure financial **sustainability of FSSM services**, it is important to **assess capacity for financing** of both capital and O&M expenditure over the plan period.
- The session will give brief overview on how to **assess financial requirements** for both **capital** and **O&M expenditures** for implementation of FSSM in a city.
- The session will also **provides guidance** on **potential sources of finance** for meeting these expenditures including through external **grants, private sector investments**, user contributions, external **debt** or through local government internal resources.

The objective of finance session is to emphasize on sustainability of FSSM services. It gives an overview on assessment of financial requirements and potential sources of finance for capital costs and O&M expenditures for implementing an FSSM plan in a city.

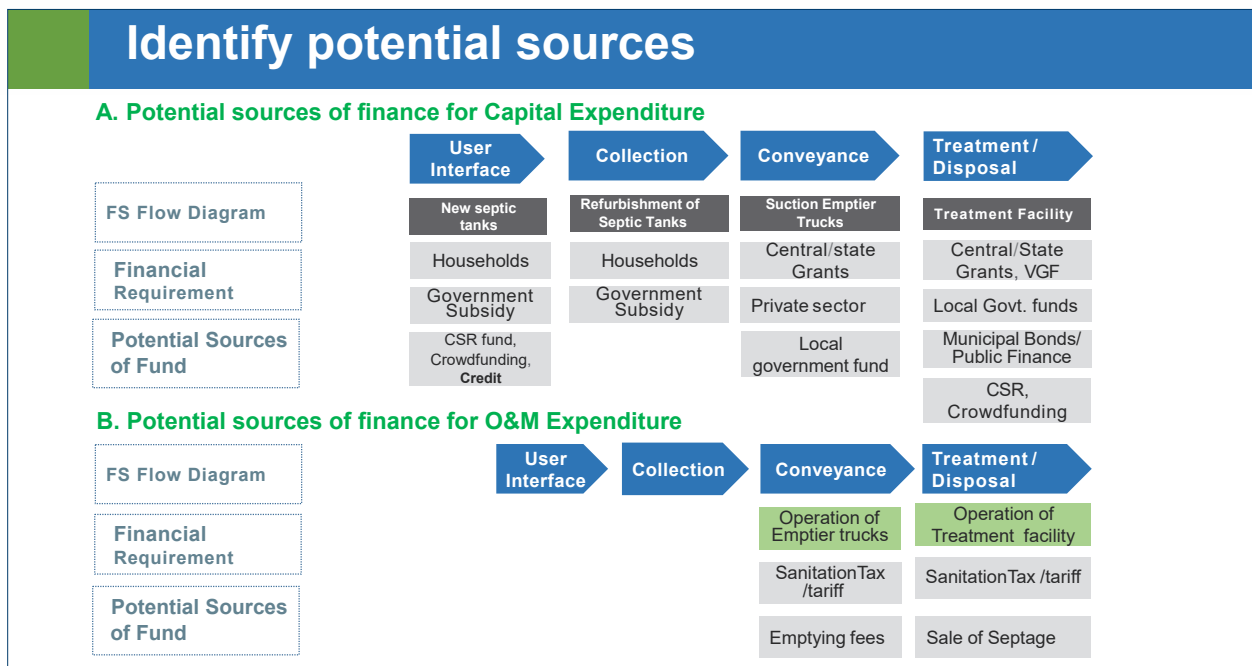
Financial requirements for FSSM



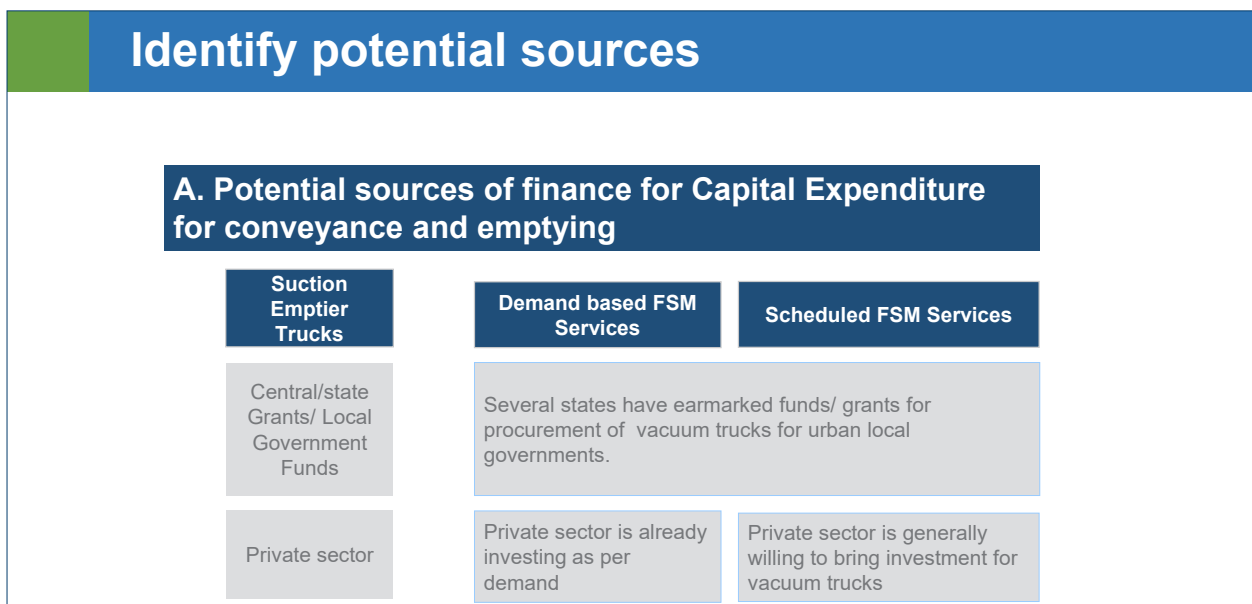
- The first step in Financial Assessment is to determine the financing requirements for proposals for the full service chain – starting with toilets in the user interface, to collection, conveyance and treatment or disposal.
- The finance requirements are essentially based on costs of achieving the various improvement activities planned.
- It is also important to ensure that both capital costs and O&M costs are assessed.

Financial requirements categorized in two set, capital expenditure (one time) and operational expenditure (recurring). The financial requirements essentially based on cost of achieving the various improvements activities planned. The main components of Capex are new toilets and new septic tanks, refurbishment of old toilets and tanks, new vacuum trucks, land acquisition cost construction cost of FSTP etc. The Opex are mainly for conveyance and treatment components like O&M of trucks and FSTP.

1. Identification of potential sources



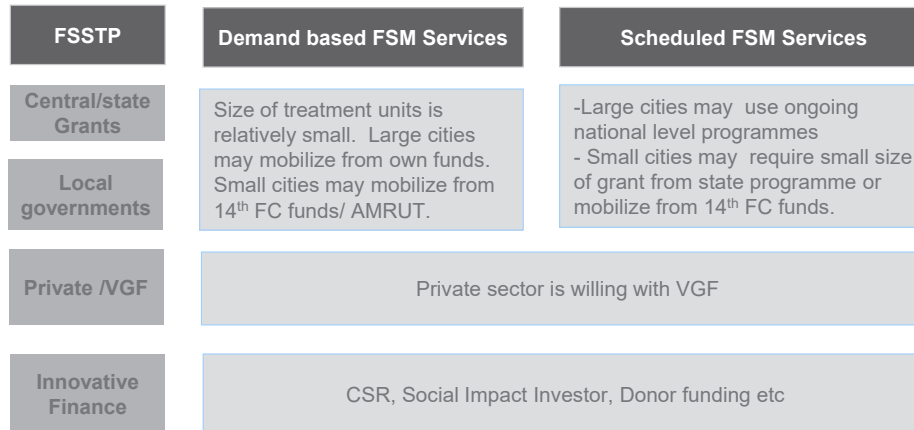
The costs for Capex and Opex can have multiple potential sources of finances. For Capex of access and containment components like toilets and septic tanks the main source of finances are households and government subsidies, CSRs, Credit if available. Central and State Govt grants and local govt. funds and PPP are the potential sources for Capex of Conveyance and Treatment. Other sources like municipal bonds, Public finance, CSR and crowdfunding can also be used for Capex of treatment plant. Levying Sanitation tax is a potential source of finance for covering Opex of conveyance and treatment if desludging is provided a service and User charges or emptying fees in case of demand based desludging.



Purchase of suction emptier trucks requires investment at an earlier stage, which can be met through funds earmarked by state government for ULBs. For demand based emptying the private sector and ULB are already catering the demand for desludging but in case of schedule based emptying the private sector is willing to bring in investment for vacuum trucks as it generates enough business.

Identify potential sources

B. Potential sources of finance for Capital Expenditure for treatment



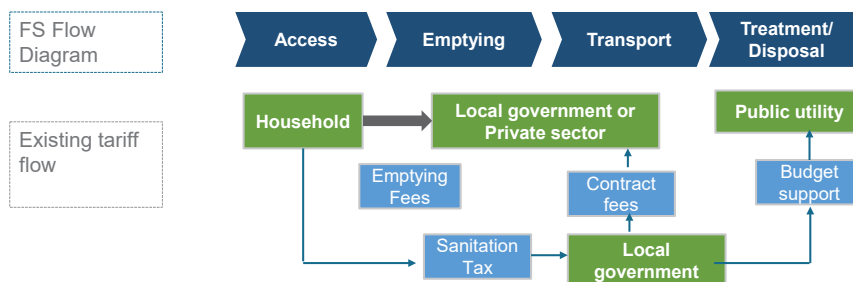
For the capital expenditure of treatment plant, central/state grants can be used. Large cities can use their own funds for the same. In case of scheduled service, large cities may use funds from national level programmes while smaller cities can mobilize funds from 14th Finance Commission. Viability gap funding can be used to involve private sector where more funds may be required. Innovative finance methods can be used by ULBs for treatment facility like donor funding, CSR etc

Identify existing revenue sources

To make FSM activities sustainable, assessing the revenue sources is very important

- Local government become financially sustainable by levying taxes and/or user charges so as to recover O&M costs of recent urban development programmes.
- It is therefore imperative that any proposed investment plan includes ways to recover O&M costs.
- Besides meeting operating expenses, the ULB is required to keep sufficient surplus to meet repayment obligations in addition to its committed capital expenses.

Assessment of current tariffs levels across FSM service chain



Source: Diagram adopted from Faecal Sludge Management: Systems Approach for Implementation and Operation, Linda Strande, Mariska Ronteltap, Damir Brdjanovic, IWA 2014

Levying taxes or user fee is an important source of revenue to make treatment plant financially sustainable. It is important to explore various revenue sources to recover O&M cost. The current tariff flow shows that HHs pay either emptying fees to private sector/ ULBs or sanitation tax to ULBs. ULBs also pay contracting fees to private sector for desludging. Additional budget support may be required for O&M treatment facility. Assessing various revenue sources based on current tariff is important.

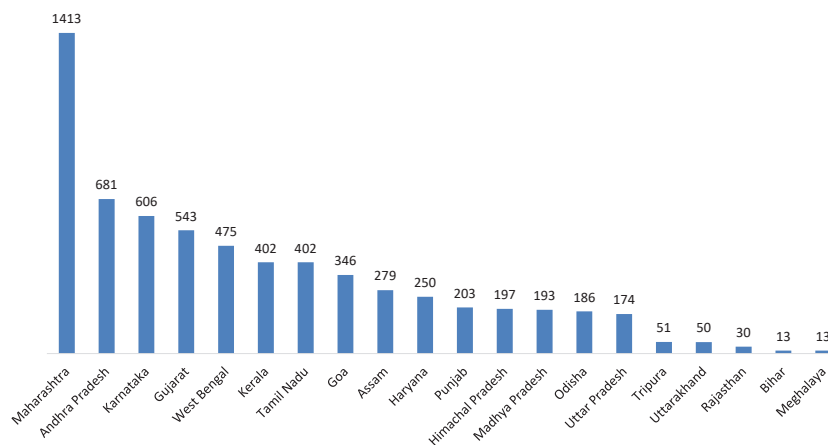
Legal Provision for Sanitation Tax/ user charge/ fee

State	Sanitation Tax	User charge/ fees/ cess
Gujarat	General sanitation tax upon private latrines, premises or compounds cleansed by municipal agency	
Maharashtra	Special sanitary tax upon private latrines, premises or compounds cleansed by municipal agency	
West Bengal		a fee with regard to a scavenging
Uttar Pradesh/ Uttarakhand	a conservancy tax in areas in which the Corporation undertakes the collection, removal and disposal of excrementitious and polluted matter from privies, urinals and cesspools	
Punjab	Scavenging tax as percentage of annual value	Sewerage Cess
Haryana		a fee with regard to a scavenging
Rajasthan		User charge for provision of drainage and sewerage

Various states have legal provisions in their tax structure for charging tax and are already charging fees in terms of sanitation tax/user charge, which is a major source of revenue. Gujarat, Maharashtra, Uttar Pradesh, Uttarakhand and Punjab have provisions for taxations in different heads like general sanitation tax for Gujarat, Special sanitary tax for Maharashtra etc. In case of West Bengal, Punjab, Haryana, Rajasthan there are provisions for fees and user charges for drainage, scavenging etc.

Possible subsidization through property tax

Per Capita Property Tax (2012-13)



Source: Municipal finances and service delivery in India (2014), ASCI

Property tax can be used as a source to subsidize the cost of FSSM services to be provided. A comparative assessment of property tax per capita across states shows that the Maharashtra Property Tax is very high as compared to the other states. Rajasthan, Meghalaya and Bihar have very low tax.

Assess HHs willingness to pay and Reuse market



HHs willingness to pay

- Assess how much the people are willing to pay for regular or demand based emptying service
- Assess willingness of the local government to levy sanitation charges/taxes



Landscape assessment of reuse market

- Identify nearby industries or agriculture land
- Assess their willingness to reuse the treated septage and water
- Assess how much they are willing to pay to buy treated septage and water

There are various fees and taxes that are involved in the FSSM process like sanitation tax, emptying fees, licensing fees and purchase price. Assessment of willingness to pay is important before levying of such fees or taxes to decide the amount. Sanitation tax can be decided based on the willingness of HH to pay additional property tax to cover the O&M of the FSTP. Emptying fees can be decided based on distance and frequency of desludging to cover the functioning of conveyance of septage. The end use product can be sold and the purchase price can be set based on end user willingness to reuse and pay for treated products.

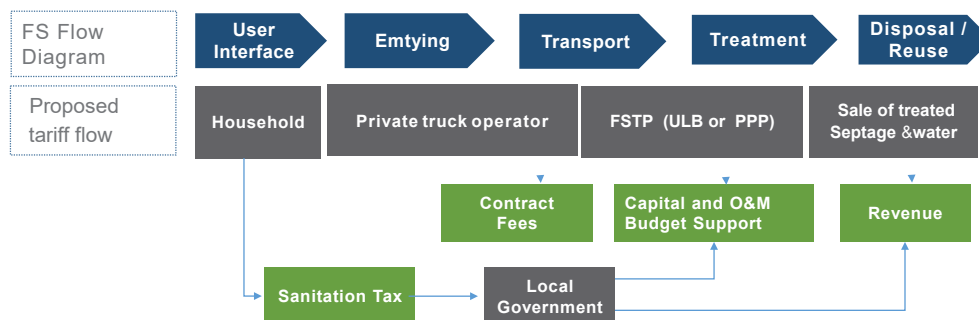
2. Potential revenue structure

Potential revenue structure

Scheduled Desludging through Sanitation Tax Basis

- sanitation tax collected from owners of OSSs, and
- mandatory scheduled desludging of tanks/pits.

Sanitation tax is collected by the local authority either as a percent age of property tax or by the public utilities as a surcharge on water bills.



A potential revenue structure is recovery of scheduled desludging and treatment O&M through Sanitation Tax. This tax is collected by local authority either as a percentage of property tax or by the public utilities as a surcharge on water bills. Under the proposed tariff flow the local government receives the sanitation tax and pays contract fees to the private government. Capital and O&M of treatment facility is covered by tax and budget support. Some revenue can also be generated from sales of end product.

Sanitation tax – A case study of Wai

Current taxes levied

कराचे ताल	आधील वसुली	वस्तु मूल्य	वसुली
अवकाश कर			
पुढ कर			
सिद्ध कर			
सोळाव्या इली कर			
पानी कर			
अडोड्या कर			
दुधा कर			
सुद्ध			
१% निवडणुकीचे			
सुद्ध			

Appropriate awareness can ensure willingness to increase local taxes

- Currently, households clean their septic tanks once in 8-10 years and spend INR ~1000 in Wai and INR ~400 - 800 in Sinnar
- Property owners currently have to pay local taxes of about Rs 2200/annum in Wai and Rs.1600/annum in Sinnar
- To cover the costs of a cleaning cycle of ~3 years would require an increase in annual tax spend for a household of about 10% in Wai and 20% in Sinnar.
- As these are reasonable increases for a regular service and related environmental as well as personal benefits, it is expected that with appropriate awareness there will be willingness to pay additional taxes.

The ULB can consider using its conservancy taxes to support the integrated faecal sludge management plan, and will need to compensate private players directly through a management fee

In Wai, sanitation tax is imposed for a regular service and related environmental as well as personal benefits. It is observed that with appropriate awareness, there was a willingness to pay additional taxes. The taxes have been levied for a year and the citizens have paid the taxes. These taxes cover the desludging of septic tanks every three years for the property owner.

Sale of treated septage for revenue – source of revenue

“Larger farmers who export their crops are bound by restrictions on the use of animal and human waste. **Sludge can be sold mainly to small and marginal farmers**, who lack access to synthetic fertilizers.”

- Person X

“**Faecal sludge cannot be used in organic farming** due to concerns about e-coli and shigella infections. However, it is often used by small farmers as ‘son-khad’.”

- Person Y, Farming association

“We make compost from solid waste. The market is extremely seasonal. Creating a continuous market for this waste is tough. People say that you are creating compost from waste so we don’t want to use it.”

Source is very important.”

- Person Z, Entrepreneur

“I often have to pay farmers to dump sludge in their farms, I do not think the sale of septage is a viable revenue source.”

- X Enterprises

“It (sale of septage) is possible, **but will require investment in marketing and distribution**, which we do not do.”

- Y Enterprises

There is demand for sludge among small and medium farmers, but willingness to pay is unclear

Market at a city level and nearby area should be analyzed in terms of acceptance of treated sludge for farming and willingness to pay for the same. As observed from discussion with various enterprises there appears to be a demand for the treated sludge but willingness to pay is unclear.

Discussion Points

- What are key issues in financing FSSM?
- Emptying charge or Sanitation tax?
- Potential Sources for CAPEX and OPEX in your state?
 - Emptier trucks
 - Treatment plant

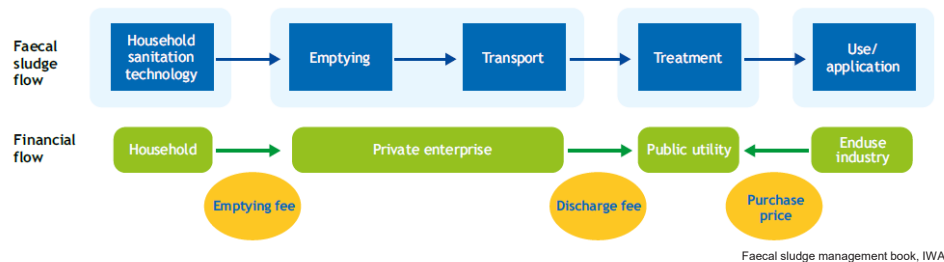
Financing FSSM, emptying charge or Sanitation tax, and potential sources for CAPEX and OPEX are the key points which needs to be explored in depth.

REFERENCES

- Chary S. and Prasad R. (2014), "Municipal Finances and Service Delivery in India: A Study Sponsored by the Fourteenth Finance Commission Government of India", ASCI, Hyderabad
- Performance Assessment System Project. (2014). "Report on Workshop on Financing Urban Sanitation", Mimeo, retrieved from: <http://pas.org.in/Portal/document/UrbanSanitation/uploads/Workshop%20report%20financing%20urban%20sanitation%20in%20Maharashtra.pdf>
- Performance Assessment System Project & Dalberg, (2014). "A review of innovative financing options for urban sanitation", Mimeo, retrieved from: [http://pas.org.in/Portal/document/UrbanSanitation/uploads/Financing Options Urban Sanitation.pdf](http://pas.org.in/Portal/document/UrbanSanitation/uploads/Financing%20Options%20Urban%20Sanitation.pdf)
- Performance Assessment System Project & Dalberg, (2014). "Demand and investment opportunity in urban sanitation in Maharashtra", Mimeo, retrieved from: <http://pas.org.in/Portal/document/UrbanSanitation/uploads/Demand%20for%20sanitation%20in%20Maharashtra.pdf>
- Performance Assessment System Project, (2015). "Assessment Tool for Citywide Integrated FSM Planning", Mimeo, Retrieved 1 August 2016, from <http://ifsmtoolkit.pas.org.in/>
- Strande, L., Ronteltap, M., & Brdjanovic, D. (2014), "Faecal sludge management Systems : Approach for Implementation and Operation", IWA Publishing, London.

3. Financing models

Discrete collection and treatment model



PROS

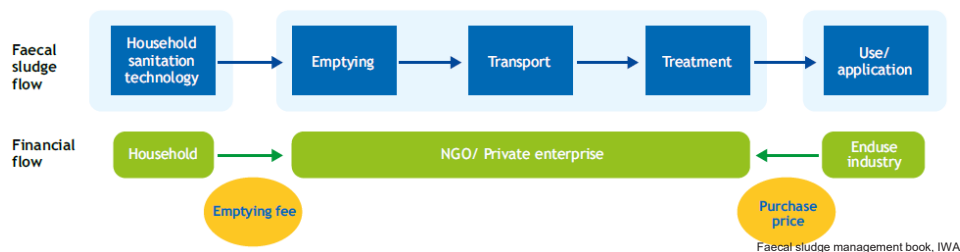
- + Households are free to choose the most competitive offer for emptying
- + Timing of emptying is flexible and can be done when financially feasible
- + The household is not committed to a fixed sanitation tax

CONS

- The utility's operating expenses must be covered by the discharge fee

The discrete collection model the HH pay the emptying charges, emptying and transport carried out by the private operator & they pay the discharge fees for disposal of sludge and the end use industry pay the purchase price for buying the treated products. This model is advantageous to the households as they are not fixed to any sanitation tax, free to choose the financially viable option for emptying and can decide the frequency of emptying as per feasibility. This does not help ULB cover the O&M expenses so the private operators have to pay a discharge fee for emptying.

Integrated model



PROS

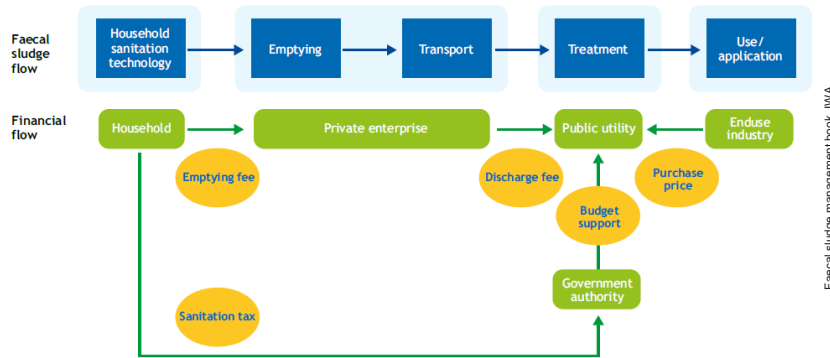
- + A single operator is able to optimise the business model and improve efficiency
- + Less potential for illegal discharge as the single entity will discharge at the self-run treatment works

CONS

- High fees may be passed onto the household

In an integrated model HH pays the emptying fees for desludging, a single private operator/NGO is appointed for emptying, transport and treatment facility and the treated products are sold to an end use industry paying a purchase price. This type of model improves the efficiency of operations and optimizes the business model due to single source operations. There is less potential for illegal discharge as the treatment facility is self-run by the operator. This type of model high fees of emptying may be passed on to the HHs

Parallel tax and discharge fee model



PROS

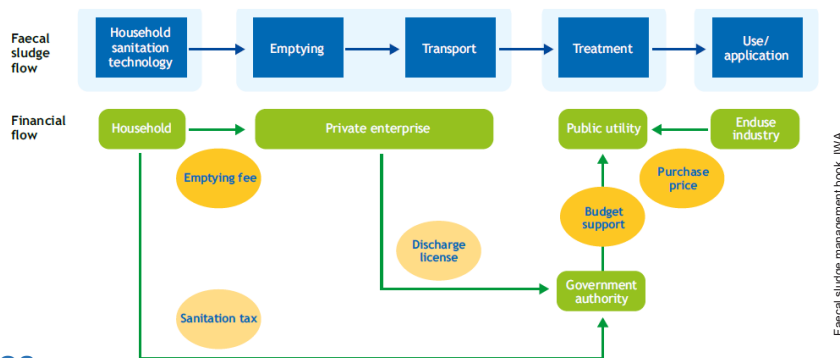
- + Low-income households' that are not connected to the sewer may have lower C&T costs from cross subsidies
- + C&T operators may benefit from lower discharge fees
- + Collection and coverage increases

CONS

- C&T businesses may avoid discharge fees by discharge illegally

In the parallel tax model there is sanitation tax/emptying fee for desludging by ULB / private contractors. The private operators have to pay discharge fees for disposing in the public utility. In this case government authority may take budget support to cover costs and keep the sanitation tax low. In this model the overall collection and coverage of services increases as the Conveyance and Transportation charges become low. The operator may benefit from discharge fee being lower. The discharge fee may result into illegal dumping

Dual licensing and sanitation tax model



PROS

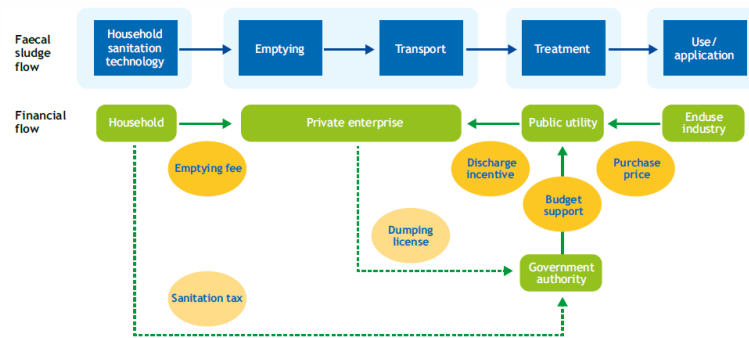
- + Industry regulation and legitimisation through licensing
- + Improvement in health and safety conditions
- + Unlimited discharges minimises risk of illegal dumping

CONS

- The management of too many aspects of the service chain by one entity could prove difficult

In the dual licensing model, the private operators have to pay a licensing fees for operations and a onetime discharge fees for discharge license to the ULB. This optimizes and brings in regulations for operations through licensing. This also gives the operators the benefit of unlimited disposal discharges at the treatment facility decreasing the risk of illegal dumping.

Incentivised discharge model



PROS

- + Emptying fees for households may be reduced;
- + Households that are difficult to access, or located far from the treatment plant, may become attractive to C&T operators because of incentives

CONS

- Incentives must be corruption proof (e.g. not given for diluted sludge etc.)
- FSTP operator requires significant budget support

In the incentivized discharge model, the private operators are given dual licensing along with incentive for discharging at the treatment plant. This incentive generates more revenue and in turn efforts for the private operator to carry out desludging. This model can help reduce emptying fees and also inaccessible and far away septic tanks also become attractive as they receive monetary incentive in addition to the emptying fees. For this model significant budget support is required by the treatment facility.

Bundling contracts

Advantages

- Ensures greater accountability.
 - SPOC
- Aligns performance incentives.
 - Increases efficiency of private sector
- Simplifies contract management.
 - Saves time and paper work to make service delivery chain functional

Disadvantages

- High non-performance risk
 - Non performance puts all activities at risk.
- Not a jack of all trades!
 - A single company might not have expertise in operating and managing complete service delivery chain.

Since integrated faecal sludge and septage management is based on sanitation value chain, performance in one part of chain affects the other part. Hence bundled contracts have tangible benefits over unbundled contracts.

Integrated FSSM plan is based on various activities or contracts which are a part of the service value chain. Performance in one component of the service chain affects the other component. Thus, when contracts are bundled they have tangible benefits over unbundled contracts as they are linked. The advantages of having bundled contracts are there is greater accountability, aligns performance incentives and simplifies contract management. The major disadvantage is it has high non-performance risk as non-performance across one components puts all activities at risk. Also, one single company may not have expertise across all components of service chain.

Lifecycle costing

Life Cycle Costing is widely accepted that the total economic cost of a given system is best determined by assessing both the capital and operational costs together over the entire life cycle of the system.

Lifecycle costing and FSTPs

The application of LCCA to FSTPs is particularly appropriate because of the significant cost variability that exists between different locations. Individual systems may have different CapEx and OpEx profiles depending on location, and therefore, should be assessed on a case by case basis.

There are three types of temporal LCC variations that have to be considered in the analysis of FSTPs:

- Initial capital expenditure (CapEx),
- Recurring costs i.e. Operation and maintenance expenditure (OpEx), and
- One-off replacement costs.

Lifecycle costing

LCC analysis across FSTPs

FSTPs	Capacity, KLD	CapEx, in Lakh INR	NPV - O&M in Lakh INR	NPV -LCC in Lakh INR	Total LCC in Lakh INR	LCC / year in Lakh INR	LCC / KLD in Lakh INR
Jabalpur	50	50.23	129.70	179.93	359.86	29.99	7.20
Devanahalli	6	70.90	118.69	189.59	346.67	28.89	57.78
Puri	50	73.90	193.01	266.91	533.83	44.49	10.68
Leh	12	52.20	119.63	171.83	343.66	28.64	28.64
Tenali	20	20.00	98.69	118.69	237.37	19.78	11.87
Phulera	20	239.45	163.39	402.84	805.68	67.14	40.28
Bhubaneswar	75	167.90	209.52	377.42	754.84	62.90	10.06
Warangal	15	110.00	229.17	339.17	678.34	56.53	45.22

- From the LCC analysis of the different technologies, it is evident that the technologies focusing primarily on liquid management are far lesser in the total LCC, when compared to technologies which focuses on both liquid as well as solids management.
- Phulera, Bhubaneswar and Warangal show total LCC, at about 3-4 times that of Jabalpur, Leh and Tenali.

Life Cycle Costing is widely accepted that the total economic cost of a given system is best determined by assessing both the capital and operational costs together over the entire life cycle of the system. The concept introduced a new level of transparency to costing, and exposed hidden costs with traditional costing methods. This approach makes it possible to determine the most cost-effective solution amongst alternatives by considering all cash flows over the lifetime of the system and allows practitioners to identify potential trade-offs between initial capital investment costs and long-term cost savings.

The results of the LCC analysis across the 8 FSTPs are presented in the table above.

4. Group exercise: Calculation of O&M for conveyance and treatment

Prepare FSSM plan for your city

Participants will plan for infrastructure that is required for implementing a FSSM plan for a city.

FSSM PLAN		
Sr.No	Description	No.
Input details		
A	Population	65251
B	Total households (HHs)	13112
C	HHs having toilets with septic tanks	9900
D	No. of community/ public toilets having septic tanks	21
E	Average volume of household and community toilet septic tanks (cum)	5
F	Septic tank cleaning cycle for HHs (Years)	3
G	Septic tank cleaning cycle for CT/PT (Days)	7
H	No. of working days in an year	300
I	No. of trips possible per emptying vehicle per day (trip/day/vehicle)	4

Input parameters based on previous group exercise to be considered for calculation of sanitation tax

Key outputs

- **Number of tanks to be emptied daily = 14 daily**
 - HHs toilets connected to septic tank / cleaning cycle for HHs = 3300 annually
 - HHs toilets to be cleaned daily = annual cleaning / number of working days = 11 daily
 - CTs connected to septic tank / cleaning cycle for CTs = 3 daily
- **Number of trucks required = 3.5~4 nos**
 - Number of tanks to be emptied daily / Number of trips per day = 3.5 nos
- **Volume of septage to be treated = 70 cum/day**
 - Average volume of HHs and CTs septic tanks x Number trips per day = 70 cum/day

Input parameters based on previous group exercise to be considered for calculation of sanitation tax

Tariff requirement to recover O&M

Step 1: O& M cost for schedule septic tank emptying service

1	Fuel cost for schedule emptying service = (Number of septic tank to be emptied daily*300* Average distance * 2 * Fuel price/ Fuel efficiency) - Assume Fuel efficiency for truck = 5 km per liter - Assume Fuel price = Rs . 4 er liter - Assume Average distance= 12 km	
2	Repair and maintenance cost = (Number of suction emptier truck requirement* 12 * 2,000) - Assume average repair & maintenance cost = Rs 2,000 per month	
3	Establishment expenses = ((Number of suction emptier truck requirement* 12 * No of manpower* Monthly Salary) - Assume, 2 manpower requirement per truck - Assume, Salary = Rs 10,000 per month	
4	Sub-total = (1+2+3)	
5	Overhead + Insurance + other Miscellaneous cost = Sub-total(4)*X% - Assume, other cost as X% of sub-total (4) (X = 15%)	
6-A	Total O&M cost for schedule septic emptying service = (4+5)	

Various operation and maintenance parameter calculations for conveyance (scheduled septic tank emptying service)

Tariff requirement to recover O&M

Step 2: O& M cost for septage treatment facility

1	Energy cost for Septage treatment facilities = (Energy cost per month * 12) Energy cost - < 25 cum/day = Rs 5,000 per month - 25-50 cum/day = Rs 10,000 per month - 50-75 cum/day = Rs 15,000 per month - > 75 cum/day = Rs 20,000 per month	
2	Repair and maintenance cost = (Avg. Repair & maintenance cost * 12) - Assume average repair & maintenance cost = Rs 10,000 per month	
3	Establishment expenses = (No. of manpower*Monthly Salary *12) - Assume, 4 manpower requirement (in 2 shifts) - Assume, Salary = Rs 10,000 per month	
4	Sub-total = (1+2+3)	
5	Overhead + Insurance + other Miscellaneous cost = (4*X%) - Assume, other cost as X% of sub-total (4) (X = 15%)	
6-B	Total O&M cost for managing Septage treatment facility = (4+5)	

Various parameters which needs to be considered during the calculation of operation and maintenance of treatment plant are given.

Key outputs

A. Annual O&M Cost = 6-A +6-B

B. Per property tariff requirement for septage management (annually) =

=Annual O&M cost (A)/(total properties* collection efficiency)

- Considering tax collection efficiency =70%
- Assume 1 households = 1 property
- Note: users may calculate differential tariff structure across property uses: properties with toilet facility v/s properties dependent on community toilet etc.

Annual cost of O&M is the key output of this exercise. On the basis of annual O&M cost, per property tariff required for septage management can be calculated.

Session

07

Interaction with State and ULB Officials

Objective:

To discuss learnings in implementation of FSSM with state and ULB officials

Format:

Presentation followed by discussion/Q&A

Duration:

60 minutes

Points to be covered:

- Interaction with senior State/City Officials to understand the overall process and implementation of FSSM.
- Interaction with Private Sector involved in emptying and technology for on ground implementation and challenges.

7. Interaction with state and city officials

Organization of interactive learning session with relevant stakeholders involved in the implementation of FSSM services for learning of the participants through experience sharing.

1. Interaction with Senior Officials from State/City

- Discussion on the detailed assessment and preparation of FSSM plan for the State/City based on ground conditions.
- Sharing learnings about advocacy and policy level decisions for implementation of FSSM plan pan State/city
- Understanding the viable technology options available and the instrumental decision-making process for finalization of emptying and technology selection.
- Discussion on the efforts implementation of FSSM plans.
- Discussion about implementation of FSSM plans on ground and challenges faced in operationalizing FSSM
- Discussion on the scope and involvement of private sector across the service chain
- Understanding the finances and fund allocation for FSSM planning and implementation
- Discussion on integration of services delivery across different components of the chain
- Share learning about performance and monitoring of FSSM service delivery across various components of value chain.

2. Interaction with Private Sector Stakeholders (Emptying and Technology)

- Understanding the system of schedule/demand based desludging in the city
- Discussion on daily challenges faced in on site implementation of desludging and the improvisations required to overcome the challenges
- Understanding the process of technology selected and implemented for septage treatment in the State/City
- Discussion on the operational challenges and functional costs for the technology

Session

08

Action Plans

Objective:

Formulation of a detailed action plan for respective cities

Format:

Group exercise

Duration:

30 minutes

Points to be covered:

- Formulation of action plans in groups based on learnings of 3 days:
 - Existing situation assessment
 - Source of funding
 - ULB level resolutions/ regulations
 - Demand/scheduled desludging
 - Site selection, technology selection
 - Stakeholder engagement
- Presentation of action plans prepared by each group

Group Exercise

	PLANNING AND OVERALL ADMINISTRATION	TECHNOLOGY	FINANCE	IEC ACTIVITIES
1				
2				
3				
4				
5				

Identify stakeholders
Mention timeline for all activities

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scbp.niua.org

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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