



सत्यमेव जयते

Ministry of Housing and Urban Affairs
Government of India

FAECAL SLUDGE AND SEPTAGE MANAGEMENT ORIENTATION MODULE

PART B: LEARNING NOTES

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Faecal Sludge And Septage Management — Orientation Module (Part B: Learning Notes)

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CONTENT

The module has been developed with the collaborative effort of NFSSMA partner organisations under Training Module Review Committee (TMRC) anchored by NIUA.

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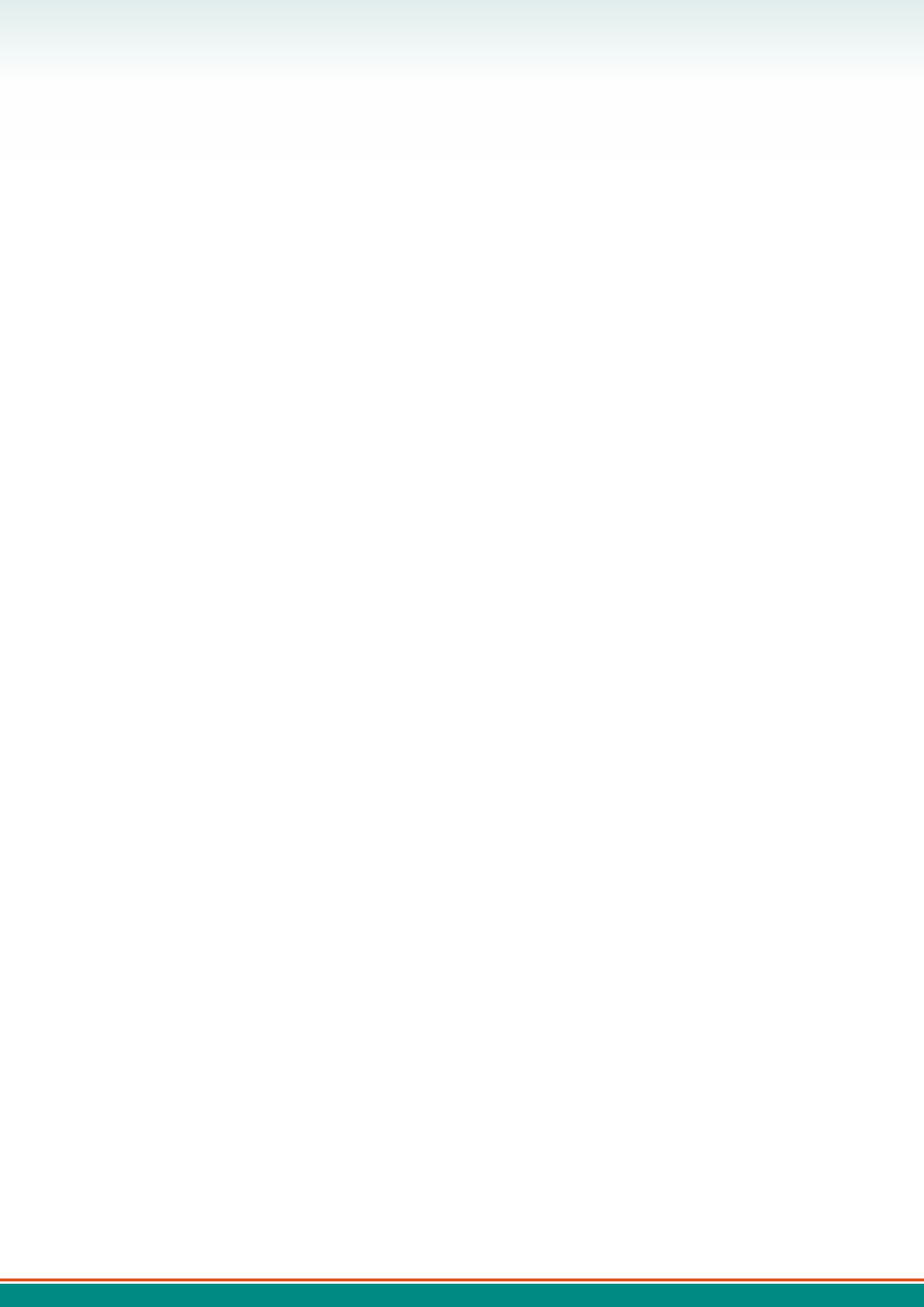
Ministry of Housing and Urban Affairs
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FAECAL SLUDGE AND SEPTAGE MANAGEMENT ORIENTATION MODULE

PART B: LEARNING NOTES

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:

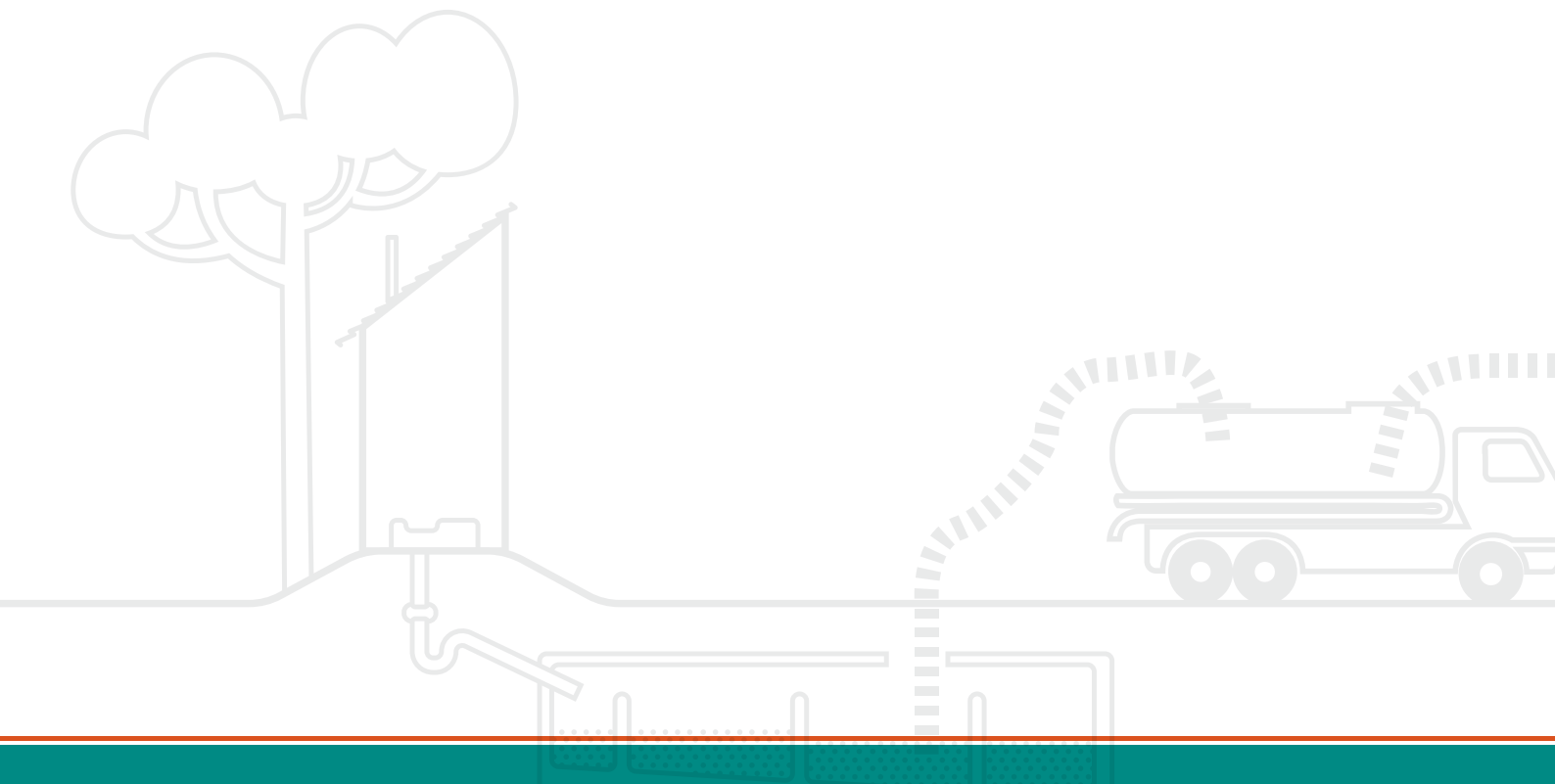
- Identification of priority stakeholders and accordingly training modules for Capacity Building
- Development of a Normative Framework – For Capacity Building at State Level
- Standardization of priority training modules – appropriate standardization of content with flexibility. for customization based 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	Faecal Sludge And Septage Management – Orientation Module for Uttarakhand
Purpose	<p>There are centralized and decentralized / on site systems of treatment of wastewater and septage. While conventional sewerage may be a comprehensive system for sewage collection and transport, it also is a highly resource intensive technology for CapEx and OpEx. Consequently, high capital cost and significant O&M cost of this system inhibits its widespread adoption in all sizes of urban areas.</p> <p>Decentralized FSTP are emerging as solutions to the challenge of addressing safe treatment and disposal of faecal sludge and septage. However, it does not imply that all small towns and cities need FSTP infrastructure.</p> <p>The Handbook attempts to instil a rational perspective for tackling urban sanitation challenge, without being prescriptive or offering single technology solutions. This is compendium of planning process and technologies involved in treatment of faecal sludge and septage considering solid and liquid treatment.</p>
Target Audience	Officials from State and Urban Local Bodies – Executive Officers, Junior and Mid-Level engineers, Sanitary Inspectors, SBM and AMRUT nodal officers, Elecetd Representatives
Learning Objectives	<p>The module aims to convey the following learning:</p> <ul style="list-style-type: none"> • Understanding the sanitation situation and need of FSSM at Uttarakhand state. • Understanding the different approaches and its applicability under different constraints to tackle these problems which covers the planning process of FSSM and its technical aspects. • Faecal sludge and septage quantification, characterization, emptying and conveyance and treatment solutions and its situation specific selection. • Designing of faecal sludge and septage treatment technologies and their applicability under different contexts. • Assessment and planning both technical and financial for FSSM at the city level.
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 any state depending on the profile of the participants, their areas of interest and time available for the training.</p>
Duration	The module is for one day orientation training. The duration and content can be altered depending on the profile of the participants, their areas of interest and time available for the training.

AGENDA

Activity	Material /Methods
9.30-10.00 hours	Introduction of Participants
10.00-10.30 hours	Introduction of participants & expectations
10.30-11.15 hours	Setting the context of FSSM for Uttarakhand State
11.15-11.30 hours	Tea/Coffee Break
11.30 –12.15 hours	FSSM policy and Septage Management Protocol, GoU
12.15 –13.00 hours	Challenges in Sanitation Systems in Uttarakhand
13.00-14.00 hours	Lunch Break
14.00-14.45 hours	Emptying and Conveyance of Faecal Sludge and Septage
14.45-15.45 hours	Treatment of Faecal Sludge and Septage
15.45 -16.00 hours	Tea/Coffee Break
16.00-17.00 hours	Planning and Financial aspects of FSSM
17.00 -17.30 hours	Wrap up - Feedback and closure



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Session

00

Introduction Session

1. Session Objectives

This session intends to:

- To create a pleasant environment for learning and sharing.
- To get to know each other.
- To establish training expectations.
- To present the objectives of the training.
- To list down the training ground rules.

2. Session Plan

Activity	Time	Material /Methods
Introduction of Participants	20 min	Flip charts, markers, colour cards
Icebreaking Activity	10 min	Statements related to FSM, Signs of Agree/Disagree.
Understanding participants Expectations	10 min	Colour cards, sticky posts, pens.
Introduction to the agenda	10 min	PowerPoint ,flipchart
Pre-evaluation form	10 min	Pre evaluation forms

Session time: 60 min

3. Learning Notes

3.1 Activity 01-Introduction of Participants:

This session recommends a particular way of introducing participants to one another. Any other appropriate method may be used, provided the participants enjoy themselves, gain some useful information about one another and remember one another in future.

Welcome the participants; briefly introduce yourself and other organisers of the training. The workshop should start with a round of introductions as an 'ice breaker': as a minimum, everyone in the group should take turns to state their name, where they work and their role. If wanted, people can add something a bit more personal about their background. The following are some examples:

Introducing your neighbour: Allow about 20 minutes depending on workshop size. Ask all participants to select a partner for this ice-breaker, ideally someone they have never met before. Give the participants ten minutes to have a conversation with each other (five minutes for each interview) so that they can introduce their partner to the rest of the group. Give each participant about one minute to introduce his or her partner .Make a note of people's names as group members introduce themselves on flip-chart paper and keep it visible as an aide-mémoire.

Circle method: Make the participants stand in two circles facing each other. Tell them to move and stop with the music that will be played for this game. They may infer, or you can point out, that their partners will keep on changing. Each circle moves clockwise when the music is played. When the music stops, each participant pairs with the one opposite her, ask the other's name, address and something about the women's groups she has known or belongs to. Start the music again. When the music stops, participants form new pairs and ask each other the same questions. It takes ten minutes to complete one round. Organize a maximum of three rounds. Ask the participants to sit down after two or three rounds.Make sure that all participants are introduced. It is good if the trainer/s joins the group activity. If the trainer does not play the game, then at the end s/he must introduce herself/himself too. Joining the participants in the game or singing with them establishes quick rapport between trainer and trainees.

It is important to encourage participants to be informative but concise. Activities generally take longer within larger groups. Allowance needs to be made for this as there may be less time for individual contributions.

3.2 Activity 02- Icebreaker:

Generally, ice-breakers are used to facilitate and enhance the training environment. This session will help in understanding the participant's views on faecal sludge management. Prepare in advance two signs with the words “agree, “disagree” and place them on two opposite walls in the room. Ask participants to stand up. Stand at the centre of the room and read aloud the statements (Refer ANNEX01 for sample statements). Ask participants to move across the place depending on their opinion to the statement introduced. E.g., the more they agree or disagree with confident states, the closer to the wall with that sign they should move. If all the participants agree on a statement, try to spice up the exercise by walking over to the opposite side of the room and asking, “Why would anyone be standing on this side of the room? Moderator should try to engage all the participants to take a stand. However, if some of them do not feel comfortable expressing their opinion or do not have opinion on a certain subject, allow them to stand in the middle of the room as an “undecided” group.

Another way of doing the activity to do a snow bowl exercise. Moderator can throw questions on what the participants know about septic tanks. Questions can be directed by following set of questions like what is the size of septic tank, how it fills up, calculate over number of years and what happens to disposal when desludged. This will help participants to discuss in groups and set the momentum for the training.

3.3 Activity 03-Understanding Participant's Expectations

This activity is to get a better understanding of the participants' expectations of the training and to clear the objectives of the training. Hand out two sticky posts /colour cards to each participant. Ask them to think what they expect from the training, e.g., asking themselves “What do I want to bring home from this training?” Instruct them to write their expectations on a sticky post/color card. Ask them to stick the sticky post or color card on the flipchart (or other designated space in the room). Read some of the most common expectations out loud.

Present with the help of a PowerPoint to explain participants what were the pre-set objectives of the training and how they will converge with their expectations. If some expectations cannot be met, make sure to discuss that with the participants, explaining to them why specific topics will not be covered.

3.4 Activity 04-Introduction to the Agenda

Present the participants with the agenda of the training and discuss with them any outstanding issues. Inform participants about the training methodology, which is interactive, participatory and based on adult and experiential learning. Encourage them to participate through the training. Powerpoint can be used as a tool for the session.

It will be an ideal session to explain the set objectives for the training. As it is an orientation module, explain the objectives and outcome expected from the training.

3.5 Activity 05-Pre-evaluation Form

A pre-evaluation form is a method for evaluating training programs regarding improving the knowledge of the participant. Identical tests may be used for pre- and post-tests to compare scores before and after the training. A sample question paper is given in Annexure 01 for reference.

Trainers can add and reduce the number of questions as per the targeted audience.

Before moving on to the second session, clarify 'housekeeping' issues including:

- Toilet facilities
- Fire procedure, emergency exits and whether any routine fire testing is expected
- Off/silence mobile phones/bleepers
- Smoking policy
- Start and close times
- Any other practicalities

Establish ground rules including topics such as:

- Confidentiality
- Respect
- Open to differing views
- Constructive challenging
- Being present
- Timekeeping
- Responsibility for learning
- Participation, not domination
- One person to talk at a time

Make explicit the kind of behaviour expected, so that is easier to deal with unhelpful behaviour later (if it occurs). Write up ground rules on the flipchart to use as a reference for discussion and clarification.

Session

01

Urbanisation and Sanitation

1. Session Objectives

This session intends to:

- Understand the sanitation service chain
- To understand urban sanitation and the associated challenges
- To learn from strategies adopted by some states to achieve ODF cities
- To understand difference between black and grey water as well as sludge and septage
- To comprehend the concept of Faecal sludge management
- To illustrate National/State level Policies and Programs, Manual Scavenging, Gender and Social Concerns

2. Session Plan

Activity	Time	Material /Methods
Sanitation Systems	30 min	PowerPoint, flipcharts
Policy and programmes	30 min	PowerPoint, flipcharts

Session time: 60 min

3. Learning Notes

3.1 Activity 01-Sanitation Systems

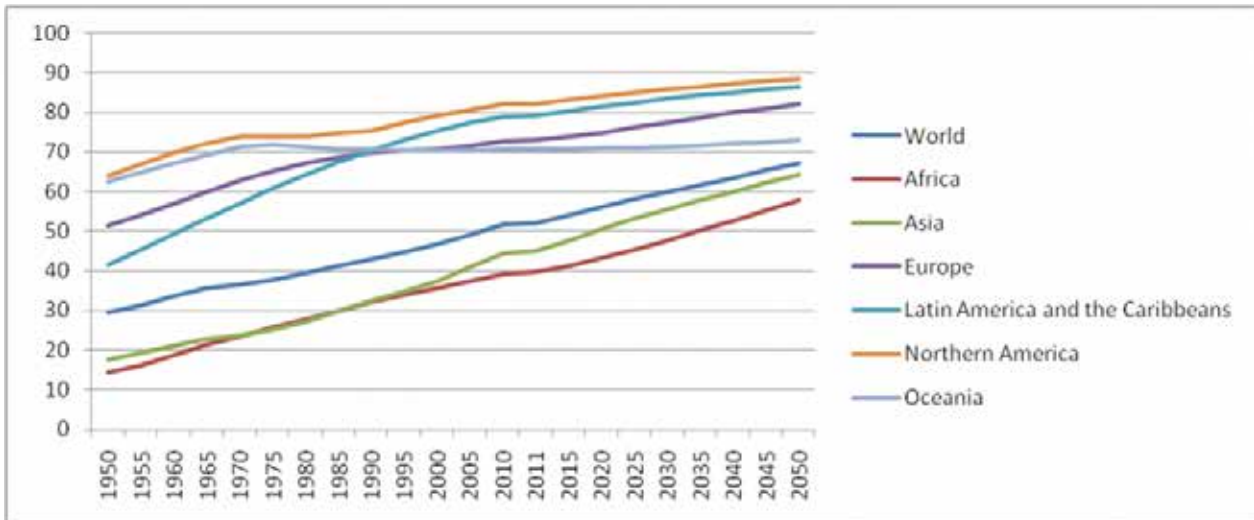
The session will cover on the background of global perspective of Urbanisation and sanitation with a focus on defining the concept of faecal sludge management.

Urbanisation

Urbanisation is one of the most important demographic trends of our time. In 2008, the number of people living in urban centres worldwide has for the first time surpassed the number of people living in rural areas. Today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050. Projections show that urbanization, the gradual shift in residence of the human population from rural to urban areas, combined with the overall growth of the world's population could add another 2.5 billion people to urban areas by 2050, with close to 90% of this increase taking place in Asia and Africa, according to a new United Nations data set launched today.

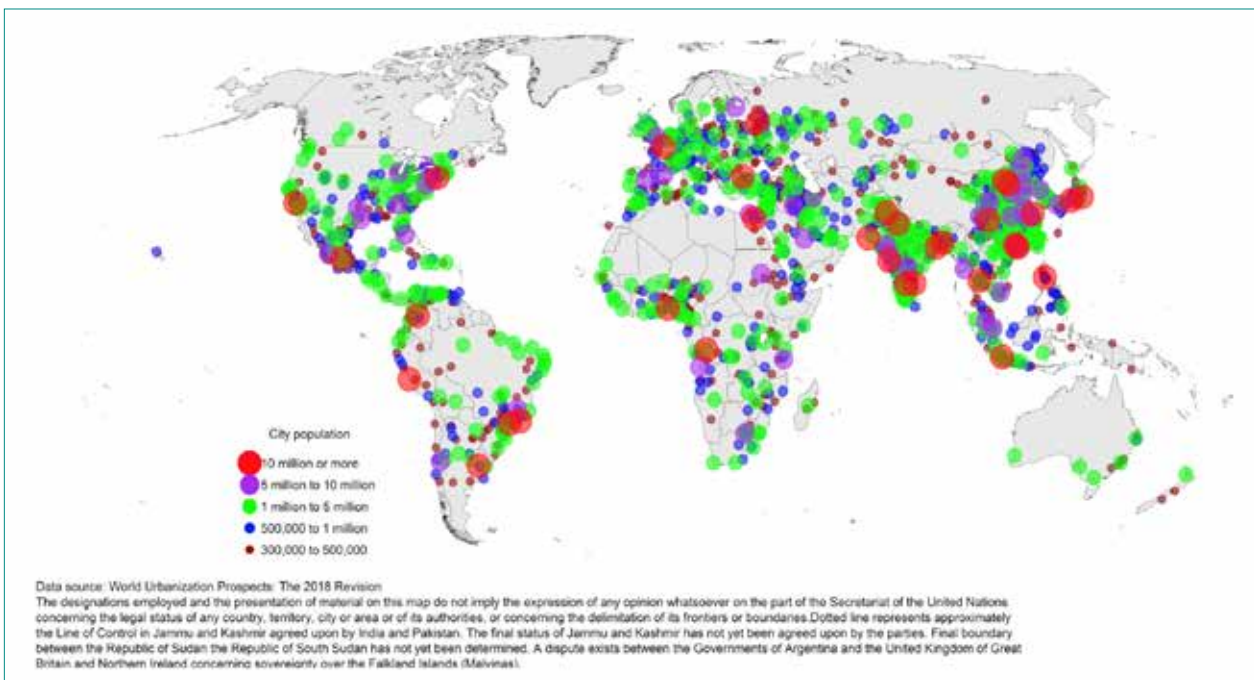
The 2018 Revision of World Urbanization Prospects produced by the Population Division of the UN Department of Economic and Social Affairs (UN DESA) notes that future increases in the size of the world's urban population are expected to be highly concentrated in just a few countries. Together, India, China and Nigeria will account for 35% of the projected growth of the world's urban population between 2018 and 2050. By 2050, it is projected that India will have added 416 million urban dwellers, China 255 million and Nigeria 189 million.

Figure 1: Urbanisation trends and estimates in major regions of the world (in % from 1950 to 2050)



Source: UN-DESA (2010) and UN-DESA (2011)

The urban population of the world has grown rapidly from 751 million in 1950 to 4.2 billion in 2018. Asia, despite its relatively lower level of urbanization, is home to 54% of the world's urban population, followed by Europe and Africa with 13% each. Today, the most urbanized regions include Northern America (with 82% of its population living in urban areas in 2018), Latin America and the Caribbean (81%), Europe (74%) and Oceania (68%). The level of urbanization in Asia is now approximating 50%. In contrast, Africa remains mostly rural, with 43% of its population living in urban areas.



Four main factors are responsible for urban growth: a) the natural demographic growth of urban populations b) the absorption of rural settlements located at the edges of expanding cities, c) the transformation of rural towns into urban centres and d) migratory movements from rural areas to cities.

Urbanisation represents a challenge for water and sanitation management in developed as well

as in developing countries. While cities in developed countries often struggle with high operation and maintenance costs and the decay of existing infrastructure, rapid urban growth in the developing world is seriously outstripping the capacity of most cities to provide adequate services for their citizens (COHEN 2006). In rapidly growing urban slums where there is no planning and few facilities, the number of people living without access to basic water and sanitation services is still increasing. This is of particular concern considering that the WASH sector represents the foundation on which broader goals of poverty reduction, environmental sustainability, social development, and gender equality must be built (BIRCH et al. 2012)

For the past decade, the pace of urbanisation has picked up steadily. Currently, more than half of the world's population of 3.9 billion people, or nearly 54 percent, live in towns, cities, and megacities. This number is expected to grow to two-thirds by 2050. As urbanisation is a must for economic growth, the rate of people's migration to cities is now happening at a breakneck speed, in the process putting enormous pressure on the ability of cities to provide adequate infrastructure to support the burgeoning population.

According to estimates released by UN-Habitat, more than one-third of the developing world's urban population of over 863 million people lives in slums. As city infrastructure starts to crumble under pressure, availability of adequate sanitation facilities becomes the first casualty. Due to an acute shortage of adequate toilets, nearly 100 million people globally are being left with no other option but to practice open defecation. The remaining 600 million people rely on toilets that do not fulfil the minimum requirements of hygiene, safety or privacy — including dirty and crowded communal toilets. It is estimated that almost one-fifth of all urbanites — that is nearly 700 million people live without a decent toilet. To put that into perspective, the queue for people waiting for toilets globally would stretch around the world 29 times! These severely compromised sanitary conditions are not only damaging the environment but also posing a real-time health risk to the people in the form of infectious diseases, such as cholera and more.

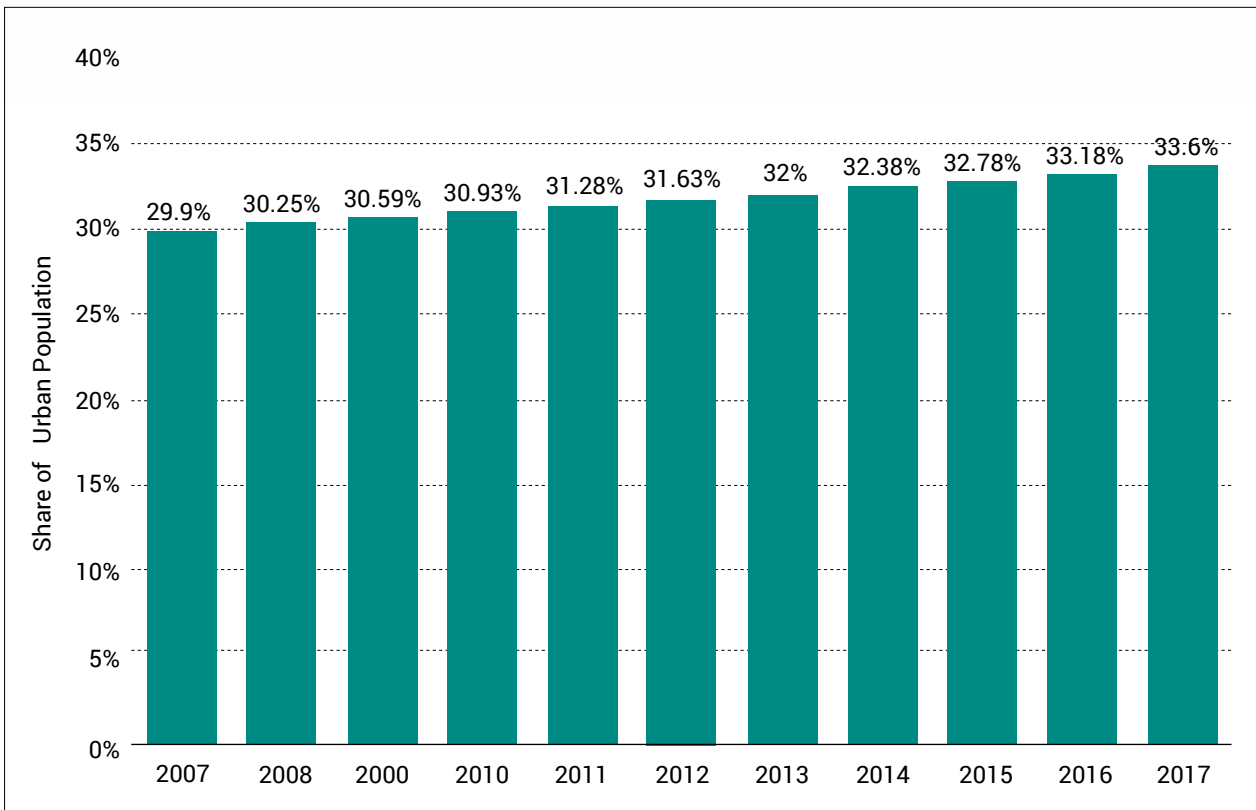
Urban Sanitation In India

Level of Urbanisation

Among all the States and Union territories, the National Capital Territory of Delhi and the Union territory of Chandigarh are most urbanized with 97.5 percent and 97.25 percent urban population respectively, followed by Daman and Diu (75.2 percent) and Puducherry (68.3 percent). Among States, Goa is now the most urbanised State with 62.2 percent urban population, a significant increase since 2001 when urban population of Goa was 49.8%. Another significant instance of rapid urbanisation is that of Kerala, its urban population is now 47.7 per cent, while a decade ago it was just 25.9 percent. Among the North-Eastern States, Mizoram is most urbanised with 51.5 per cent urban population, though in terms of absolute contribution to total urban population in the country, Mizoram's contribution is just 0.1 percent. Similarly Sikkim, which was just 11.0 urbanised a decade ago became almost 25 percent urbanised in 2011. Among major states, Tamil Nadu continues to be the most urbanized state with 48.4 percent of the population living in urban areas followed now by Kerala (47.7 per cent) upstaging Maharashtra (45.2 percent) (MoHUA, 2019).

The proportion of urban population continues to be the lowest in Himachal Pradesh with 10.0 per cent followed by Bihar with 11.3 percent, Assam (14.1 percent) and Orissa (16.7 percent). In terms of absolute number of persons living in urban areas, Maharashtra continues to lead with 50.8 million persons which comprises 13.5 percent of the total urban population of the country. Uttar Pradesh accounts for about 44.4 million, followed by Tamil Nadu at 34.9 million.

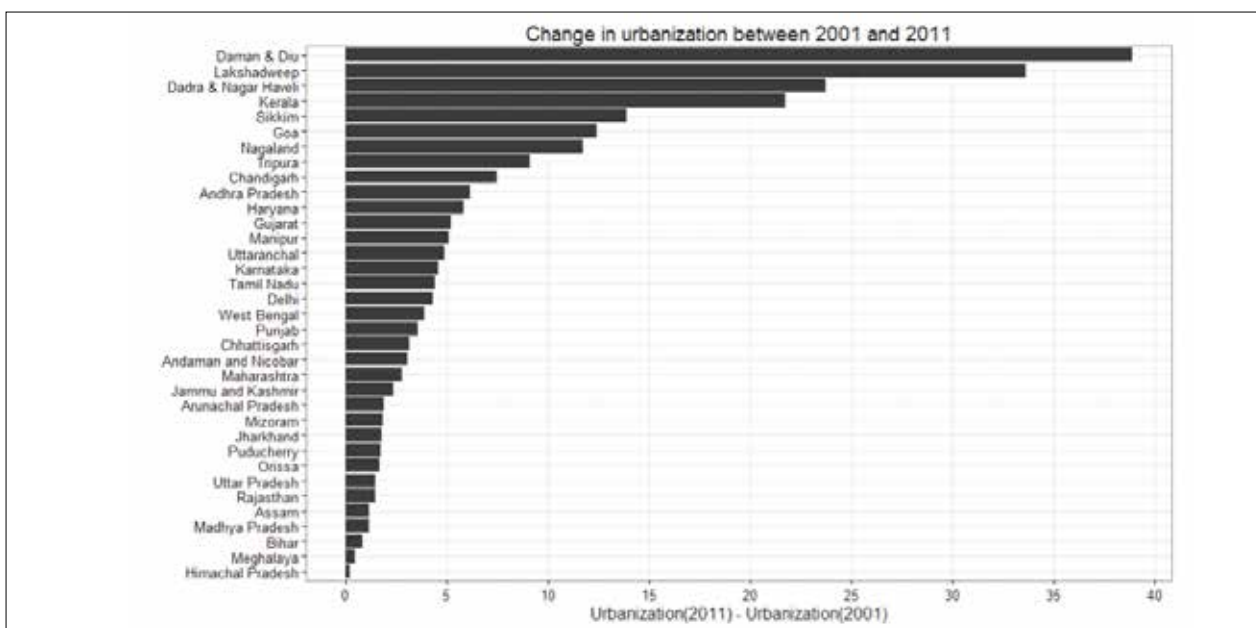
Figure 2: India- Degree of Urbanisation 2007-2017



Source :Statista ,2019,web:<https://www.statista.com/statistics/271312/urbanization-in-india>

The statistic shows the degree of urbanization in India from 2007 to 2017 and details the percentage of the entire population, living in urban areas. In 2017, approximately 33.6 percent of the total population in India lived in cities.

Figure 3: The State Urbanisation Status 2001-2011



Source :URL

The Challenge of Water Supply and Sanitation in the Context of Urbanisation

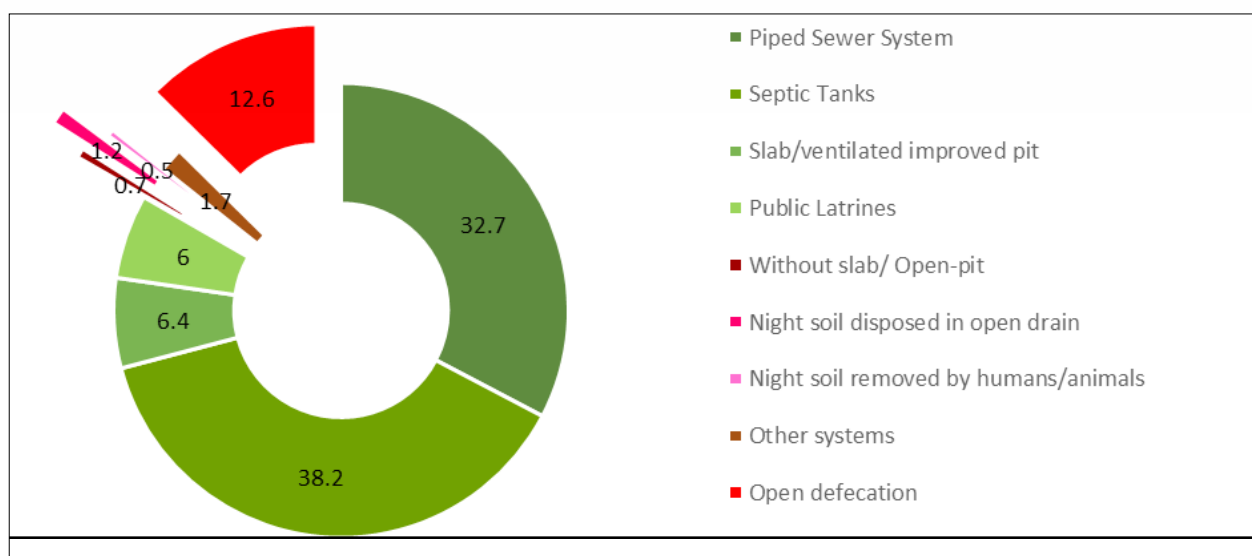
Conventional urban water supply and sanitation management is generally characterised by an unsustainable use of water and nutrients. This represents important environmental, economic and social challenges, which are intensified by the process of urbanisation.

- **Disruption of the natural water cycle:** The conventional urban water cycle is characterised by a linear infrastructure that transports clean water into and wastewater out of urban neighbourhoods. Due to a high percentage of sealed soil and thus impervious surfaces, evapotranspiration and groundwater recharge are reduced and low quality surface runoff is increased – utilities are often left to deal with extremely large volumes of water, especially during wet weather (CORCORAN et al. 2010). Climate change will further intensify these challenges in many regions as it will lead to more erratic patterns of droughts and storms.
- **Pollution of water sources:** Urban settlements are the main source of point source pollution (UNESCO et al. 2004). It is estimated that more than 90% of sewage in the developing world is discharged directly into rivers, lakes, and coastal waters without treatment of any kind (LUETHI et al. 2009). In low- and middle-income countries, leaking on-site sanitation facilities together with the absence of sewerage pipes that dispose the wastewater, result in large volumes of local wastewater soaking into the soil, and eventually seeping into aquifers and polluting groundwater (GROENWALL et al. 2010).
- **Depletion of groundwater sources:** In urban settings, the use of shallow groundwater sources is an especially common feature of many low-income communities in low- and middle-income countries. More than half of the world’s megacities depend on groundwater
- **Broken nutrient cycles and impoverished soils:** The “end-of-pipe” paradigm discourages recovery and reuse so that nutrients are lost to water bodies. This waste of valuable resources can lead to eutrophication and cause algal blooms and a depletion of oxygen in receiving water bodies (HOWE et al. 2011). In Africa, 85% of arable land is losing an average of 30kg of nutrients per hectare per year (LUETHI et al. 2009).
- **Waste of resources:** Water treated to potable water is used for non-potable purposes such as toilet flushing, garden use and industry. When water is heavily subsidised or charged based on a fixed rate, users have little financial incentive to use it sparingly (HOWE et al. 2011).
- **High water demand:** The concentration of a great quantity of population and activities on a small area involve the need of a great amount of good quality water (CHOCAT 2002). Urban areas usually have a higher per capita consumption of water compared to rural areas. Water demand is additionally increased as urban population grows and per capita water consumption in many cities is on the rise.
- **Cost-intensive infrastructure for water supply and wastewater collection:** The increase of urban population asks for a continuous expansion of water networks and wastewater networks. Centralised networks are very cost-intensive in terms of construction, operation and maintenance. If the networks are not sufficiently maintained, leakages lead to a loss of valuable resources, unreliable or irregular water supply and low revenue collection for the utilities. Many large cities suffer from chronic water shortages due to over-exploitation of raw water resources, and to losses of water, which sometimes reach up to 60% of the volume of water supplied (UNESCO et al. 2004).

As per the Census 2011, every one out of five HHs in urban areas does not have a HH toilet and have to depend on shared facilities. About 17.4% of the urban population dwells in slum areas with 36.1% being in notified slums, 27.6% in recognized slums and 36.3% in identified slums. The coverage of individual toilets in slums is 66% at the national level which is very low as compared to the coverage of 81.5% at a pan-city level. A majority of these HHs thus have to depend on using a community or a public toilet¹.

¹ http://censusindia.gov.in/2011census/hlo/Data_sheet/India/Latrine.pdf

Figure 5: Types of Toilets in India



Source: Census 2011

However, over the past few years, India has witnessed an unresidential momentum to tackle sanitation challenges and seen impressive achievements in making cities open defecation free under the Swachh Bharat Mission. As on June 2021, over 62 lakh individual household toilets have been constructed with 6.0 lakh community toilets in order to make 98% of our cities open defecation free. However, the question remains as to what happens to the wastewater after it is flushed down the toilet? Focusing only on toilet construction leads to a situation where most of the waste remains untreated.² Untreated waste is one of the main factors for the spread of water borne diseases which are a major cause of infant and child mortality in India.

Figure 6 Status of Open Defecation Free Status as per 29th June 2021



Source: MOHUA, "Swachh Bharat Mission Urban – Dashboard" Retrieved from <http://swachhbharaturban.gov.in/dashboard/> on 29 June 2021

However, there are several challenges such as social and caste hierarchy, fragmented institutional roles and responsibilities, lack of an integrated city-wide approaches and reaching the un-served and the poor.

² MoHUA, GoI. (2020). *Advisory On On-site And Off-site Sewage Management Practices*. Retrieved from <https://scbp.niua.org/?q=content/advisory-site-and-site-sewage-management-practices-cpheeo-goi-0>

Urban Sanitation: What are the Challenges?

The challenges fall into four categories

- Low infrastructure
- Service coverage
- Low service usage
- Weak institutional arrangements

Low Infrastructure Coverage

South Asia contains more people without safe sanitation than any other region in the world. While infrastructure coverage is gradually improving, it has so far failed to keep pace with the rate of urban growth. In India, it is estimated that 17 percent of the urban population currently has no access to any sanitary facilities at all, while 50–80 percent of wastewater is disposed of without any treatment (National Urban Sanitation Policy, 2007).

It may take several decades for sewerage and other sanitation services to become available to all of urban India. In the meantime, the vast majority of urban residents (around 70%) will remain dependent on on-site sanitation facilities such as pour flush toilets discharging to leach pits or septic tanks. Municipal sanitation plans should, therefore, include measures to improve on-site sanitation—otherwise, they will meet the needs of just a small portion of the city.

Municipal planners should also recognize that the worst sanitary conditions tend to be found in poor areas. Construction of a toilet is generally regarded as the householder's responsibility but, for poor households, investments in sanitation are often constrained by issues relating to:

- Affordability, including the cost of connecting to sewer networks;
- Uncertainty over land tenure (fear of eviction)
- Space constraints
- The low priority is given to sanitation (people may not appreciate its importance)

Special measures may, therefore, be needed to support service improvements for the poorest sections of the community. This does not just mean subsidies and awareness campaigns; technology options are also required that suit the physical conditions in poor neighbourhoods.

Limited Access to Services

- Official coverage figures do not, on their own, give the full picture regarding access to sanitation services. Existing arrangements can be deficient in many ways.
- There may be a complete lack of facilities. For example, there may be settlements with no toilets at all, while facilities for the safe emptying of septic tanks, and the treatment of septage, may be lacking across the entire town.
- Sanitation facilities may be available but could be inconvenient, unpleasant or unhygienic. This may be the result of inappropriate design or construction or inadequate management arrangements. Poor management is often a problem with community toilet blocks.
- Sanitation facilities may be available, but some people have limited access to them. For example, people may not be able to afford to connect to an existing public sewer.
- Sanitation facilities may be in place but are not operated or maintained properly. Poor operation and maintenance of a facility shorten its useful life and could, at worst, result in rapid total failure.
- There may be no provision for the treatment of wastewater or excreta. Local drains and sewers may relocate waste to another part of town where it causes local pollution. Households are primarily concerned about the cleanliness of their immediate surroundings and much less worried about the wider impact on the environment

Low Service Usage

Even where toilets are available, some are not used or are underused, with family members defecating outside most of the time. This might be because the facilities are unacceptable in some way (for example, people may not be willing to share toilets), or because there is a long-held preference for open defecation. Alternatively, people may underuse their toilet because of misunderstandings about its functioning and maintenance.

In the case of twin-pit pour-flush toilets, for example, some people fear that the pits will fill rapidly if the toilet is used too often; and they may not know that the contents of a full pit can safely be removed manually once they have been given time to degrade. Such problems indicate the need for effective communication in sanitation programs, so that community awareness, preferences, and behavior are appropriately understood and then addressed through information, advice, and hygiene promotion.

Weak Institutional Arrangements

State agencies and municipalities sometimes make huge investments in sanitation infrastructure, but these do not always deliver their intended benefits. There can be several reasons for this, for example:

- The investments are made on an ad hoc basis when funds become available, without reference to an overarching strategy or plan.
- Within the state government and municipalities, sanitation has no ‘institutional home,’ meaning that no single department or agency is accountable for it. Responsibilities for different aspects of sanitation are often assigned to many agencies, and coordination between them is not always good. There have been cases, for example, where a state agency has developed a sewage treatment plant even when there are no sewers in the town, then handed it over to a municipality that does not have the technical capacity or financial resources to operate and maintain it.
- Significant capital investments are rarely matched with detailed arrangements—both practical and financial—for future operation and maintenance.
- Improvements are often implemented on a norms basis, meaning that technologies are selected without reference to local conditions or the preferences of users. Therefore, the new facilities may not function properly, or may not be used as intended.
- Especially in smaller towns, municipal and line agency staff tend to have limited technical expertise or awareness of the range of non-technical factors that affect the outcome of sanitation investments.

Shift towards Citywide Inclusive Sanitation

Considering the current sanitation scenario calls for a paradigm shift in the sanitation approach moving from conventional to a public service approach. Achieving equitable and sanitation service delivery is not possible with a single approach. Citywide Inclusive Sanitation (CWIS) is an urban sanitation approach, which ensures everyone in a city has access to sustainable and safely managed sanitation by promoting a range of solutions—both onsite and sewerred, centralized or decentralized—tailored to the on-ground situation of the cities. Instead of focusing on infrastructure, CWIS focusses on service provision and its enabling environment (Gambrill et al., Citywide Inclusive Sanitation—Business as Unusual: Shifting the Paradigm by Shifting Minds, 2020).



CWIS brings various evolved thinking of urban sanitation under one umbrella

Source: <https://az659834.vo.msecnd.net/eventsairseasiaproduct/production-adb-public/71f43c077b5742ea92692cc9eb86aece>

CWIS is based on the four building blocks:

(1) Prioritization of the right of all to sanitation, with inclusive strategies reaching informal settlements and vulnerable populations; (2) Delivery of “safe management” along the entire sanitation service chain by focusing on service outcomes rather than technologies, and by embracing innovation and incrementalism; (3) Recognition of sanitation’s contribution to a thriving urban economy by integrating sanitation into urban planning, reforming regulatory policies, and embracing resource recovery and reuse; and (4) Commitment to work in partnership across sectors and stakeholders to make progress through clear institutions with accountability, embedding sanitation within urban governance systems (citywideinclusivesanitation.com).

Thus CWIS being a public service approach helps to advocate the following principles (Narayan and Lüthi, Solving Urban Sanitation – Sustainably and Equitably, 2020):

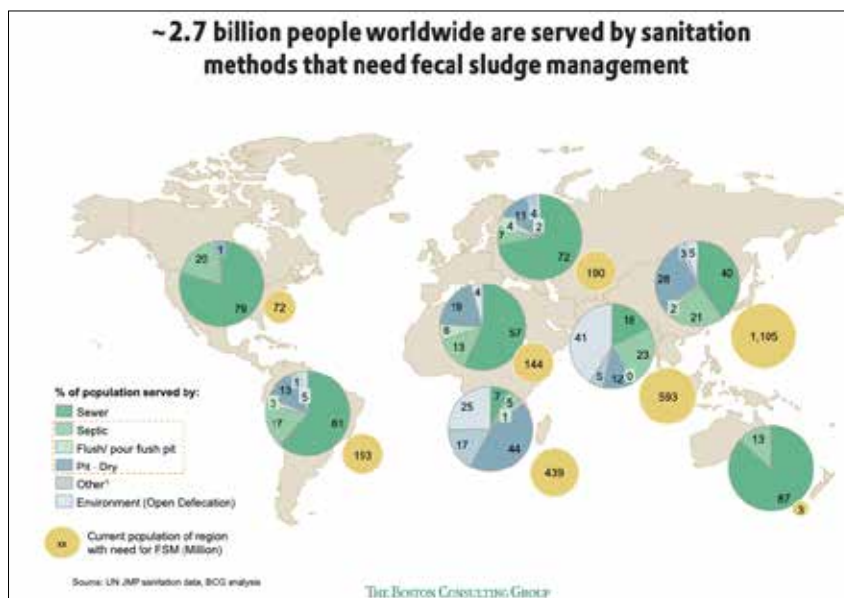
- **EQUITY:** Everyone in an urban area including communities marginalised benefit from equitable, affordable, and safe sanitation services
- **COMPREHENSIVE PLANNING:** Inclusive and holistic planning with participation from all stakeholders along with short-and long-term vision and incremental perspective and synergistic with other urban development goals
- **ENVIRONMENT AND PUBLIC HEALTH:** Human waste is safely managed along the entire sanitation service chain, starting from containment to reuse and disposal
- **MIX TECHNOLOGIES:** Variety of sewerred and non-sewerred sanitation solutions coexist in the same city, depending on context and resource recovery potential
- **MONITORING AND ACCOUNTABILITY;** Authorities operate with a clear, inclusive mandate, performance targets, monitoring requirements, human and financial resources and accountability
- **MIX BUSINESS MODELS:** Sanitation services deployed through a range of business models, funding sources, financial mechanisms to reach all equitability

Defining faecal sludge, on-site sanitation and FSM?

A sanitation system deals with human excreta from the time it is generated until it is used or disposed of safely. Faecal sludge management includes emptying, transportation, treatment, and use or disposal of faecal sludge from an on-site sanitation technology (like a pit latrine or septic tank). It addresses the last three components of a non-sewered sanitation system. Faecal sludge management is a relatively new term and field that is gaining increased acknowledgement in the sanitation sector. The following definitions help explain the scope of faecal sludge management:

- Excreta is urine and feces that are not mixed with any flush water. An on-site sanitation technology is made up of the parts included in the first two components of a sanitation system: user interface and excreta storage. Excreta is collected and stored where it is produced (for example, a pit latrine, septic tank, aqua privy, and non-sewered public toilets). Often, the faecal sludge has to be transported off-site for treatment, use or disposal.
- **On-site sanitation** is a system of sanitation whose storage facilities are contained within the plot occupied by a dwelling and its immediate surrounding. For some systems (e. g. double-pit or vault latrines), faecal matter treatment is conducted on site and also by extended in-pit consolidation and storage. With other systems (e. g. septic tanks, single-pit or vault installations), the sludge has to be collected and treated off-site. (WHO, 2006)
- **Faecal sludge (FS)** comes from onsite sanitation technologies, and has not been transported through a sewer. It is raw or partially digested, a slurry or semisolid, and results from the collection, storage or treatment of combinations of excreta and blackwater, with or without greywater. Examples of onsite technologies include pit latrines, unsewered public ablution blocks, septic tanks, aqua privies, and dry toilets. FSM includes the storage, collection, transport, treatment and safe enduse or disposal of FS. FS is highly variable in consistency, quantity, and concentration. (Strauss et al., 2002)

Figure 7: Percent of Population Served by Onsite Sanitation Technologies



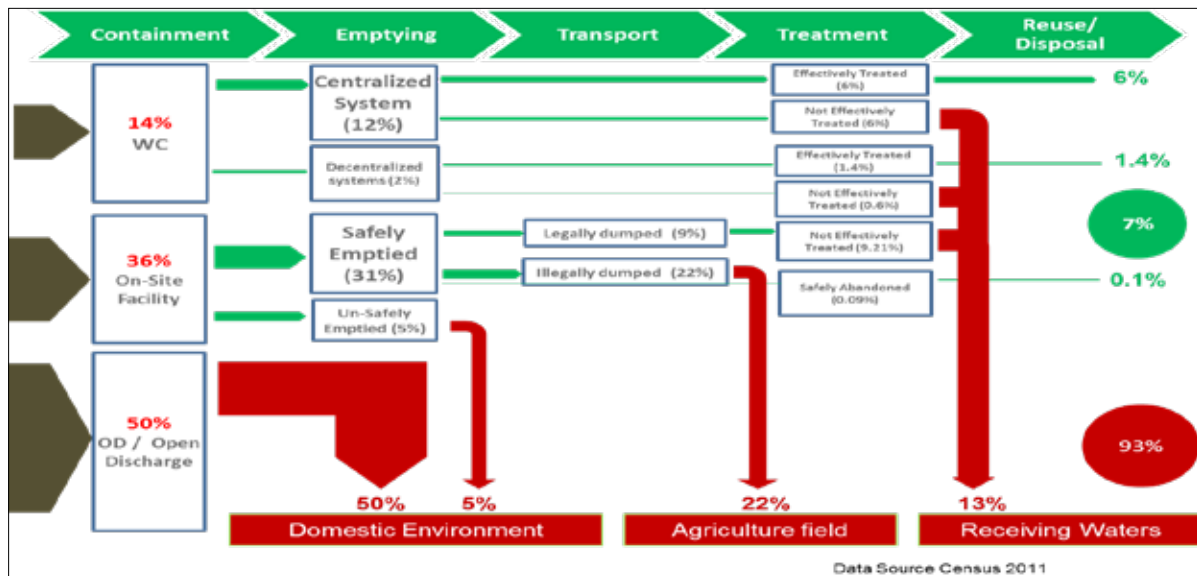
Source: EAWAG, 2014

Shit Flow Diagram

- As per the Census of India 2011, 31.16% of the country was urbanized. Linkages in the sanitation value chain in urban India have been patchy. A shit flow diagram of urban India reveals that only 6.7% of all waste water generated in cities of India is safely disposed⁴. A staggering 93.3% of the waste water is either discharged in the open or agricultural fields or in water bodies.

Only 50% of all the waste water is emptied through centralized systems and emptying of OSS systems. Out of this 50%, 34.8% of the waste water is then conveyed to a treatment or disposal site and only 6.6% is treated.

Figure 8: Shit Flow Diagram



Data source: Census 2011, Data Analysis: (Consortium for DEWATS Dissemination Society)

3.2 Activity 02-Policy and programmes

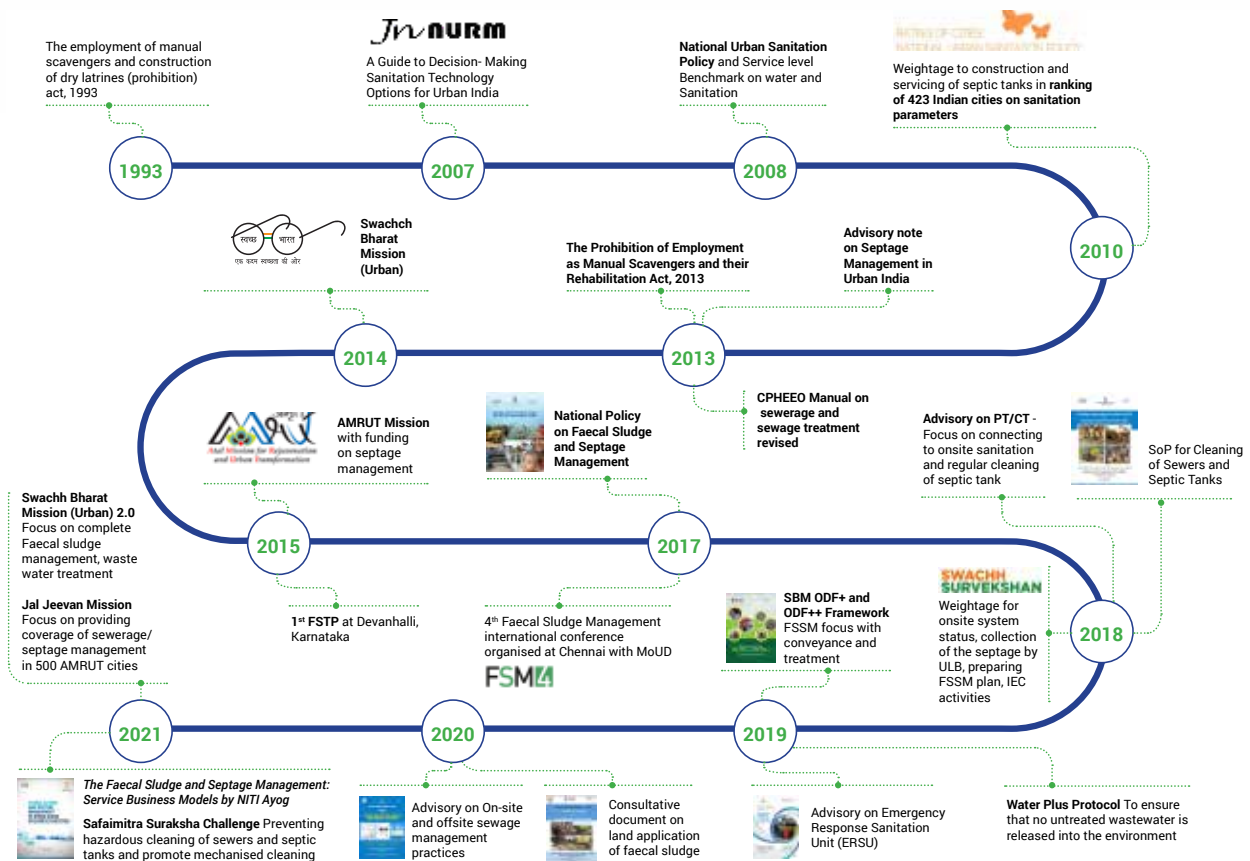
Sanitation has been at the forefront of urban policy in India in recent times. The need to improve sanitation, however, was realised much earlier. Post-independent India was constantly struggling with its image as the symbol of insanitary living conditions. It was not long before the planning commission noted the magnitude of the problem by identifying the blatant disregard for sanitation in the development of towns by local authorities (First Five Year Plan, 1951). But urban policy on basic services in India traditionally linked sanitation with water supply, largely focusing on sewerage services. The Fourth Five Year Plan (1969-74) acknowledged that the “problems of sanitation require to be dealt with on a long term basis” The Sixth Plan (1980-85) finally recognised that urban development is inescapably connected with the provision of safe water supply and adequate sanitation and stated that the position in regard to urban sewerage and sanitation is even less satisfactory than water supply.

History of Sanitation Efforts and the Shifting Paradigm towards FSSM

Sanitation was included as an agenda item in Government of India’s First Five Year Plan (1951-56), but the focus of the Central Government in the fifties was largely on housing and redevelopment of slums. The Slum (Clearance and Improvement) Act was formulated during this period. In the sixties and seventies, urban policy in India began taking a more concrete shape. There was a huge focus on promoting planned development of cities through the implementation of master plans. By eighties, when the 1981 Census revealed that 23.3% of Indian population lived in cities, most cities were characterized by lack of infrastructure, planning and unimproved sanitation facilities.

³CDD. (2016). *Faecal Sludge Management in India: Case of Devanahalli*. Retrieved May 2017, from <https://smartnet.niua.org>

Figure 9: Initiatives in the Sanitation Sector in India: A Timeline



Central government shifted from urban policy to infrastructure development. Sanitation became a prerogative of the local governments only with the passage of the landmark 74th Constitutional Amendment Act in 1992 that recognized cities and towns as the third tier of government through the constitution of ULBs. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM), a massive urban renewal program targeting integrated development of urban infrastructure in 63 identified cities, mandated reforms and preparation of City Development Plans (CDP) that charted out plans by cities as to how they would develop land-use, transport and other basic infrastructure including sanitation. There was provision of funds and focus on creating sewage network and treatment facilities. However, all funds allocated to the sanitation sector were spent on construction of underground sewerage projects⁵.

Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

Recognizing the huge infrastructure deficits in Indian cities, the government of India launched JNNURM in late 2005. The programme was meant to infuse capital for infrastructure into select Indian cities as well as initiating a set of urban reforms. The mission focused on 65 selected cities (mostly million-plus), and included two sub-missions: Urban Infrastructure and Governance (UIG), which focused on infrastructure; and Basic Services for the Urban Poor (BSUP), with a focus on shelter for the urban poor. For all other medium and small towns in the country, the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and the Integrated Housing and Slum Development Programme (IHSDP) were launched with focus areas mirroring those of UIG and BSUP respectively. Sanitation investment went to expansion or retrofitting of sewerage networks, and there is little evidence of funds going to faecal sludge management. Only 6 per cent of the funds went to construction of STPs.

While there was a dedicated fund for the urban poor, it was limited to one-third of the investments. Moreover, most of this funding went to low-cost housing, as opposed to reaching out to larger numbers of urban poor through a range of slum upgrading programmes. JNNURM was designed to enable cities to develop their own priorities on the basis of city-wide planning, and the mission cities were required to submit a City Development Plan before they could access funds. However, most City Development Plans show remarkable similarities in priorities and kinds of projects selected across sectors. While this similarity could be attributed to many factors, one possible constraint could have been that the projects had to be prepared in accordance with Central Public Health and Environmental Engineering Organisation (CPHEEO) manuals– and these listed only sewerage systems, leaving little scope for other technological options. Thus, most investment in urban sanitation in the last decade was directed to networked systems in larger cities. There is little evidence of cities adopting the whole wastewater approach.

National Urban Sanitation Policy (NUSP)

The National Urban Sanitation Policy was launched in 2008. It is remarkable that a policy was actually formulated for urban sanitation, given that there is no matching policy for urban water supply. Along with Indonesia's Sanitation Sector Improvement Programme, the NUSP is one of the few initiatives that has established a broad enabling environment for urban sanitation. The NUSP has several significant features, most of which point to new directions for urban sanitation in India. It recognizes the importance of the entire waste cycle, as well as open defecation free cities, and 100 per cent collection and treatment of waste are explicitly laid out as goals. In a remarkable departure from earlier initiatives, it promotes no particular technological solutions, instead encouraging all kinds of solutions. It also underlines the importance of operation and maintenance of all sanitary installations and facilities. Realizing the vast differences in the cities, it recommends that each state in India prepare a state sanitation strategy, and each city prepare a city sanitation plan.

The NUSP also places the needs of the urban poor right at the centre, highlighting the constraints that might limit their access – legal status, affordability and space constraints. It calls for the urban poor to be provided with sanitation facilities, irrespective of the legal status, and for delinking tenure from service provision. The NUSP addresses most of the priorities laid out in this paper. The biggest policy drawback is the absence of dedicated funding. It has had minimal impact on the nature of JNNURM investments, since the launch/design of JNNURM preceded the NUSP. However, other initiatives have been launched as a result of the NUSP. A rollout of state urban strategies and city sanitation plans as well as some of the initiatives listed below, can at least partly be attributed to the NUSP.

Swachh Bharat Mission (Urban)

The urban component of the Swachh Bharat Mission was launched in 2014 to eliminate open defecation, eradicate manual scavenging as well as implement modern and scientific SWM, generate awareness about sanitation and its linkages to public health, capacity augmentation for ULBs and to create an enabling environment for private sector participation in capex (capital expenditure) and opex (operation and maintenance) (GoI, 2014). The mission is implemented by the Ministry of Urban Development (now Ministry of Housing and Urban Affairs) and is supposed to cover 4,041 statutory towns in India till 2019. At the national level, the infrastructure driven approach started moving towards a holistic, integrated, people centered approach with the release

⁴Ministry of Urban Development, GoI. (2014, April 29). Completed Projects. Retrieved November 21, 2014, from JNNURM: <http://jnnurm.nic.in/wp-content/uploads/2014/04/Completed-Projects-29-04-20141.pdf>

⁵Wankhade, K (2012), JNNURM: An Opportunity for Sustainable Urbanisation, Indian Institute for human Settlements.

of the NUSP in 2008. The policy moves away from prescribing piecemeal infrastructure solutions such as construction of toilets or STPs towards planning and implementing measures related to sanitation in various sectors as a cross-cutting issue.

Key thrust areas of the mission include:

- Elimination of open defecation
- Eradication of Manual Scavenging by converting insanitary toilets to sanitary
- Modern and Scientific Municipal Solid Waste Management
- Effecting behavioural change regarding healthy sanitation practices
- Awareness generation about sanitation and its linkage with public health
- Capacity Augmentation for Urban Local Bodies (ULBs) to create an enabling environment for private sector participation

In the recent Union Budget 2021, Government of India announced second phase of the mission (SBM 2.0) aiming to sustain the open defecation free status and improve the management of solid and liquid waste. The mission is aimed at progressing towards target 6.2 of the Sustainable Development Goals (SDGs) established by the United Nations in 2015.

The total fund allocated for SBM 2.0 is Rs 1,41,600 Crore. The mission aims to focus on the complete faecal sludge management, wastewater treatment, source segregation of garbage, reduction in single use plastic, reduction in air pollution by effectively managing waste from construction and demolition activities, and bio-remediation of all legacy dumpsites. At the end of the mission, the following outcomes are expected to be achieved:

- All statutory towns will become ODF+ certified.
- All statutory towns with less than 1 lakh population will become ODF++ certified ,
- 50% of all statutory towns with less than 1 lakh population will become Water+ certified
- All statutory towns will be at least 3-star Garbage Free rated as per MoHUA’s Star Rating Protocol for Garbage Free cities
- Bio-remediation of all legacy dumpsites.

Figure 10: SBM program coverage as June 2021



Source: MOHUA, “Swachh Bharat Mission Urban” Retrieved from <http://swachhbharaturban.gov.in/>

National Policy on Faecal Sludge and Septage management(FSSM)

MoHUA recognizes that the end objectives and corresponding benefits of SBM cannot be achieved without proper management of faecal sludge and septage across the sanitation service chain. Further, it is well understood that sewerage coverage will not meet the complete sanitation needs in all areas, and a strategy which is a combination of OSS and off-site (decentralised and centralised) must co-exist in all cities and must be given equal attention. Over time the relative proportions of coverage by OSS and off- site systems may change but both will need to be managed well. However, the current policies are not explicit enough and also do not provide an outcome-focused direction on this issue. As a first step, MoHUA and a host of research and civil society organisations jointly drafted and signed a National Declaration on Faecal sludge and Septage management (FSSM) on 9th September, 2016. Pursuant to the Declaration, this FSSM Policy is being promulgated to address the gaps and provide the necessary directions to diverse stakeholders engaged in provision of FSSM services. The key objective of the urban FSSM Policy is to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city.

Only on-site sanitation facilities and areas served by such facilities would fall under the purview of this FSSM Policy. It does not seek to cover network or conventional sewerage system (including treatment plants) of wastewater/sewage management. However it will address synergies between FSSM and sewerage systems or municipal solid waste (MSW) management, e.g., co-treatment of faecal sludge and septage at sewage treatment plants or co-treatment and management of faecal sludge and septage, and MSW.

Unless otherwise specified, the scope of this Policy extends to all the projects, programs and schemes of the Central Government that facilitate and support sanitation services, urban development and improved delivery of services in urban and peri-urban areas of India. It also covers the initiatives undertaken and/or supported by all Central Government Ministries, Departments, Agencies, Authorities and Public Sector Undertakings that have a bearing on sanitation services in urban and peri-urban areas. Further, the Policy applies to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbases, Ports and harbours, defence establishments, special economic zones, State and Central Government organisations, places of pilgrimage, religious and historical importance as may be notified by respective State Government from time to time.

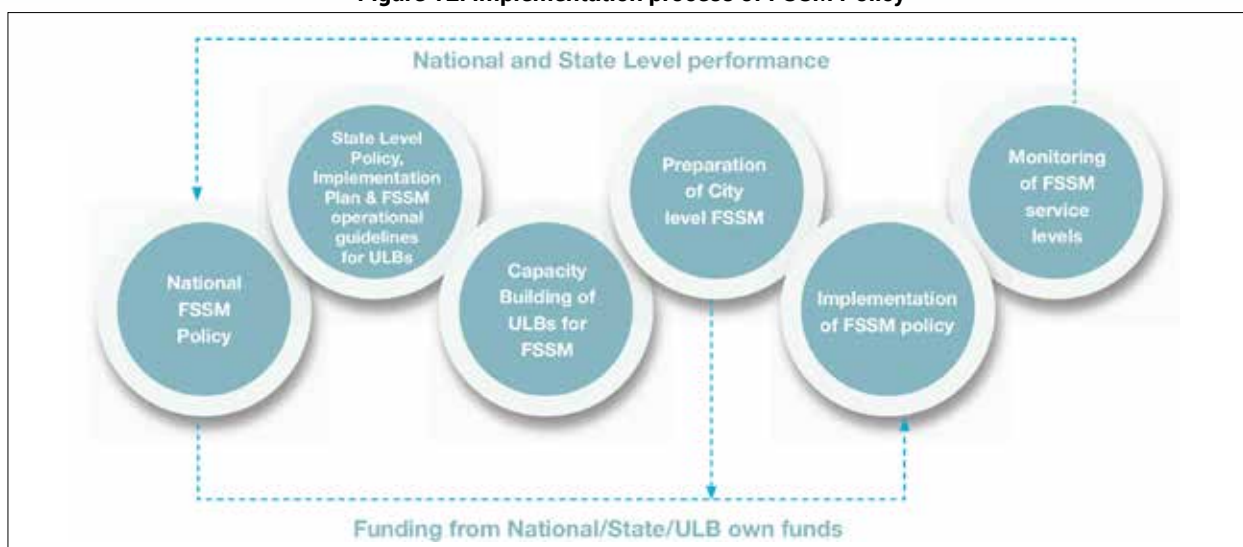
The State Governments, ULBs, and relevant public and private utilities should take necessary steps to ensure that this Policy covers all the projects, programs and schemes related to provision of onsite sanitation services in their respective jurisdictions, irrespective of the source(s) of funding for these projects, programs and schemes.

Figure 11: Pioneer States to Implement FSSM



⁶Retrieved from 13th Finance Commission report, Ministry of Finance <http://fincomindia.nic.in/ShowContentOne.aspx?id=28&Section=1>

Figure 12: Implementation process of FSSM Policy



Source: FSSM guidelines, 2016

Jal Jeevan Mission-Urban (JJM-U) Mission

This is a new initiative of Ministry of Housing and Urban Affairs launched in 2021 which focuses primarily on providing universal coverage of water supply to all urban households (4,378 ULBs). Under JJM(U), the estimated gap of 2.68 Crore household taps and 2.64 Crore sewer connections/septage in 500 AMRUT cities is proposed to be covered.

Key objectives are:

1. To ensure the rejuvenation of water bodies to augment sustainable fresh water supply and creating green spaces and sponge cities.
2. To promote circular economy of water through development of city water balance plan, focusing on recycle/reuse of treated sewage, rejuvenation of water bodies and water conservation. 20% of water demand to be met with reused water by development of institutional mechanism.
3. To start a technology submission for water.
4. To initiate an IEC campaign to spread awareness among masses about conservation of water.
5. To conduct Pey Jal Survekshan to ascertain equitable distribution of water, reuse of wastewater and mapping of water bodies with respect to quantity and quality of water through a challenge process.

In addition to the key objectives, the mission has a reform agenda having focus on strengthening of urban local bodies and water security of the cities. Major reforms are reducing non-revenue water to below 20%; recycle of treated used water to meet at least 20% of total city water demand and 40% for industrial water demand at State level; dual piping system, electric vehicle charging points; Wi-fi infrastructure in new buildings; unlocking value and improving land use efficiency through adequate urban planning; GIS based master plans of the cities; raising funds through issuance of municipal bonds and rejuvenation of water bodies.

Funding Sharing Pattern

Sub components/ Sub missions under JJM	Centre: State funding pattern
Coverage	<ul style="list-style-type: none">• 100:0 for UTs without legislature• 90:10 for NE & Himalayan states and UTs with legislature• 50:50 for other States
Support Activities	<ul style="list-style-type: none">• 100:0 for UTs without legislature• 90:10 for NE & Himalayan states and UTs with legislature• 60:40 for other States

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) mission

The mission was initiated in June 2015 which aimed to provide the basic utility services (e.g. water supply, sewerage, septage management, urban transport) to households and build amenities in cities which will improve the quality of life for all. The purpose of Atal Mission for Rejuvenation and Urban Transformation (AMRUT) is to ensure that every household has access to a tap with the assured supply of water and a sewerage connection, to increase the amenity value of cities by developing greenery and well-maintained open spaces (e.g. parks) and to reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling). All these outcomes are valued by citizens, particularly women, and indicators and standards have been prescribed by the Ministry of Housing and Urban Affairs (MoHUA) in the form of Service Level Benchmarks (SLBs).






The total central fund for AMRUT is Rs 50,000 crore from 2015-20 and the Mission operates as a Centrally Sponsored Scheme. The mission may be continued thereafter in the light of an evaluation done by the MoHUA and incorporating learnings in the Mission. The Mission funds consist of the following four parts:

- Project fund - 80% of the annual budgetary allocation.
- Incentive for Reforms - 10% of the annual budgetary allocation.
- State funds for Administrative & Office Expenses (A&OE) - 8% of the annual budgetary allocation
- MoHUA funds for Administrative & Office Expenses (A&OE) - 2% of the annual budgetary allocation

⁷<http://amrut.gov.in/content/innerpage/fund-allocation.php>.

Allocation of Funding for Urban Sanitation

Table 1: Fund allocation under SBM, AMRUT and 15th Finance Commission (FC)

	Budgetary Allocation	Duration	Sectors Covered
 SBM Mission	Rs 62,009 Crore	2014-19	Solid Waste Management, Sanitation, IEC and Capacity Building
 SBM Mission 2.0	Rs 1,41,600 Crore	2021-26	Solid Waste Management, Sanitation (including FSSM and wastewater management), IEC and Capacity Building
 AMRUT	Rs 50,000 Crore	2015-20	Sewerage and Septage Management, Water Supply, Storm Water Drainage, Urban Transport, Capacity Building, Reform Implementation, Development of Green Space and Parks
 Jal Jeevan Mission (Urban)	Rs 2,87,000 Crore	2021-26	Water supply, Water security (including wastewater, rainwater harvesting) IEC and Capacity Building
 15th FC	Rs 1,21,055 crore	2021-26	Untied grant, which can be used across various sectors (especially basic infrastructure such as water supply, wastewater, solid waste, storm water and air pollution) based on ULBs preference

Data source: SBM and AMRUT mission guidelines, 15th FC report

15th Finance Commission

Fund allocation under 15th Finance Commission

To cater to the needs of the growing urbanisation needs of the country, the 15th Finance Commission has recommended a total of Rs.1,21,055 crore for the urban local bodies for the period of 2021-26. Among the states and among the ULBs the fund will primarily be distributed with a weightage of 90% on population and 10% on area.

Funds for Million Plus Cities UAs

Fifty urban centres with a million plus population have been identified. They consist of forty-four urban agglomerations (excluding Delhi, Chandigarh and Srinagar) and six cities Jaipur, Visakhapatnam, Ludhiana, Faridabad, Vasai- Virar City and Kota. For these cities, during its five-year award period, grants have been recommended to the tune of INR. 38,196 crores in the form of a Million-Plus cities Challenge Fund (MCF). Each urban centre shall have one ULB as a nodal entity which will be made responsible for achieving the performance indicator for the whole UA. One third of the total MCF of each city is earmarked for achieving ambient air quality. The balance two thirds of the city-wise MCF are earmarked for achieving service level benchmarks for drinking water (including rainwater harvesting and recycling) and solid waste management. The MoHUA shall act as a nodal ministry for determining the urban agglomeration eligible to get MCF funds for drinking water (including rainwater harvesting and recycling), sanitation and solid waste management criteria under service level benchmarks.

Grants for ULBs (less than Million Plus)

The other than Million-Plus cities/towns shall get the grants as per population. Thirty per cent of the total grants to be disbursed to urban local bodies shall be earmarked for sanitation and solid waste management and attainment of star ratings as developed by the MoHUA. In addition, 30 percent of the total grants to be disbursed to urban local bodies shall be earmarked for drinking water, rainwater harvesting and water recycling. However, if any urban local body has fully saturated the needs of one category and there is no requirement of funds for that purpose, it can utilise the funds for the other category.

Further Readings

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Session

02

Existing Situation and Challenges

1. Session Objectives

This session intends to

- To understand the sanitation value chain
- To learn about the FSSM current status and challenges
- To understand challenges across various components of service chain

2. Session Plan

Activity	Time	Material /Methods
Introduction to FSSM Service Chain	15 min	PowerPoint ,flipcharts
FSSM Situation and Challenges	15 min	Video
Challenges across various components of service chain and identification of stakeholders	45 min	PowerPoint, flipcharts, markers
Solutions/Interventions/approaches adopted by the cities	15 min	Video

Session time: 60 min

3. Learning Notes

Activity 01- Introduction to Service Chain

The current condition of sanitation in the country is dismal, with over 40 million urban dwellers regularly defecating in the open (Census 2011), both due to lack of facilities and low usage of existing facilities. That is why the government's efforts are concentrated on building toilets to eliminate open defecation. However, this is just a stepping stone - the solution does not lie in only building toilets, as toilets without proper disposal and treatment of the waste don't really serve the purpose of effective sanitation. The solution also does not lie in only having networked centralised solutions. Expensive sewerage networks are still considered the ultimate solution for urban sanitation. Funding agencies also support such projects, hence presently all cities aspire for sewerage networks to solve their sanitation woes. On-site sanitation options like septic tanks with proper septage management (treatment and disposal of septage) can be a viable, lower cost solution in many cases. As Table 1 indicates, about 33% of the toilets in urban India have piped sewerage systems connected to a sewage treatment plant, which is perhaps treated to disposal standards. A majority of sewage thus remains inadequately treated and causes environmental concerns.

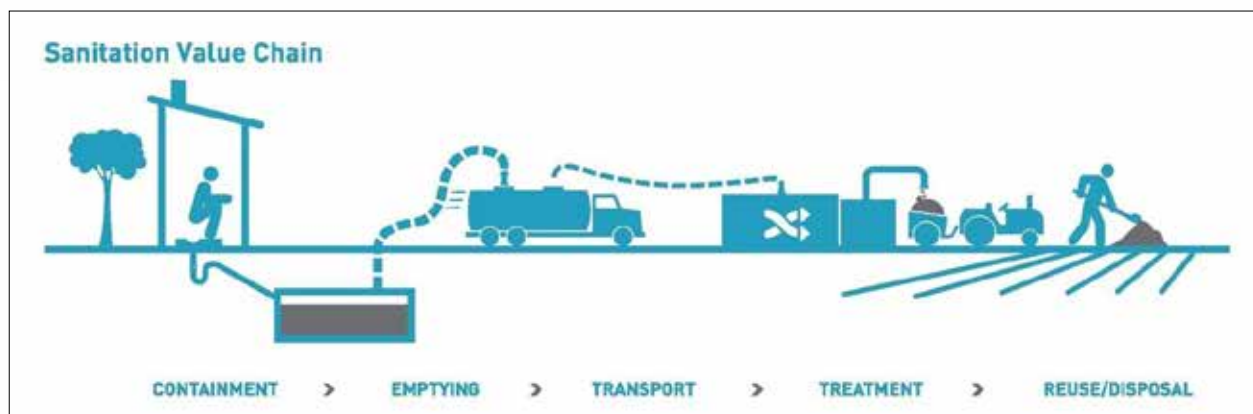
The issues involved in effective sanitation solutions are twofold: access to toilets, and treatment of waste before reuse and/ or safe disposal. The challenge is to improve the performance of the entire sanitation value chain (containment, emptying into transport vehicles, transportation, treatment, and disposal/reuse), which requires a paradigm shift in the way sanitation planning is done in urban India.

Sanitation Value Chain

Faecal sludge management refers to the approach of towards building a sustainable and environmentally safe infrastructure from containment to end use or disposal of faecal sludge from on-site sanitation systems (OSS). This includes the safe storage, collection, transport, treatment and end-use or disposal of faecal sludge. It is imperative to look at the sanitation market as a value chain where value can be added at each stage. It will, therefore, develop technologies, systems and services which accomplish this at each section of the chain, as shown in the picture below;

All technologies, ideas and knowledge have been delineated with regard the Sanitation Value Chain. The links in this chain are:

Figure 14: Sanitation Value Chain



Source BMGF

User Interface

User interface explains the type of toilet construction—pedestal, pan or urinal—with which a user comes in contact; it is the way in which the user accesses the sanitation system. In most of the cases, the choice of the user interface depends on the availability of land and water and, also sociocultural factors. Only excreta and black/yellow water and wash water originate at the user interface, and not grey water (grey water is generated from domestic sources).

Collection/Storage/Treatment

Collection/Storage/Treatment explains the collection, storage and, sometimes, partial treatment of products that are generated from the user interface. The treatment that is provided by these technologies is often a function of storage and is usually passive (e.g., no energy inputs). Thus, products that are “treated” by these technologies often require subsequent treatment before use and/or disposal. The collection/storage/treatment component has limited capacity beyond which it cannot function effectively, and needs to be emptied.

Emptying and Conveyance

Emptying and conveyance describes the removal and transportation of FS from one place to another (e.g., septic tank to treatment plant). This becomes necessary when the collection/storage/treatment component has reached its capacity. In developing countries, trucks and small bores are mainly used for the transportation of sludge.

The Sanitation Value Chain provides a useful method to divide different technologies into their useful functions and identify the type of partners that may be required. For instance, technology in the ‘capture and storage’ stage will require partners with construction expertise; whereas a technology in the ‘treatment’ phase will require partners with bio-chemical processing expertise.

Gender, Caste and Class Dimensions of Urban Sanitation

A gender specific effect and outcome of inadequate and unsafe sanitation is a weak spot in WASH. And even weaker when we address septage and waste water management. Here the gender focus is currently limited to women enterprises heading desludging operations and experiences from African context where dry sludge is managed by women at home.

More recent research literature on health impacts is restricted to a hypothesis that lack of safe sanitation causes stunting of the population at large and not on women in particular. This needs to be proven through long term medical studies and comparing other critical variables including hard physical work done by both men and women in the poorest districts of India (where stunting

is higher), impacts of successive malaria(all the three virulent types) and other most common diseases.

In Jharkhand and Gujarat villages, major illness was usually malaria and respiratory diseases and not serious stomach infections like Jaundice, Cholera, and Diarrhea. People do not attribute lack of sanitation to be the primary cause for major illness. Lack of proper nutrition, hard physical labour or general weakness of the human system over the years from early marriage and child birth, weakness from repeated bouts of malaria and viral fevers, etc., are seen as some of the most important factors for poor health condition than sanitation and hygiene borne factors. Health sector experts identify delayed breast feeding and related personal hygiene as important factors of high infant mortality in India. Page 13 of the Report⁸.

a. Gender and urban sanitation

WASH sector literature on gender and sanitation is unfortunately dominated by a limited discourse on menstrual hygiene, the life cycle cost of sanitation and women's access to toilets.

Gender equity becomes an issue when women and girls lack access to toilet facilities and appropriate hygiene education. Opportunities for learning are lost when children have to spend time collecting water or finding a safe place to defecate or urinate in the open. Many girls may permanently drop out of school with the onset of puberty if the toilet facilities are not clean or do not provide privacy to girls while they are menstruating. Menstruation is a taboo subject in many cultures and can create stigma, shame, and silence among young girls, which often continues into adulthood and perpetuates the cycle of gender inequality.

Women are often vulnerable to harassment or violence when they have to travel long distances to fetch water, use shared toilets, or practice open defecation. Women and girls often wait until nightfall to defecate, which increases the risk of assault. Many choose to 'hold it' or limit their consumption of food and drink to delay the need to relieve them, which can increase the chance of urinary tract infections. The shame and indignity of defecating in the open also affects women's self-esteem, as does a lack of water for washing clothes and personal hygiene⁹. (WaterAid, 2015)

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Women are assumed to represent a homogenous category, devoid of caste and class differentiation. The urban sanitation study undertaken by SOPPECOM highlights the issues of how women discriminate among each other(higher caste women objecting to lower caste women using common public toilets) on the basis of caste.

Gender perspective in WASH is possible when women's access to water and sanitation is looked both from the patriarchy at the family, culture, religion and social group level, as well as from the larger perspective of urbanization, dispossession and illegality of slum settlements that impacts women. The Jagori study of water and sanitation in urban slums of Delhi does this well.

⁸<http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Behaviour-Change-Formative-Research-2016.pdf>

⁹WaterAid. Post-2015 Toolkit: WASH and Gender Equality. Retrieved from <https://sustainabledevelopment.un.org/getWSDoc.php?id=2428>

The working-classes in Delhi have been subject to a systematic process of dispossession and impoverishment for the last three to four decades. Forcible eviction from slums in Delhi and relocation to the periphery of the city forms the core of this process as most of the evicted work in the informal sector. Such relocation to colonies such as Bawana on the periphery of the city make it impossible for them to continue to attempt to earn sustainable livelihoods. In order to understand the impact of eviction on people's livelihoods, action research, since 2004, has been undertaken in Bawana. The abysmal conditions of water supply in the area and the fact that the burden of filling water falls on women and young girls have been noted by Menon Sen & Bhan in "Swept off the Map: Surviving Eviction and Resettlement in Delhi" (2008: Jagori & Yoda Press).¹⁰

Within a slum or a poor urban settlement, women whose caste and class are among the lowest in the social hierarchy, usually the rag pickers or those employed in manual scavenging work, suffer the most in terms of denial of sanitation services and payment for work done.

The most studied aspect of women and sanitation (not gender and sanitation), is the women's access to public toilets and how women suffer from poorly maintained public toilets.

The Urban Management Centre (UMC), based in Ahmedabad, conducted a technical audit of all public conveniences such as PT and CT in the jurisdiction of Ahmedabad Municipal Corporation in 2013. Survey results shows, majority of the community toilets (63%) did not have separate sections for men and women. Nearly 90% of public urinals did not have separate sections for men and women. Most of the urinals were for men only. Based on discussions with user groups, 15% women expressed that they felt unsafe using PTs while 20% women felt unsafe using a toilet that did not have separate sections for females. Considering the toilet accessibility for the physically disabled, 97% PTs were not designed to be accessible for the disabled. There was no provision of ramps, handrails for easy access. (Urban Management Centre, 2013). For better designing of public conveniences in terms of gender friendly, child friendly and disabled friendly, an e-learning course is available on the Swachh Bharat e-course portal. One can register for course number "413 – Designing of Community and Public Toilets" under course series 400.

Water, sanitation, and hygiene do play a large role in the lives of adolescent girls and women, both biologically and culturally. However a limited understanding of gender as a biological differentiator and not a power construct, is usually applied in most WASH programmes and in Behaviour change communication. Gender as a power construct should not be blindly applied in WASH to show that women's preference for toilets is always negated by men or that men are never concerned about women's safety while going for open defecation (SOPPECOM study).

Caste and Urban Sanitation

It is not unknown; however there is extensive research that shows that caste has a major influence on achieving rural sanitation goals¹¹. The Hindu notions of purity and pollution, inextricably linked with the caste system and the practice of untouchability, underlie the unsanitary practices in Indian society. These beliefs perpetuate the oppression of the "polluted castes," which are forced to undertake manual scavenging, unclog manholes and clean other people's filth. The availability of cheap Dalit labour to do these dehumanizing jobs can be cited as one of the reasons why development of toilet facilities and a modern garbage and sewage management system have been neglected so far¹². (Subhash Gatade, Economic & Political Weekly, 2015)

¹⁰<http://jagoriwp.jagori.org/our-activities/fellow-research/rights-and-access-to-watsan/>

¹¹<http://riceinstitute.org/research/culture-and-the-health-transition-understanding-sanitation-behavior-in-rural-north-india/>

The World Health Organization (WHO) estimates that when a normal latrine (meaning a latrine with a 50 cubic metre, honeycomb-style pit) is used daily by a family of six members, it will fill up after about five years. When the pit fills up, the owners must either empty it or build a new pit. In rural India, as in other parts of the developing world, when honeycomb-style latrine pits are emptied, it is done by hand. Biological germs turn out not to be the barrier to pit emptying. People in rural India equate manually emptying a latrine pit with the most degrading forms of Dalit (lower caste who generally engaged in cleaning pits and sewer lines) labour. Therefore, the idea of manually emptying a latrine pit is at least as reviled for its social implications as it is for the physically disgusting nature of the work. (Diane Coffey and Dean Spears, 2017)

Urban sanitation challenges are multi-dimensional when it comes to the understanding of caste, class and gender. However not much research has been done to address urban sanitation challenges from the gender, caste and class perspective in India.

A recent research¹³ on urban sanitation by Society for Promoting Participative Ecosystem Management (SOPPECOM) highlighted the following:

- Poor slum-dwelling women have developed habits that fit their caste, stage in the life course, marital status, etc. Nonetheless, every day is a different day, and the fears and discomfort that women confront are not necessarily the same in content, intensity, or even present on any given day, depending on the circumstances that they leave at home, their physical condition that day, and the presence/absence of certain groups/individuals at/near the defecation site.
- Discussion of the multiple inequalities that constrain women's choices surrounding sites of defecation begs the question, "What might the provision of adequate sanitation do to curtail gendered violence?" We find that individual women experience the risks of inadequate sanitation differently, but at broader scales, we reach the conclusions that provision of adequate sanitation is not sufficient to alter gendered social relations. Adequate sanitation without attention to gendered relations of power puts the burden of safety on women, and does not address the caste and gender-based patterns of violence against women.
- Provision of a toilet whether public or individual is not sufficient, its maintenance is a key issue. Maintenance of PTs has to be the ultimate responsibility of the ULBs. These toilets have to respond to needs of diverse women (for example old, pregnant, with children, disabled, belonging to different religious and caste communities) by being better lit, in safer locations and with regular provisioning of water. A need for a community mental health centre was evident given the various psycho- social stresses that women faced. (Society for Promoting Participative Eco-system Management, 2013-14)

¹²Retrieved from "Silencing Caste, Sanitizing Oppression, Understanding Swachh Bharat Abhiyan" – A perspective paper by Subhash Gatade in *Economic and Political Weekly*, October 31, 2015.

¹³<https://www.soppecom.org/pdf/sanitation-vulnerability.pdf>

Anecdote of Experiences of Women Harassment¹⁴:

- Sanitation in terms of open defecation and PT maintains the status quo of unequal gender relations. These relations intersect with relations of age, caste, and class. Seen as a struggle over resources, negotiations around the safe use of OD and PT sites were often to the disadvantage of women (e.g., inability to go at night).
- Widows faced more physical insecurity, but even married women avoided telling their husbands about harassment or being assaulted out of fear of conflict.
- Husbands set limits on wives' movement, time spent going for OD, and time of day of going out.
- However, gender relations were not necessarily antagonistic at the HH scale. A woman could ask her husband to accompany her for defecation. Husbands also responded to their wives' requests for Individual household latrines (IHLs) for themselves or daughters.
- Community played a significant role in shaping women's experiences around harassment. Belonging to a majority community had some advantages in both the cities. In Pune in Ambedkar basti Marathi women told us that the Marathi municipal Corporator (ward level political representative) belonging to a right wing regional party had "fixed" the non-Marathi men and there was thus overall less violence against women in the basti.
- Research shows that membership in the slum's dominant caste served as protection to married women, while women outside that caste might still be targets of harassment. In Jaipur women of dominant castes claimed they felt no fear, faced no trouble, and had little experience with harassment. In Pune one of the few upper caste women we interviewed told us how insecure she was in the midst of Dalits and how she feared for her daughter's safety. We argue that such talk may be true, but it enables these women to put distance between themselves and other women's experiences and fears in the settlement.
- 'Women' are not a single entity, so we need not be surprised that caste and community relations present a division.
- Women showed little hesitation to point out caste groups that engaged in harassment, but responses about sexual assault usually blamed an outsider. This may be because women were reluctant in small bastis to name someone, but it also suggests that those outside community sanctions with access to women at OD places (e.g., along a busy road) seized opportunities to assault when they presented themselves. Notably, in both Pune and Jaipur, women's triumphant responses to attackers were against outsiders.
- Overall, the possibilities for women joining forces across caste groups seem minimal.
- Communities in Jaipur are rigidly caste divided, as evidenced by a riot in one of the slums during our interview period. Little community solidarity was evident against sanitation-related violence or for the provision of sanitation.

FSSM Enabling Compliance for Ending Manual Scavenging

- a. Due to lack of awareness and technical understanding, HHs typically do not construct their OSS systems as per design guidelines. Also, it's a belief that keeping more depth of the pits will not allow frequent overflow of waste water from the OSS systems. These results workers to enter into pit and manually dig out dried faeces from deep unlined pits, which lead to the dehumanizing practice of manually cleaning human excreta from dry/insanitary latrines which is known as manual scavenging. Many private and informal contractors are involved in providing emptying services. In many cases, informal workers are employed for cleaning the septic tanks by residential societies which may potentially lead to manual scavenging.

¹⁴ *Ibid*

- b. The practice of manual scavenging is linked with the caste system. A person from lower caste is expected to do this job. To eliminate manual scavenging, the “The Prohibition of Employment as Manual Scavengers and Their Rehabilitation Act, 2013” came into force. This act prohibits the construction or maintenance of insanitary toilets and engagement or employment of anyone as a manual scavenger. Violation of the Act could result imprisonment for a year or a fine of ₹ 50,000 or both. This act also offers rehabilitation of a person engaged in manual scavenging occupation. It is the responsibility of the ULBs to identify the manual scavengers in the city by conducting a primary survey and to rehabilitate them by providing alternate secured livelihood. The Act aims to help cities to identify and rehabilitate manual scavengers in the city.
- c. Typically, many private agencies operate in the sector of emptying waste water from OSS systems and who take higher charges from the owners of OSS systems. There could be potential chances of manual scavenging where private agencies provide emptying services as the ULBs have no control on private sector. To comply with the Act, cities have started empanelling the private agencies which will work on the terms and condition provided by the ULB, which ensures manual scavenging will not be occurred during emptying of OSS systems and cleaning of sewer lines and manholes. This will help cities to prevent and to end the practice of manual scavenging.
- d. Based on an elaborate study undertaken by Urban Management Centre in the Ahmedabad Municipal Corporation to help conform with the Act, Manual scavenging may occur due to manual
 - a. Cleaning of open defecation spots,
 - b. Emptying OSS systems,
 - c. Cleaning of sewer lines and manholes,
 - d. Cleaning of PTs, and
 - e. Cleaning of excreta from insanitary latrines

These are the areas where there is a possibility of manual scavenging in FSSM services but it can be avoided by considering following things:

- Cities should have adequate suction based vacuum trucks to empty the waste water from OSS systems as Manual Scavenging Act clearly states waste water emptying should be done in a mechanical way. The ULB could either have these trucks themselves or the city should empanel private agencies for emptying OSS systems.
- Safety gears should be given to the workers engaged in waste water emptying and disposal system, and
- Capacity building of the workers and staff engaged in FSSM services. (Urban Management Centre, 2015)

1. Financing challenges for construction of individual household latrine (IHHL) under SBM

- a. Non construction of toilets or incomplete toilets: after availing first installment subsidy.
- b. Most construction of single pit latrines, no space for construction of twin pit toilets.
- c. Small and inappropriate septic tanks with no soak pits.
- d. Long process of toilet construction from identification of a HH without an IHHL to verification of application to ground survey to actual construction.

Activity 02- Video on FSSM Situation and Challenges

The following videos can be shown during this session. Visual information is easier to remember. It is the perfect way to start a session with an interesting movie. Make sure the copy of the movie is set in the computer. Try to play it before to avoid any last-minute technical issue.

A Model Sanitation city on Sinnar - <https://www.youtube.com/watch?v=lGrtsXLwQQg>
Advance workshop on FSSM - https://www.youtube.com/watch?v=RQEqJ-s_XcM

Activity 03 – Group exercise and Discussion

Participants will be divided in four or five groups to discuss on Challenges across various components of service chain. Each group will present their discussions on the plenary.

Activity 04 – Video on solutions/Interventions/approaches adopted by cities

URL- Septage Treatment Plant at Bhubaneswar,Odisha by OWSSB <https://www.youtube.com/watch?v=oNtaLaUDtMI>

Session

03

Technology Options

1. Session Objectives

This session intends to

- To understand different on-site containment systems
- To understand different conveyance methods or techniques of Faecal Sludge and Septage
- To understand about the requirement of transfer stations and its types
- To understand the treatment chain for Integrated Faecal Sludge and Septage Management (IFSM).
- To understand the criteria for selection of appropriate Faecal Sludge and Septage treatment options.
- To understand different treatment technologies

2. Session Plan

Activity	Time	Material /Methods
Technology options for containment and conveyance	30min	PowerPoint, flipcharts
Technology options for treatment	30min	technology options for treatment
Video on FSTP case study	15 min	Video

Session time:75 min

3. Learning Notes

3.1 Containment System

This section explains how the output products of a user interface can be collected, stored, and treated on-site. The functional group on-site containment system describes the ways of receiving, storing, and sometimes treating the products generated at the user interface. The treatment provided by these technologies is often the function of storage, and is usually passive, without requiring energy input. Products that emanate from these technologies often require subsequent treatment before use or disposal. There's quite a wide range of technologies which belong to this functional group. The technical and physical criteria for choosing appropriate collection, storage and treatment technology are as follows;

- Ground condition (Soil and strata (percolation and cost of construction))
- Groundwater level and contamination (Cross contamination (pathogens))
- Climate-Temperature (degree of treatment) and rainfall (percolation rate)

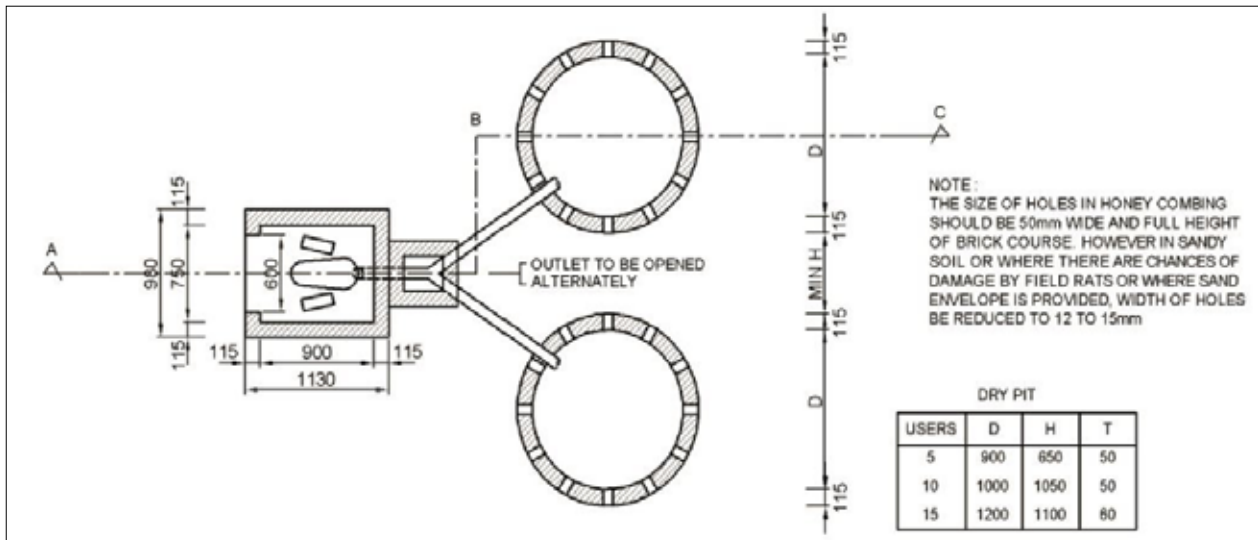
A. Twin pit for pour flush toilet

This technology consists of two alternating pits connected to a pour flush toilet. The blackwater (and in some cases greywater) is collected in the pits and allowed to slowly infiltrate into the surrounding soil. Over time, the solids are sufficiently dewatered and can be manually removed with a shovel. The twin pits for pour flush technology can be designed in various ways; the toilet can be located directly over the pits or at a distance from them. The superstructure can be permanently constructed over both pits, or it can move from side to side depending on which one is in use. No matter how the system is designed, only one pit is used at a time. While one pit is filling, the other full pit is resting.

As liquid leaches from the pit and migrates through the unsaturated soil matrix, pathogenic germs are sorbed onto the soil surface. In this way, pathogens can be removed prior to contact with groundwater. The degree of removal varies with soil type, distance travelled, moisture and other environmental factors.

The difference between this technology and the double VIP or Fossa Alterna is that it allows for water and it is not necessary to add soil or organic material to the pits. As this is a water-based (wet) technology, the full pits require a longer retention time (two years is recommended) to degrade the material before it can be excavated safely

Figure 15 :Twin Pit Pour Flush Toilet System



Source: CPHEEO, 2013

Twin pits for pour flush are a permanent technology appropriate for areas where it is not possible to continuously build new pit latrines. If water is available, this technology is appropriate for almost every type of housing density.

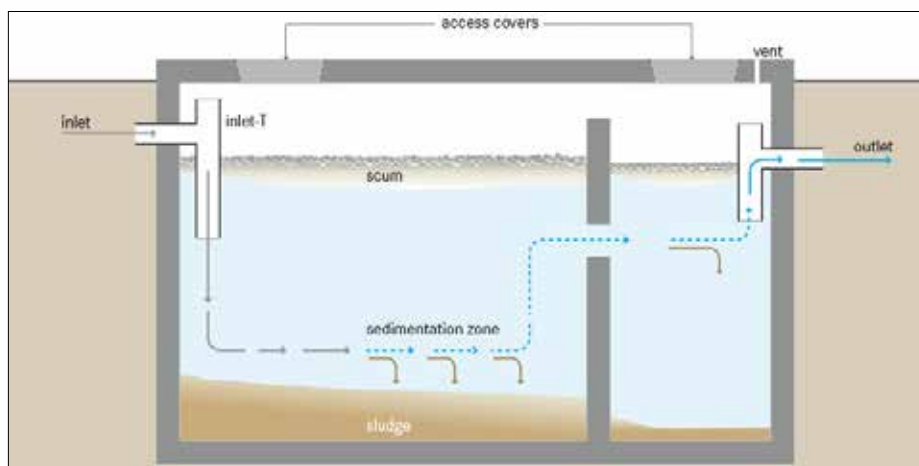
Pros	Cons
<ul style="list-style-type: none"> Because double pits are used alternately; their life is virtually unlimited Excavation of humus is easier than faecal sludge Potential for the use of stored faecal material as soil conditioner Flies and odours are significantly reduced (compared to pits without a water seal) Can be built and repaired with locally available materials Low (but variable) capital costs depending on materials; no or low operating costs if self-emptied Small land area required 	<ul style="list-style-type: none"> Manual removal of pit humus is required Clogging is frequent when bulky cleansing materials are used Higher risk of groundwater contamination due to more leachate than with waterless system

B. Septic Tank

A septic tank is a watertight chamber made of concrete, fibreglass, PVC or plastic, through which Blackwater and greywater flow for primary treatment. Settling and anaerobic processes reduce solids and organics, but the treatment is only moderate.

Liquid flows through the tank, and heavy particles sink to the bottom, while scum (mostly oil and grease) floats to the top. Over time, the solids that settle to the bottom are degraded anaerobically. However, the rate of accumulation is faster than the rate of decomposition, and the accumulated sludge and scum must be periodically removed. The effluent from the septic tank must be dispersed by using a Soak Pit or Leach Field or transported to another treatment technology via a Solids-Free Sewer. The removal of 50% of solids, 30 to 40% of BOD and a 1-log removal of E. coli can be expected in a well-designed and maintained the septic tank, although efficiencies vary greatly depending on operation and maintenance and climatic conditions.

Figure 16: Schematic diagram of septic tank



Source: Titley et al, 2014

The design of a septic tank depends on the number of users, the amount of water used per capita, the average annual temperature, the desludging frequency and the characteristics of the wastewater. The retention time should be 48 hours to achieve moderate treatment. The retention time should be 48 hours to attain moderate treatment.

Figure 17 : Recommended Size of Septic Tanks upto 20 users

No of Users	Length (m)	Breadth (m)	Liquid depth (m) Cleaning interval of	
			2 Years	3 Years
5	1.5	0.75	1.0	1.05
10	2.0	0.90	1.0	1.40
15	2.0	0.90	1.3	2.00
20	2.3	1.10	1.3	1.80

Source: CPHEEO, 2013

Figure 18: Recommended Size of Septic Tank for Housing Colony Upto 300 Users

No of Users	Length (m)	Breadth (m)	Liquid depth (m) Cleaning interval of	
			2 Years	3 Years
50	5.0	2.00	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.00	1.0	1.24
200	12.0	3.30	1.0	1.24
300	15.0	4.00	1.0	1.24

Source: CPHEEO, 2013

This technology is most commonly applied at the household level. Larger, multi-chamber septic tanks can be designed for groups of houses and public buildings (e.g., schools).

A septic tank is appropriate where there is a way of dispersing or transporting the effluent. If septic tanks are used in densely populated areas, onsite infiltration should not be used. Otherwise, the ground will become oversaturated and contaminated, and wastewater may rise up to the surface, posing a serious health risk. Instead, the septic tanks should be connected to some Conveyance technology, through which the effluent is transported to a subsequent Treatment or Disposal site.

Even though septic tanks are watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding.

Because the septic tank must be regularly desludged, a vacuum truck should be able to access the location. Often, septic tanks are installed in the home, under the kitchen or bathroom, which makes emptying difficult. Septic tanks can be installed in every type of climate, although the efficiency will be lower in colder climates. They are not efficient at removing nutrients and pathogens.

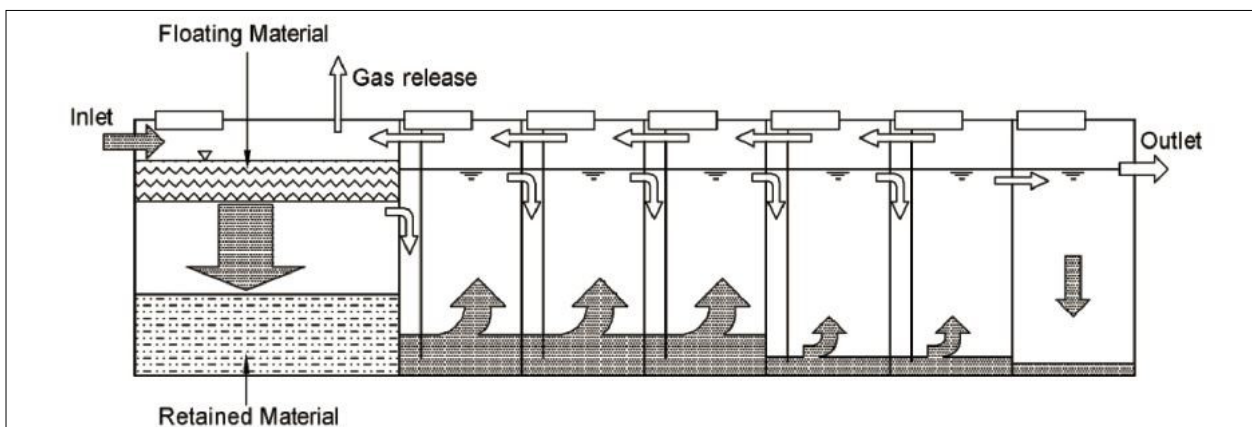
Pros	Cons
<ul style="list-style-type: none"> ▪ Simple and robust technology ▪ No electrical energy is required ▪ Low operating costs ▪ Long service life ▪ Small land area needed (can be built underground) 	<ul style="list-style-type: none"> ▪ Low reduction in pathogens, solids and organics ▪ Regular desludging must be ensured ▪ Effluent and sludge require further treatment and appropriate discharge

C. Anaerobic Baffle Reactor

An anaerobic baffled reactor (ABR) is mainly a small septic tank (settling compartment) followed by a series of anaerobic tanks (at least three). Most of the solids are removed in the first and largest tank. Effluent from the first tank then flows through baffles and is forced to flow up through activated sludge in the subsequent tanks. Each chamber provides increased removal and digestion of organics: BOD may be reduced by up to 90%. Increasing the number of chambers also improves performance. (Tilley 2008)

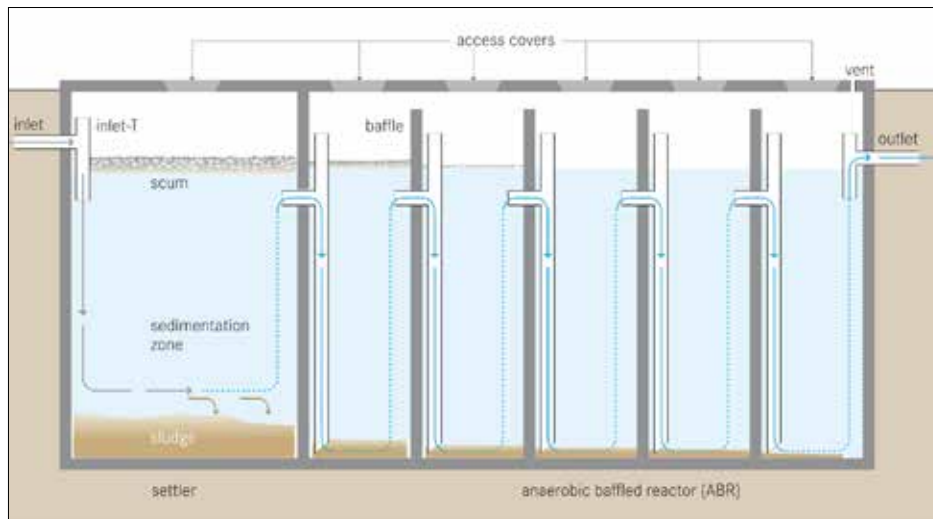
The majority of settleable solids are removed in a sedimentation chamber in front of the actual ABR. Small-scale stand-alone units typically have an integrated settling compartment, but primary sedimentation can also take place in a separate Settler or another preceding technology (e.g., existing Septic Tanks). Designs without a settling compartment are of particular interest for (Semi-) Centralized Treatment plants that combine the ABR with other technologies, or where prefabricated, modular units are used.

Figure 19: Schematic Diagram of ABR



Source: CPHEEO, 2013

Figure 20: Schematic Diagram of ABR



Source: EAWAG,2005

This technology is easily adaptable and can be applied at the household level, in small neighbourhoods or even in bigger catchment areas. It is most appropriate where a relatively constant amount of blackwater and greywater is generated. A (semi-) centralised ABR is applicable when there is a pre-existing Conveyance technology, such as a Simplified Sewer.

This technology is suitable for areas where land may be limited since the tank is most commonly installed underground and requires a small area. However, a vacuum truck should be able to access the location because the sludge must be regularly removed (particularly from the settling compartment).

ABRs can be installed in every type of climate, although the efficiency is lower in colder climates. They are not efficient at removing nutrients and pathogens. The effluent usually requires further treatment.

Pros	Cons
<ul style="list-style-type: none"> ▪ Low cost when divided among members of a housing cluster or small community ▪ Minimum operation and maintenance ▪ Resistant to organic and hydraulic shock loads ▪ Reliable and consistent treatment 	<ul style="list-style-type: none"> ▪ Requires expert design and skilled construction; partial construction work by unskilled labourers ▪ Requires secondary treatment and discharge

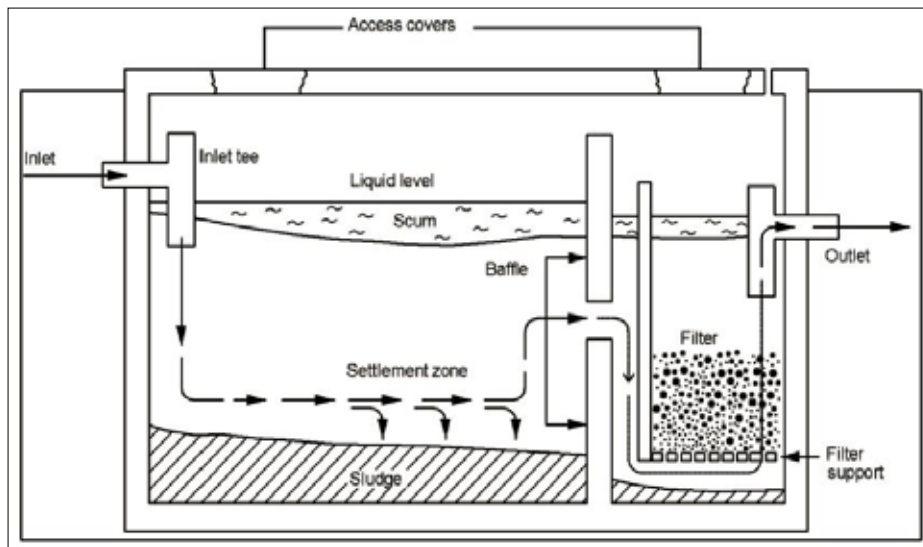
D. Anaerobic up-flow filter

An anaerobic up-flow filter is a fixed-bed biological reactor with one or more filtration chambers in series. As wastewater flows through the filter, particles are trapped, and organic matter is degraded by the active biomass that is attached to the surface of the filter material. With this technology, suspended solids and BOD removal can be as high as 90% but is typically between 50% and 80%. Nitrogen removal is limited and usually does not exceed 15% regarding total nitrogen (TN).

Pre- and primary treatment is essential to remove solids and garbage that may clog the filter. The majority of settleable solids are removed in a sedimentation chamber in front of the anaerobic filter. Small-scale stand-alone units typically have an integrated settling compartment, but primary sedimentation can also take place in a separate Settler or another preceding technology

(e.g., existing Septic Tanks). Designs without a settling compartment are of particular interest for (Semi-) Centralized Treatment plants that combine the anaerobic filter with other technologies, such as the Anaerobic Baffled Reactor (ABR).

Figure 21: Basic Schematic of Up-flow Anaerobic Filter

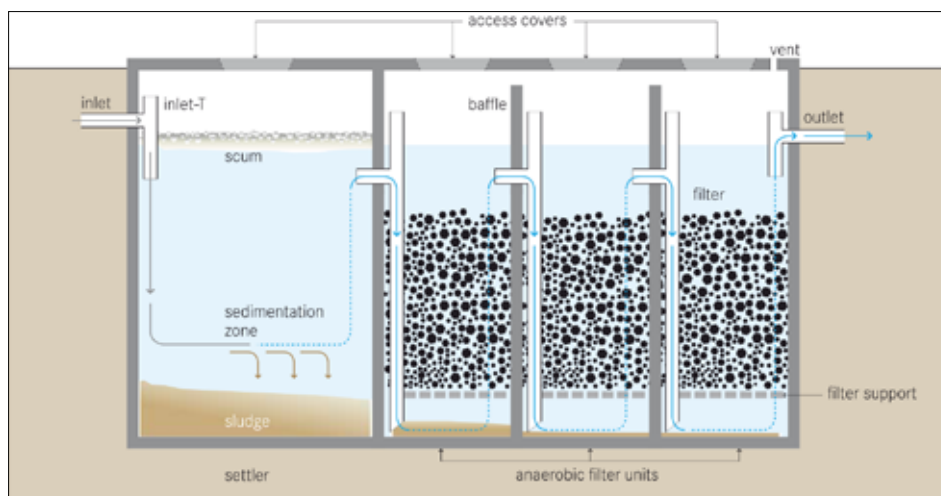


Source: CPHEEO, 2013

These filters are usually operated in upflow mode because there is less risk that the fixed biomass will be washed out. The water level should cover the filter media by at least 0.3 m to guarantee an even flow regime. The hydraulic retention time (HRT) is the most critical design parameter influencing filter performance. An HRT of 12 to 36 hours is recommended.

The microbial growth is retained on the stone media, making possible higher loading rates and efficient digestion. The capacity of the unit is 0.04 to 0.05 m³ per capita or 1/3 to 1/2 the liquid capacity of the septic tank it serves. BOD removals of 70% can be expected. The effluent is clear and free from odour. This unit has several advantages viz, (a) high degree of stabilization; (b) little sludge production; (c) low capital and operating cost; and (d) low loss of head in the filter (10 to 15 cm) in normal operation. (Source: CPHEEO, 2013)

Figure 22: Schematic diagram of Anaerobic Up flow filter



Source: EAWAG, 2005

The ideal filter should have a large surface area for bacteria to grow, with pores large enough to prevent clogging. The surface area ensures increased contact between the organic matter and the attached biomass that efficiently degrades it. Ideally, the material should provide between 90 to 300 m² of surface area per m³ of occupied reactor volume. Typical filter material sizes range from 12 to 55 mm in diameter. Materials commonly used include gravel, crushed rocks or bricks, cinder, pumice, or specially formed plastic pieces, depending on local availability.

The connection between the chambers can be designed either with vertical pipes or baffles. Accessibility to all chambers (through access ports) is necessary for maintenance. The tank should be vented to allow for controlled release of odorous and potentially harmful gases.

This technology is easily adaptable and can be applied at the household level, in small neighbourhoods or even in bigger catchment areas. It is most appropriate where a relatively constant amount of blackwater is generated. The anaerobic filter can be used for secondary treatment, to reduce the organic loading rate for a subsequent aerobic treatment step, or for polishing.

This technology is suitable for areas where land may be limited since the tank is most commonly installed underground and requires a small area. Accessibility by vacuum truck is important for desludging.

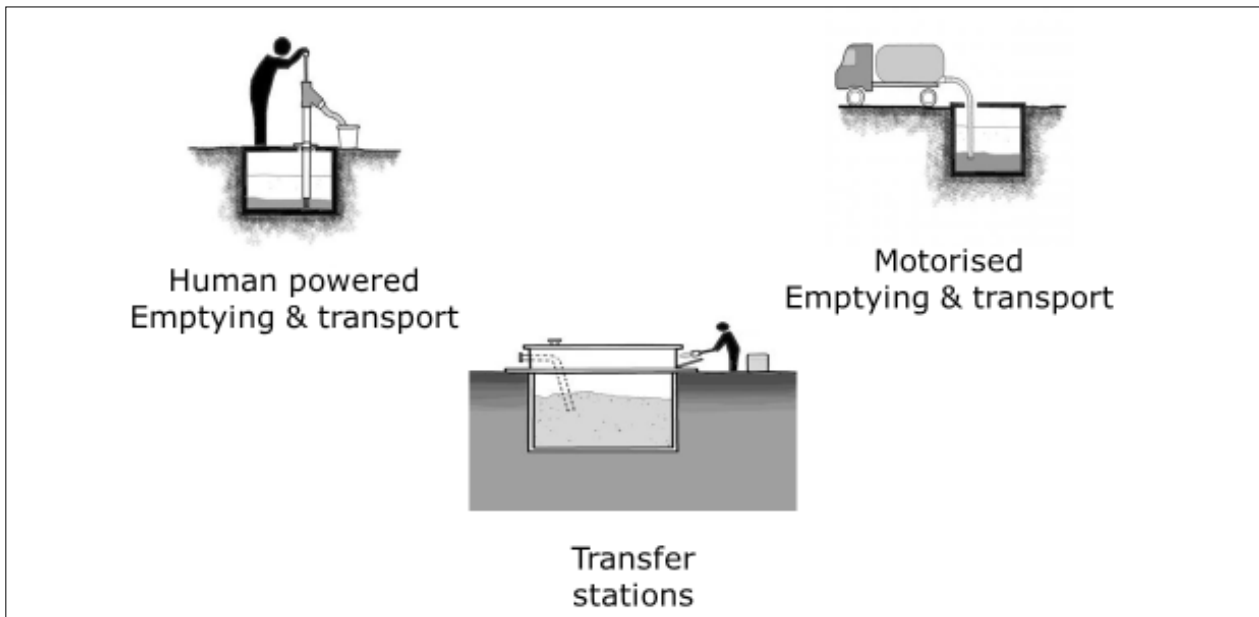
Pros	Cons
<ul style="list-style-type: none"> ▪ No electrical energy is required ▪ Low operating costs ▪ Long service life ▪ High reduction of BOD and solids ▪ Low sludge production; the sludge is stabilized ▪ Moderate area requirement (can be built underground) 	<ul style="list-style-type: none"> ▪ Requires expert design and construction ▪ Low reduction of pathogens and nutrients ▪ Effluent and sludge require further treatment and appropriate discharge ▪ Risk of clogging, depending on pre- and primary treatment ▪ Removing and cleaning the clogged filter media is cumbersome

If waste products cannot be safely disposed of or even suitably reused on site, they have to be transported elsewhere. Conveyance describes the way in which products are moved from one process to another. Although products may need to be moved in various ways to reach the required process, the long-est and most important gap lie between on-site storage and (semi-) centralised treatment.

3.2 Conveyance

If waste products cannot be safely disposed of or even suitably reused on site, they have to be transported elsewhere. Conveyance describes the way in which products are moved from one process to another. Although products may need to be moved in various ways to reach the required process, the long-est and most important gap lie between on-site storage and (semi-) centralised treatment.

Figure 23: Conveyance systems in FSSM



Source: SSWM tool box

The technical and physical criteria for choosing appropriate conveyance technology/system are as follows;

- Water availability,
- Ground condition,
- Ground water level and contamination.

A. Human-powered Emptying

Human-powered emptying and transport refer to the different ways in which people can manually empty and/or transport sludge and solid products generated in on-site sanitation facilities.

Human-powered emptying of pits, vaults and tanks can be done in one of two ways:

- using buckets and shovels, or
- using a portable, manually operated pump specially designed for sludge (e.g., the Gulper, the Manual Diaphragm Pump or the MAPET).

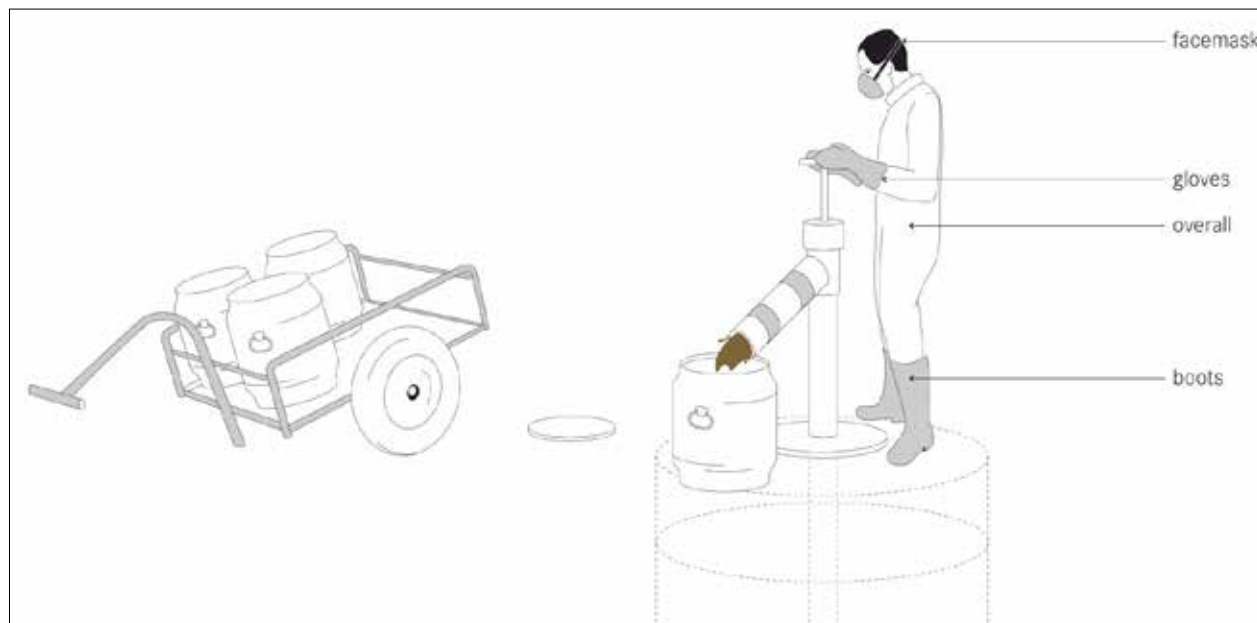
Manual sludge collection falls into two general categories, namely 'cartridge containment' and 'direct lift'. Cartridge containment and direct lift methods can be practiced safely when operators perform their tasks with the proper equipment following appropriate procedures. For instance, descending into pits as currently practiced in several areas of our country is not safe and legally banned through manual scavenging act.

Dumping of FS directly into the environment rather than discharging at a transfer or treatment site must also be avoided. In addition, local government, can help promote hygienic FS collection by highlighting best practices, imposing restrictions on unsafe practices, and providing incentives such as training, capacity building, and licensing. Formalising the informal sector through training and licensing will drive the demand for improved services, will improve hygiene, and enable business development and job creation.

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.

Figure 24 : Human Powered Emptying and Transport - Gulper



Source: Titley et al., 2014

Pros	Cons
<ul style="list-style-type: none"> ▪ Potential for local jobs and income generation ▪ Simple hand pumps can be built and repaired with locally available materials ▪ Low capital costs; variable operating costs depending on transport distance ▪ Provides services to areas/communities without sewers 	<ul style="list-style-type: none"> ▪ Spills can happen which could pose potential health risks and –generate offensive smells ▪ Time-consuming: emptying pits out can take several hours/days depending on their size ▪ Garbage in pits may block pipe ▪ Some devices may require specialized repair (welding)

Manually operated diaphragm pumps, are simple low-cost pumps capable of extracting low viscosity FS 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.

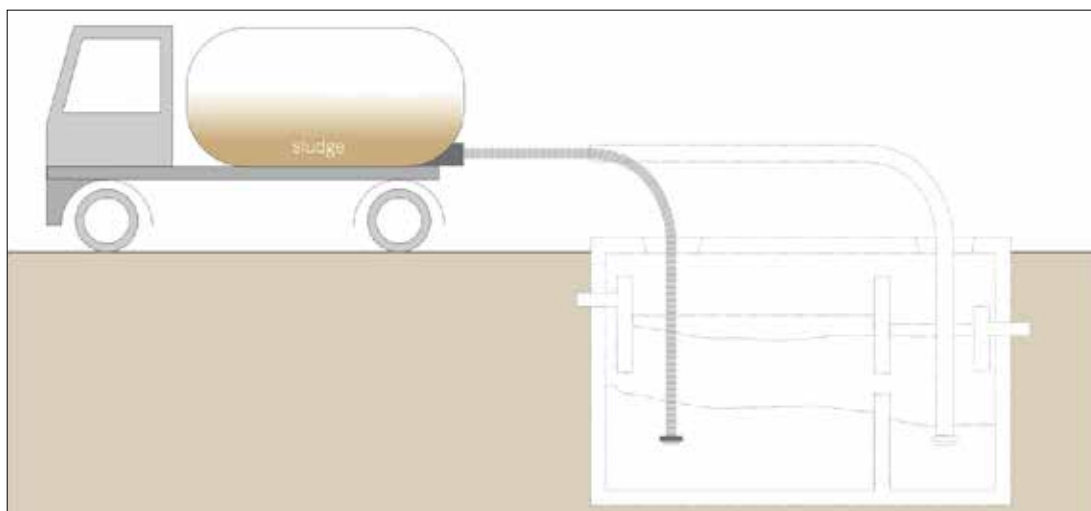
Figure 25: Manually Operated Diphragm Pump used in Bangladesh



B. Motorised Emptying and Transport

Motorized emptying and transport refer to a vehicle equipped with a motorised pump and a storage tank for emptying and transporting faecal sludge and urine. Humans are required to operate the pump and manoeuvre the hose, but sludge is not manually lifted or transported. A truck is fitted with a pump which is connected to a hose that is lowered down into a tank (e.g., Septic Tank) or pit, and the sludge is pumped up into the holding tank on the vehicle. This type of design is often referred to as a vacuum truck.

Figure 26 : Schematic Diagram of Motorised Emptying and Transport



Source: EAWAHG,2005

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;
- 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.

Figure 27: Representative Vacuum Trucks



Depending on the Collection and Storage technology, the sludge can be so dense that it cannot be easily pumped. In these situations, it is necessary to thin the solids with water so that they flow more easily, but this may be inefficient and costly. Garbage and sand make emptying much more difficult and clog the pipe or pump. Multiple truckloads may be required for large septic tanks.

Although large vacuum trucks cannot access areas with narrow or non-driveable roads, they remain the norm for municipalities and sanitation authorities. These trucks can rarely make trips to remote areas (e.g., in the periphery of a city) since the income generated may not offset the cost of fuel and time. Therefore, the treatment site must be within reach from the serviced areas.

In Vacutug, the storage tank is 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 motorised tricycle	9,75,375
V	1000	Narrow	Medium Haul	Mounted on chassis of motorised tricycle	9,75,375

Transfer Stations and adequate treatment are also crucial for service providers using the small-scale motorised equipment. Field experiences have shown that the existing designs for dense urban areas are limited regarding their emptying effectiveness and travel speed, and their ability to negotiate slopes, poor roads and very narrow lanes. Moreover, demand and market constraints have prevented them from becoming commercially viable. Under favourable circumstances, small vehicles like the Vacutug can recover the operating and maintenance costs. However, the capital costs are still too high to run a profitable business sustainably.

Both the sanitation authority and private entrepreneurs may operate vacuum trucks, although the price and level of service may vary significantly. Private operators may charge less than public ones but may only afford to do so if they do not discharge the sludge at a certified facility. Private and municipal service providers should work together to cover the whole faecal sludge management chain.

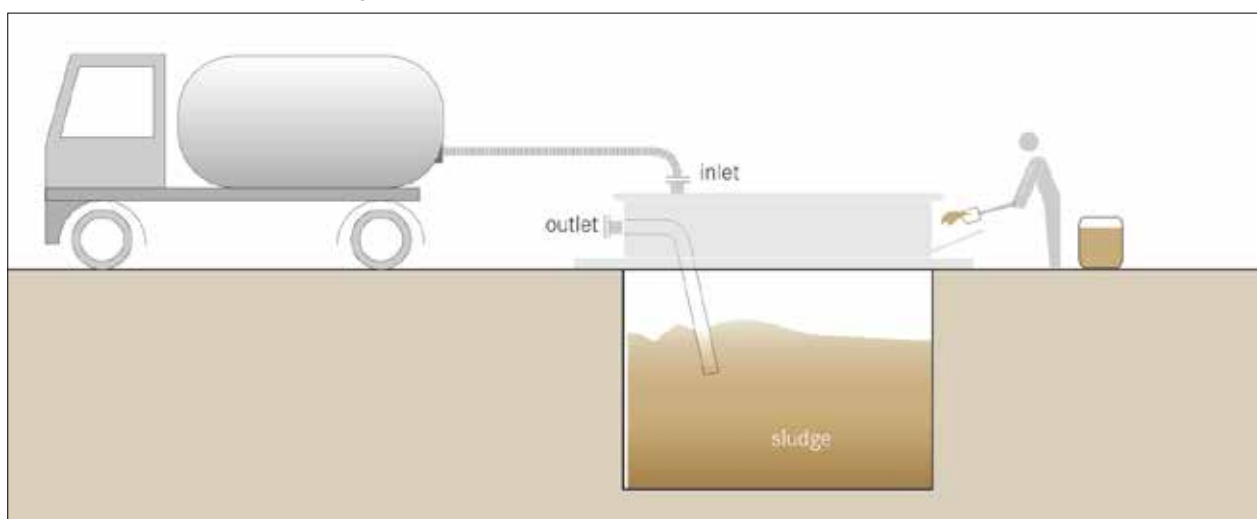
Pros	Cons
<ul style="list-style-type: none"> ▪ Fast, hygienic and effective sludge removal ▪ Efficient transport possible with large vacuum trucks ▪ Potential for local job creation and income generation ▪ Provides an essential service to non-sewered areas 	<ul style="list-style-type: none"> ▪ Cannot pump thick, dried sludge (must be thinned with water or -manually removed) ▪ Garbage in pits may block hose ▪ Cannot empty deep pits due to limited suction lift ▪ Very high capital costs; variable operating costs depending on use and maintenance ▪ Hiring a vacuum truck may be unaffordable for poor households ▪ Not all parts and materials may be locally available ▪ May have difficulties with access

C. Transfer Stations

Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge when it cannot be easily transported to a Faecal Sludge or Septage Treatment facility. A vacuum truck is required to empty transfer stations when they are full.

Operators of human-powered or small-scale motorised sludge emptying equipment (see Human-Powered and Motorized Emptying and Transport) discharge the sludge at a local transfer station rather than illegally dumping it or travelling to discharge it at a remote treatment or disposal site. When the transfer station is full, a vacuum truck empties the contents and takes the sludge to a suitable treatment facility. Municipalities or sewerage authorities may charge for permits to dump at the transfer station to offset the costs of operating and maintaining the facility.

Figure 28: Schematic Presentation of Transfer STATION



Source: EAWAG, 2005

In urban settings, transfer stations have to be carefully located. Otherwise, odours could become a nuisance, especially, if they are not well maintained. A transfer station consists of a parking place for vacuum trucks or sludge carts, a connection point for discharge hoses, and a storage tank. The dumping point should be built low enough to minimise spills when labourers manually empty their sludge carts.

Additionally, the transfer station should include a vent, a trash screen to remove large debris (garbage) and a washing facility for vehicles. The holding tank must be well constructed to prevent leaching and surface water infiltration. A variation is the sewer discharge station (SDS), which is like a transfer station but is directly connected to a conventional gravity sewer main. Sludge emptied into the SDS is released into the sewer main either directly or at timed intervals (e.g., by pumping) to optimise the performance of the sewer and of the wastewater treatment plant, and reduce peak loads.

Transfer stations can be equipped with digital data recording devices to track the quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads.

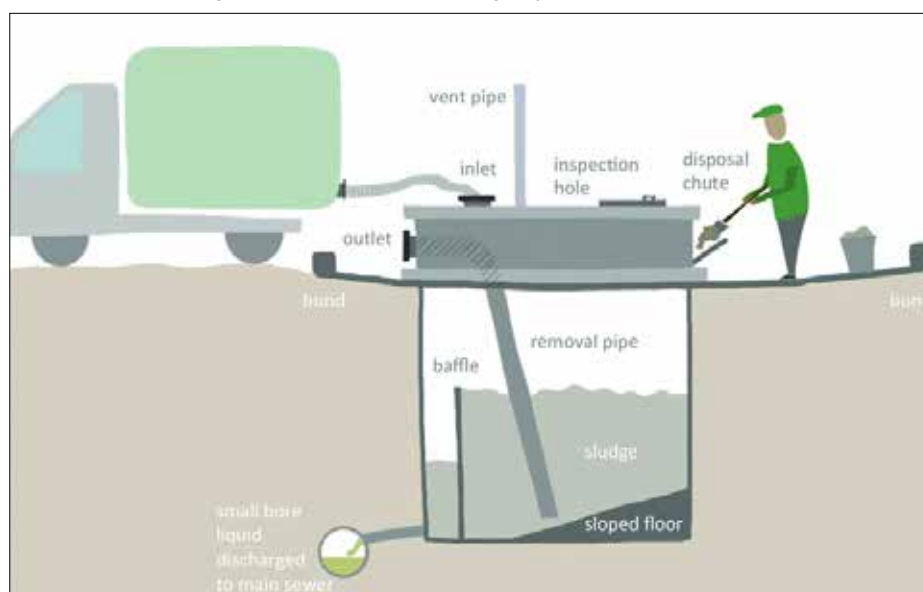
The system for issuing permits or charging access fees must be carefully designed so that those who most need the service are not excluded because of high costs, while still generating enough income to sustainably operate and maintain the transfer stations.

Pros	Cons
<ul style="list-style-type: none"> ▪ Makes sludge transport to the treatment plant more efficient, especially where small-scale service providers with slow vehicles are involved ▪ May reduce the illegal dumping of faecal sludge ▪ Costs can be offset with access permits ▪ Potential for local job creation and income generation 	<ul style="list-style-type: none"> ▪ Requires expert design and construction ▪ Can lead to odours if not properly maintained

A. 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.

Figure 29: Permanent Storage Type Transfer Station



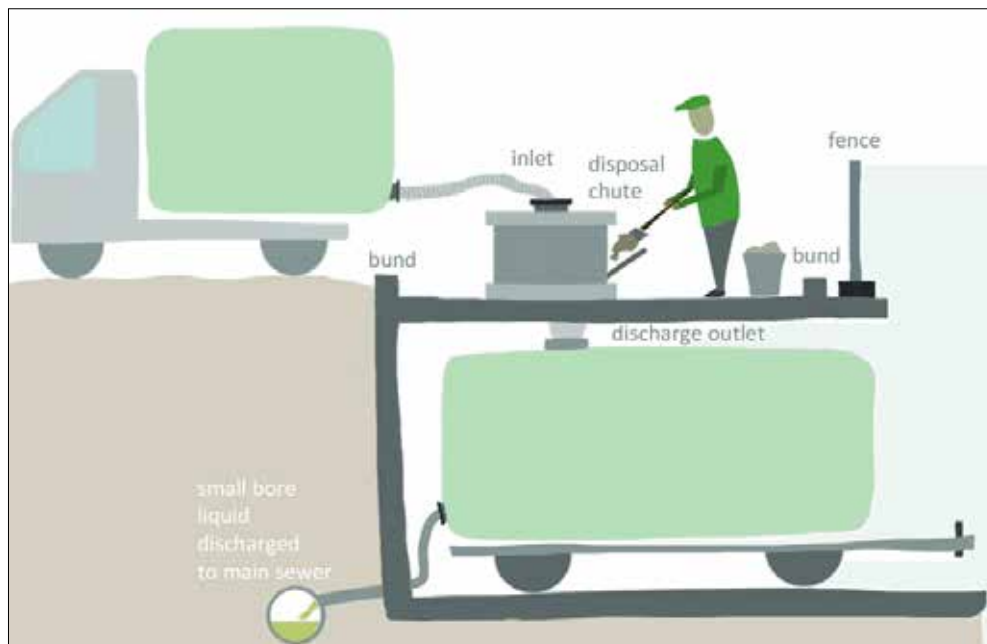
Source: IWFSM Book, IWA

B. 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)

Figure 30: Mobile Transfer Station



Source: FSM Book, IWA

C. Multifunctional Permanent Tank

Multi-functional permanent tank in addition to providing storage capacity, it can also accept fresh FS from a public toilet, and/or provide partial sludge treatment. This latter design feature could include processes such as dewatering (settling tanks, drying beds, geotubes - ERE Consulting Group and Indah Water Konsortium, 2012) or anaerobic digestion (e.g. septic tanks, anaerobic baffled reactors, biogas digesters). The main advantage of stations providing both access to fresh FS and treatment capacity is easier siting due to acceptance by community and a reduction in secondary transport fees due to dewatering. Furthermore, treatment byproducts (e.g. liquid effluent or biogas) could be used if further treatment is provided.

Figure 31: Multifunctional Permanent Tank

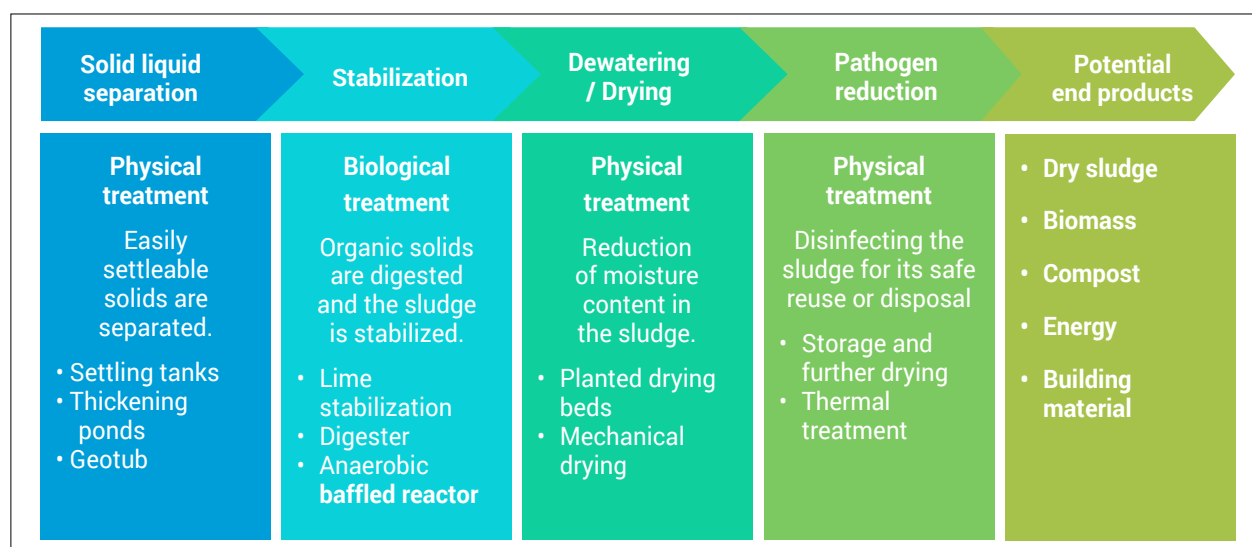


Source: FSM Book, IWA

3.3 Treatment Chain of Integrated Faecal Sludge and Septage Management (IFSM)

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 be numerous uses as listed in table.

Figure 32: Treatment Chain of IFSM



3.4 Selecting Context – Appropriate Treatment Options

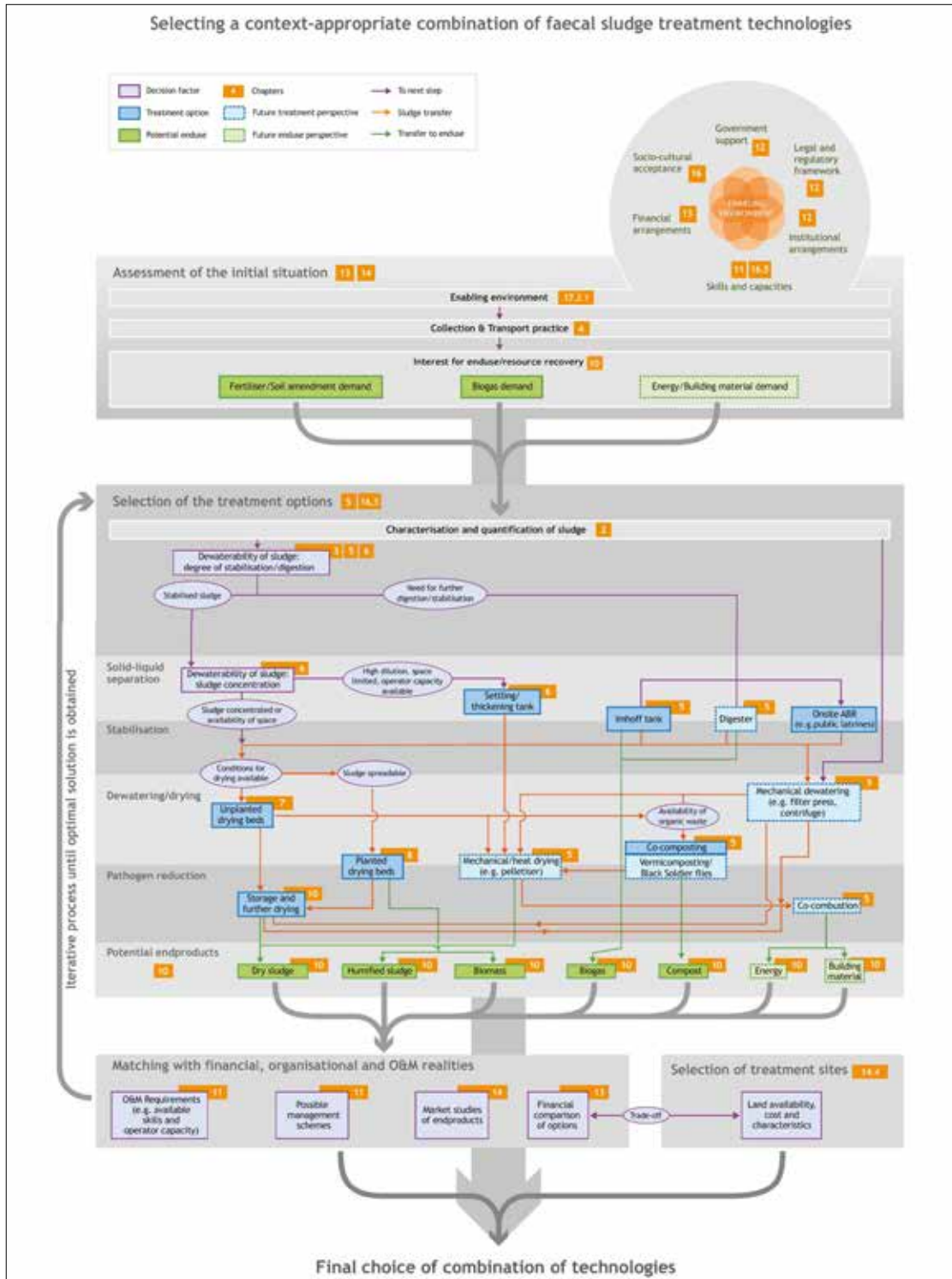
Setting up an FSM system is not only about the selection of single technological options, but about finding a sustainable combination of services that guarantees the appropriate collection, conveyance, treatment and disposal or enduses of FS, in a way that ensures household satisfaction, broad coverage and cost recovery.

An FSM system should be efficient and flexible, i.e. able to function normally and adapt to the frequency of sludge delivery and sludge quantities and characteristics, cope with climatic variations, produce end-products that are safe for use, be able to guarantee that the investment and O&M costs are acceptable and that are skilled employees for operation. Eleven criteria for the selection of a combination of technologies are proposed, divided into four categories: treatment performance, local context, O&M requirements and costs,

Table 2: Criteria for selection of treatment options

Treatment Performance	Local Context	Local Context	Costs
<ul style="list-style-type: none"> ▪ Effluent & sludge quality according to national standards 	<ul style="list-style-type: none"> ▪ Characteristics of sludge (dewaterability, concentration, degree of digestion, spreadability) ▪ Quantity & frequency of sludge discharged at the FSTP ▪ Climate ▪ Land availability & Cost ▪ Interest in enduses (fertiliser, forage, biogas, compost, fuel) 	<ul style="list-style-type: none"> ▪ Skills needed for operation, maintenance & monitoring available locally ▪ Spare parts available locally 	<ul style="list-style-type: none"> ▪ Investment costs covered (land, infrastructure, human resources, capacity building) ▪ O & M costs covered ▪ Affordability for households

It is important to realize that for the conversion of FS into a product that is safe for enduse or disposal, several processes need to take place. FS typically contains large volumes of water and hence needs to be dewatered, which can be achieved on its own, or in combination with solid/liquid separation. Depending on the end-goal, further treatment needs could include converting organic matter into a stabilized form and/or pathogen reduction. One of the key elements in designing any particular series of technologies is to keep the final goal in mind. If the final goal is to make a dry product that can be reused in agriculture, then particular care has to be paid to dewatering and pathogen reduction. If the goal is to incinerate the sludge for energy production, then dryness is very important while pathogens do not play a role (outside of worker protection).



3.5 Treatment Technologies

A. Co-treatment of FS in STP

One of the approaches for FS treatment is co-treatment with sewer-based wastewater treatment technologies. However, appropriate treatment facilities are needed at sewage treatment plants to receive, pre-treat, and distribute the septage into the appropriate process units. Septage which may be considered a high strength wastewater, can be either dumped into an upstream sewer or added directly into various unit processes in a sewage treatment plant. The considerably higher solids content of faecal sludge may lead to severe operational problems such as solids deposition and clogging of sewer pipes. This is mostly because the diameter and slope of sewers are designed for the transport of municipal wastewater typically containing 250 to 600 mg/L rather than the 12,000 to 52,500 mg/L present in FS. Hence, the first step in designing a co-treatment system includes determining how the FS will be transported to the treatment facility and discharged into the influent stream. Common problems with co-treatment of FS in STPs range from the deterioration of the treated effluent quality to overloading tanks and inadequate aeration.

B. Deep Row Entrenchment

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.

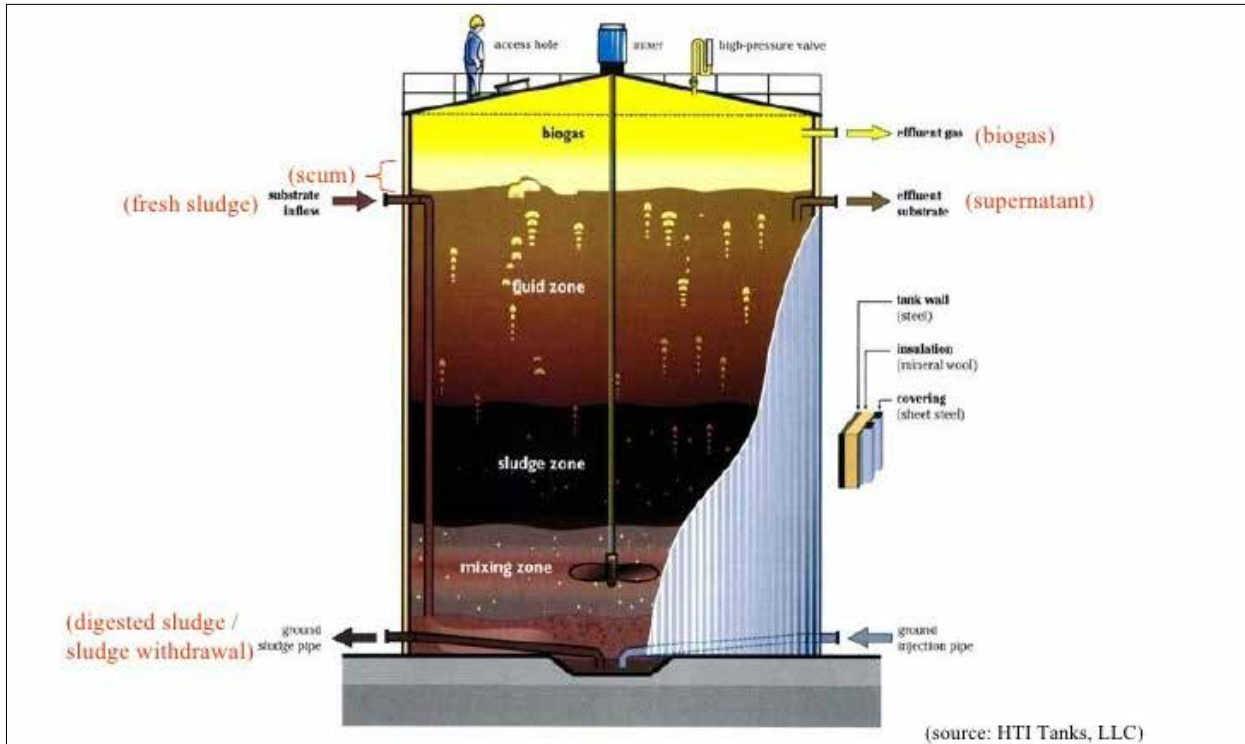
Constraints are that sufficient land has to be available in an area with a low enough groundwater table and, moreover, legislation still needs to catch up in many countries to allow for this technology.

C. Anaerobic Digestion

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)
- Hydraulic Retention Time (HRT)
- Temperature
- Alkalinity
- pH
- Toxic / inhibiting substances
- Bioavailability of nutrients and trace elements.

Figure 33: Representative Image of Anaerobic Digester



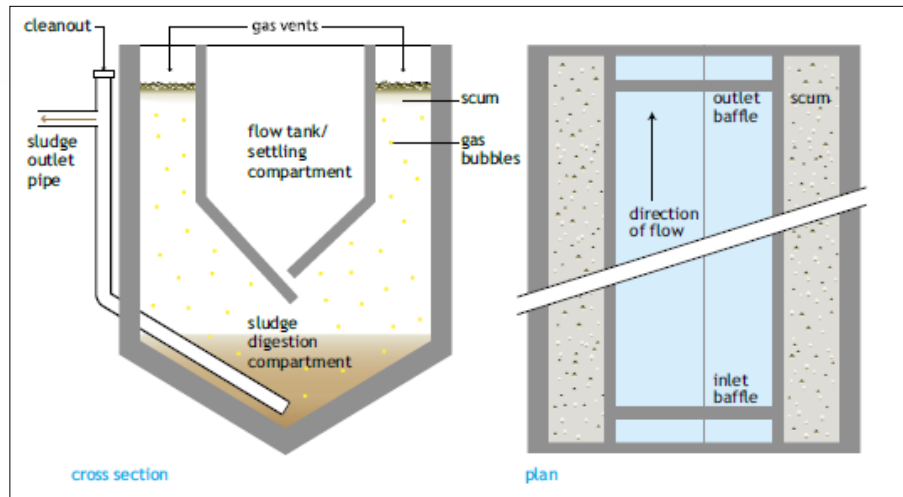
Advantages and Constraints

Anaerobic digestion has the potential to produce biogas while stabilising 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.

D. Imhoff Tanks

An Imhoff tank is a compact sized tank that combines the effect of a settler and an anaerobic digestion system in one. It is a compact system which is well-known for wastewater treatment and has been implemented in Indonesia for FS treatment. Imhoff tanks are most often used as a primary treatment technology in wastewater treatment where it serves as a solid-liquid separation system including partial digestion for the settled sludge. The Imhoff tank is a high raised tank (up to nine meters for wastewater sludge) where sludge settles at the bottom and biogas produced by the anaerobic digestion process rises to the top. The settling compartment has inclined walls (45° or more) and a slot at the bottom, which allows the sludge to slide down to the center into the digestion compartment. The gas transports sludge particles to the water surface, creating a scum layer. T-shaped pipes or baffles are used at the inlet and the outlet to reduce velocity and prevent scum from leaving the system. The sludge accumulates in the sludge digestion chamber, and is compacted and partially stabilized through anaerobic digestion.

Figure 34: Representative Schematic of Imhoff Tank



Source: FSM Book, IWA

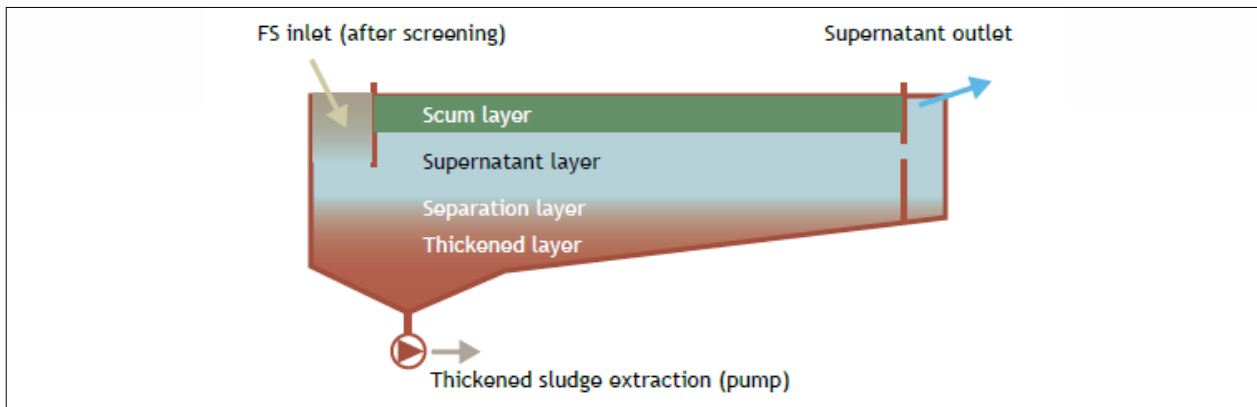
Advantages and Constraints

The main advantages of Imhoff tanks compared to settling-thickening tanks are the small land requirement, the possibility of operating only one tank, and the physical separation between the settled sludge and the liquid fraction. The main constraints compared to settling thickening tanks are the increased operational complexity, slightly higher costs as the Imhoff tanks require an additional elevation to accommodate the inclined baffles, and the risk of damage to the sludge draw-off pipe in case of an inadequate draw-off frequency. Operation and maintenance of an Imhoff system is not as complex as some technologies, but it requires skilled operators. Cleaning of flow paths, the sides of the tank as well as the removal of scum is very important.

E. Settling / Thickening Tanks

Settling-thickening tanks are used to achieve separation of the liquid and solid fractions of faecal sludge (FS). Settling-thickening tanks for FS treatment are rectangular tanks, where FS is discharged into an inlet at the top of one side and the supernatant exits through an outlet situated at the opposite side, while settled solids are retained at the bottom of the tank, and scum floats on the surface. During the retention time, the heavier particles settle out and thicken at the bottom of the tank as a result of gravitational forces. Lighter particles, such as fats, oils and grease, float to the top of the tank. As solids are collected at the bottom of the tank, the liquid supernatant is discharged through the outlet. Quiescent hydraulic flows are required, as the designed rates of settling, thickening and flotation will not occur with turbulent flows. Baffles can be used to help avoid turbulence at the inflow, and to separate the scum and thickened sludge layers from the supernatant.

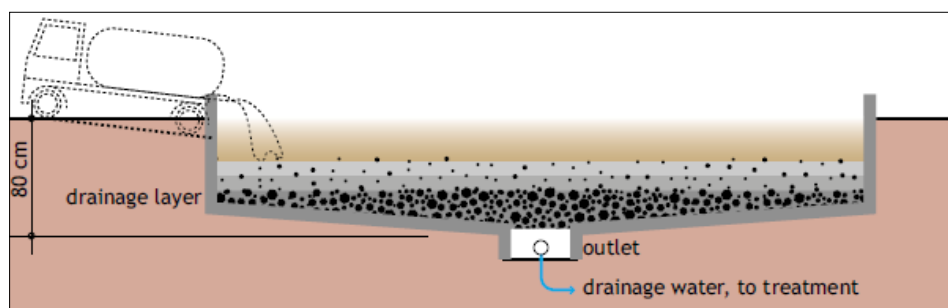
Figure 35: Representative Diagram of Settling-Thickening Tank



F. Unplanted Sludge Drying Beds

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.

Figure 36: Representative Diagram of Unplanted Drying Beds

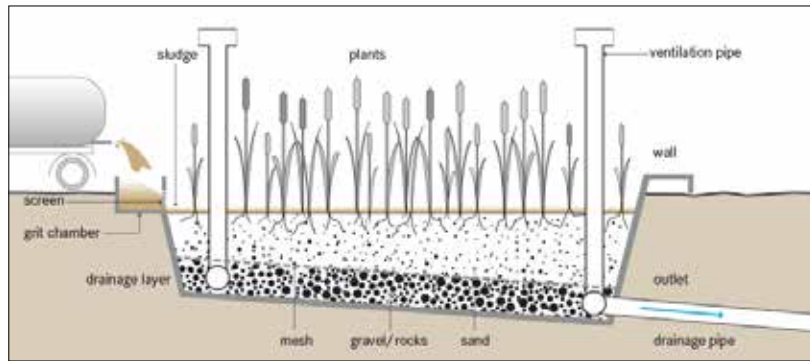


Source: FSM Book, IWA

G. Planted Drying Beds

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.

Figure 37: Representative Diagram of Planted Drying Beds



Source: Tilley et al. 2014

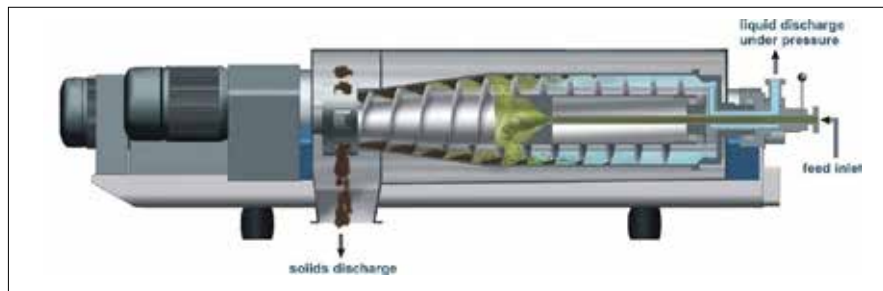
H. Mechanical Sludge Treatment

Mechanical dewatering or thickening can be carried out prior to, or following other treatment steps. Dewatering and thickening are important for reducing the volume of sludge that needs to be further treated or managed. After the sludge thickening process, additional reduction of the water content is often necessary and this can be done either naturally or by machine processes such as centrifugation or pressing. Four technologies that are widely used for dewatering WWTP sludge are the belt filter, the centrifuge, the frame filter press, and the screw press.

1. Centrifuge

Centrifuge 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.

Figure 38: Representative Diagram of Centrifuge

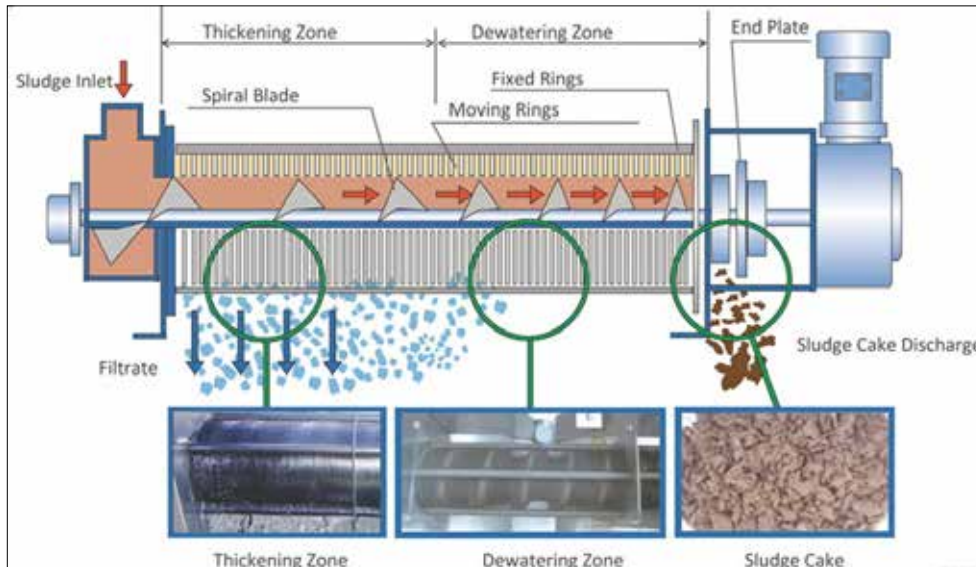


Source: www.flottweg.com

2. Screw Press

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.

Figure 39: Representative Diagram of Screw Press



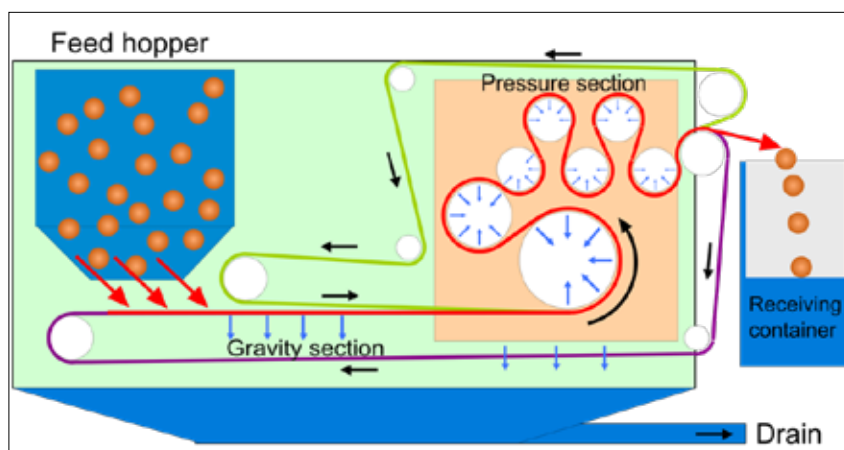
Source: www.ecologixsystems.com

3. Belt Press

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.

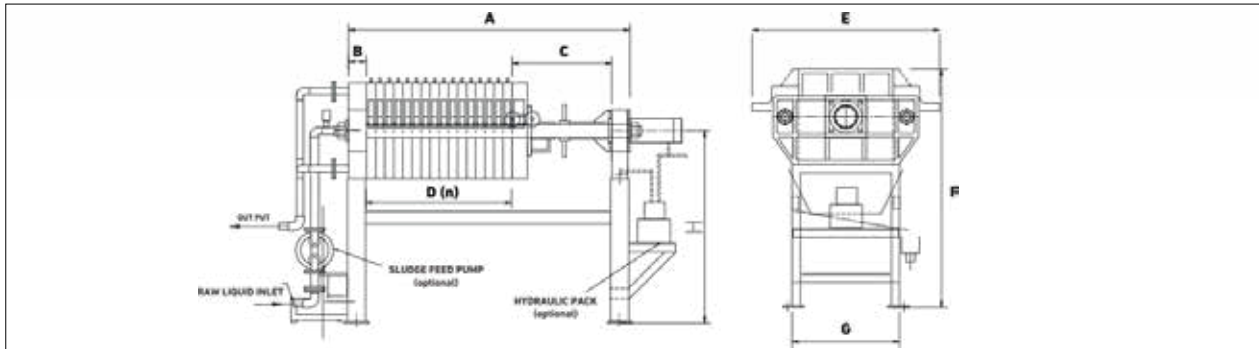
Figure 40: Representative Diagram of Belt Press



4. Frame-Filter Press

Frame-filter press system consists of porous vertical frames fixed in two walls that are positioned in front one of the other to create a chamber. This is a batch process in which the sludge is filled into the chamber at high pressure (up to 15 bars resulting in the leachate being released through the porous frames and the dewatered sludge being released through the opening of the lower wall).

Figure 41: Representative Diagram of Frame-Filter Press



Source: <https://www.fantasirekasembada.com/filter-press/>

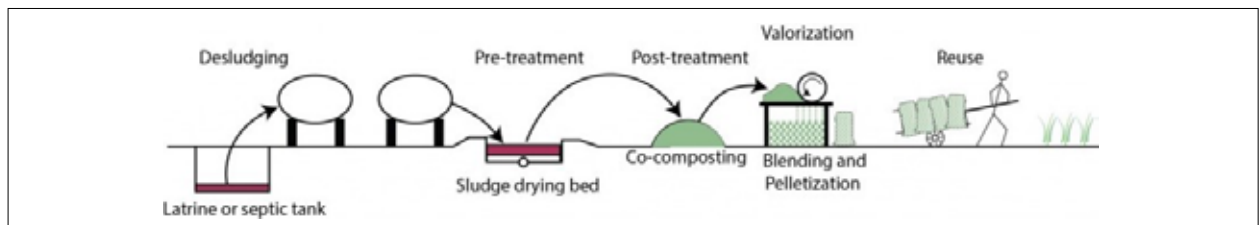
I. Co-composting of FS

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.

Figure 42: Representative Process of Co-composting



Source: www.wateratleeds.com

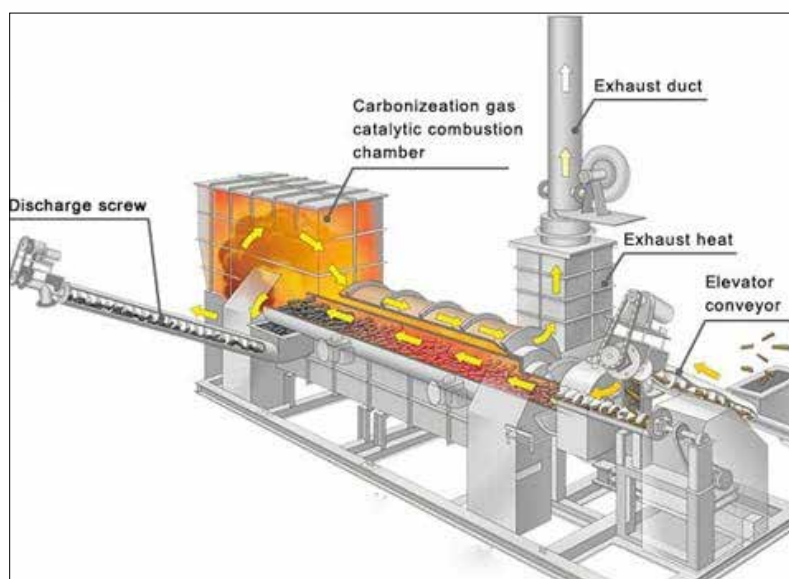
J. Sludge Incineration

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.

Figure 43: Representative Picture of Sludge Incineration Plant



Source: www.carbonizationfurnace.com

K. Thermal Drying and Pelletising – LaDaPa System

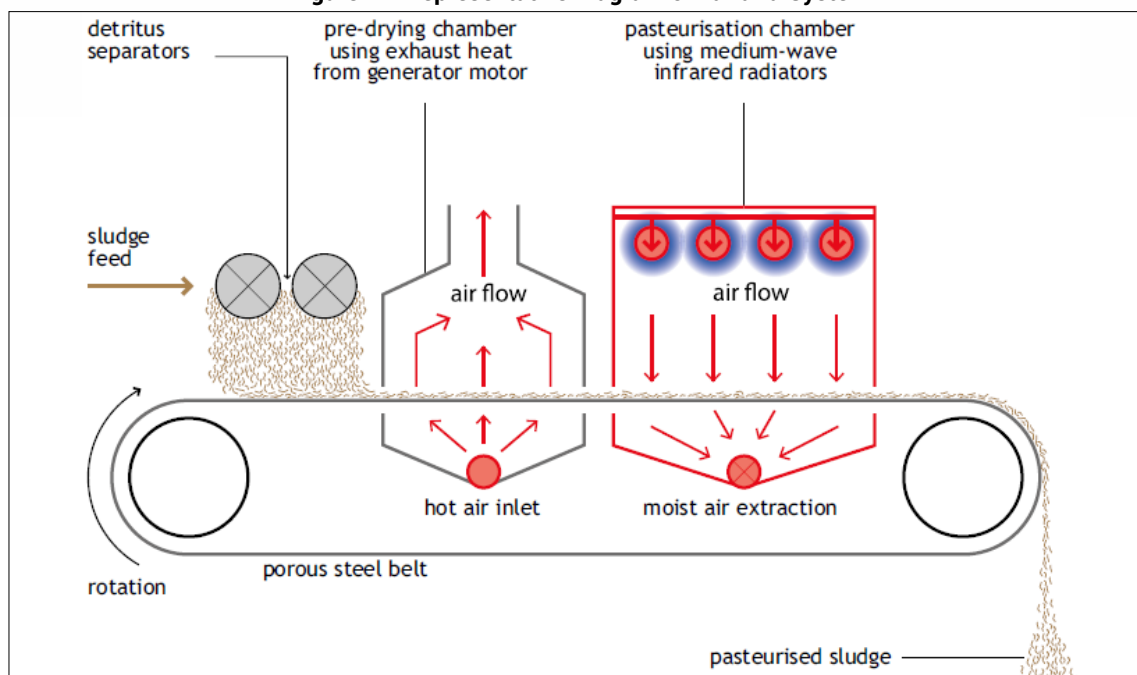
These systems require preliminary dewatering if used for sludge that is high in water content. In direct thermal driers, the hot air or gases are mixed with the dewatered sludge, as they pass through it, or are transported with it. In indirect thermal driers, a heat exchanger is used, which allows the 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 Constrains

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.

Figure 44: Representative Diagram of LaDaPa System



(Source: FSM Book, IWA)

L. Geotubes

Geotubes are of high-strength, permeable, specially engineered textiles designed for containment and dewatering of high moisture content sludge and sediment. They are available in a variety of sizes, depending on your volume and space requirements.

Figure 45: Geobags and its Application for Solid -Liquid Separation



Advantages and Constraints

The advantage is as high flow rate allows residual materials to dewater, whilst containing solids and Custom fabricated with seaming techniques that withstand pressure during pumping operations. The main constraint is it has to be disposed of after first use and can't be reuse it for second.

Further Readings

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2. EAWAG/SANDEC (2008): (Sandec Training Tool 1.0, Module 5). Duebendorf: Swiss Federal Institute of Aquatic Science (EAWAG), Department of Water and Sanitation in Developing Countries (SANDEC). http://www.susana.org/images/documents/07-cap-dev/c-training-uni-courses/available-training-courses/sandec-tool/05_fsm/index_05.htm
3. Rezek, J. AND I. Cooper. SEPTAGE MANAGEMENT. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/8-80/032 https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=ORD&dirEntryID=49911
4. https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=ORD&dirEntryID=49911 https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=124828

Session

04

Planning for FSSMs

1. Session Objectives

This session intends to

- To understand factors and decisions guiding the planning of septage (generation and its conveyance and treatment) management.
- To learn about the tools used for assessments.
- To know the sources of financing FSSM for towns
- To understand challenges and criteria for selection of faecal sludge treatment technologies

2. Session Plan

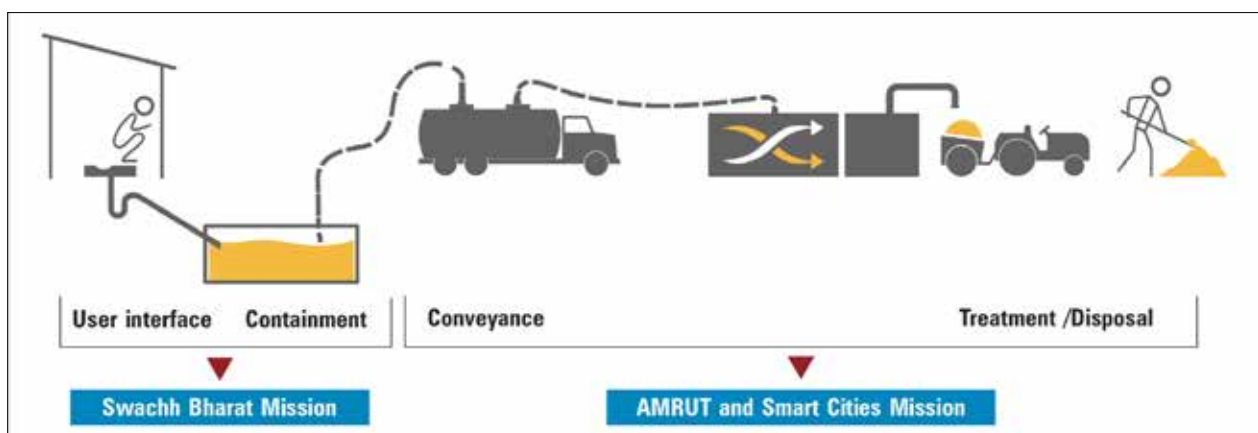
Activity	Time	Material /Methods
Financing- Estimation the per capita cost O&M Costing for Desludging Operations in small town	30 min	PowerPoint, flipcharts, markers
Preparing FSSM plan for respective ULB's – short term and long term action plan	60 min	PowerPoint, flipcharts, markers
Challenges across various components of service chain and identification of stakeholders	45 min	PowerPoint, flipcharts, markers
Solutions/Interventions/approaches adopted by the cities	15 min	Video

Session time: 60 min

3. Learning Notes

After understanding all the components of the FSSM value chain, it is essential to identify the possible financial sources to implement the FSSM plan in the city. Currently, SBM, Smart Cities Mission and AMRUT are the missions which have fund allocation for implementing FSSM in the city. Funds can be availed from the SBM for construction of individual toilets, public toilets, community toilets and OSS systems. Whereas fund for procuring vehicles and equipment for conveyance of septage, establishing treatment plant and disposal site, can be availed from the Smart Cities Mission and AMRUT mission. and services which accomplish this at each section of the chain, as shown in the picture below;

Figure 46:Source of across the sanitation value chain



Assessment of Financing Requirement Across the FSSM Value Chain

The ULB needs to assess the requirement of capex and opex across the value chain for better planning of FSSM.

Table 4: Assessment of Capex and Opex across FSSM Value Chain

	User Interface	Containment	Conveyance	Treatment/Disposal
Capex	Construction of new individual toilets, PTs and CTs	Construction of new septic tanks and refurbishments of septic tanks	Procurement of new suction emptier trucks	Land cost and construction cost of treatment plant
Opex	Fuel cost for emptier trucks, salaries of drivers, maintenance of machines etc.		Fuel cost for emptier trucks, salaries of drivers, maintenance of machines etc.	Operations of the treatment facility. Staff salaries, electricity bill etc.

Potential Sources of Financing for Capex and Opex

To ensure financial sustainability of FSSM services, it is important to assess capacity for financing of both capex and opex over the planned period. This can start with an assessment of financial requirements for both capex and opex, along with subsequent tariff restructuring, to make the system sustainable. The assessment also provides guidance on potential sources of finance for meeting these expenditures including funding through external grants, private sector investments, user contributions, external debt or through local government internal resources. (Ministry of Housing and Urban Affairs, 2013)

The ULB needs to identify the potential financial sources available to avail fund for capex across the value chain. For construction of new septic tanks, possible sources for supporting capex include HHs, government subsidy and CSR funds. For refurbishment of septic tanks, which is a part of containment, the predominant source of capex would be government subsidy or HHs have to borne the capex. For conveyance of septage, capex can be sought from central or state grants, and under local government schemes. Private sector participation is also a potential source for capex to procure vehicles. Establishing the FSTP and the disposal site are major areas where more funds will be required if any private land needs to be procured. Possible sources from where capex can be obtained would be grants from central and state governments, funds from local government and CSR funds. Private sector participation is also a potential source of finance but willingness of the private sector is to be assessed. The government typically will support only for the capex and not for opex; the ULBs have to explore possible sources to cover opex costs. Potential sources for opex may include housing society fees, annual sanitation tax, and desludging fees taken from the property owners on the request of desludging their OSS systems. Revenue generated by selling of product after the treatment of septage will also feed into opex revenues.

Identification of Revenue Sources

The ULB can decide to levy taxes/user charges or both, on the HHs for FSSM services. Opex can be recovered by levying taxes and user charges from HHs. The ULBs could introduce a sanitation tax. Such a sanitation tax will be paid by the HHs to the ULB as part of annual property taxes. An exercise is designed on how to fix the amount of tariff for sanitation tax for the properties.

Citywide FSSM Planning

A Rapid Assessment Tool is available which can be used for planning FSSM services in the city. Apart from this, the Centre for Water and Sanitation (C-WAS) has released a tool called SANIPLAN. With the help of these tools, FSSM planning will become quite easier for the city managers.



Rapid Assessment Tool

“Rapid Assessment Tool for City Septage Budgeting” is a tool designed and released by the MoHUA. The tool helps cities to assess cost estimates for faecal sludge management. Census data of 100 smart cities and 31 AMRUT Cities is built into the tool. The Ministry aims to support 131 designated cities in India to implement citywide faecal sludge management.

The objective of this tool is to estimate:

- Number of vehicles for FSSM service
- Capex for creating infrastructure for treatment of septage
- Opex for maintaining infrastructure and equipment

The ULB needs to fill up general information such as demographics, number of public and community toilets, individual toilets constructed, number of toilets with septic tanks and twin pits to be constructed in the remaining mission period, cleaning cycle of OSS systems, number of HHs using community toilets, existing number of vehicles for emptying septic tanks etc. After filling up the information asked in the tool, capex and opex will be calculated automatically.

SANIPLAN Tool for FSSM

SANIPLAN is a decision support tool that provides a structured approach to planning for urban sanitation. It focuses on integrated service performance with a detailed assessment of finances. It is a planning tool which can support more informed stakeholder participation. Based on local priorities, users can identify key actions for service improvement. Its dashboards also support more informed interaction with decisions makers. Sources of required data are also available³⁹.

SANIPLAN has three modules: 1) performance assessment, 2) planning and 3) financial planning. It provides a multi-year planning framework for improving performance on five service themes: access, equity, service levels and quality, efficiency and financial sustainability. A key feature of SANIPLAN is to develop a feasible financing plan for both capital and operating expenditures in context of local finances. SANIPLAN can be used for various sectors - water, sanitation, solid waste; and can also be customized for a specific context. (Centre for Water and Sanitation)

SaniTab

SaniTab is an easy to use app (android based only) for conducting sanitation surveys. It can be used to generate baseline information and to create a database for properties connected with OSS systems. It can be used for planning and monitoring ODF and faecal sludge management activities in cities, or for impact assessment. It is easy to administer and allows quick analyses.

Key features of SaniTab app:

- Citywide digital data collection tool
- Providing enabling environment for spatial analysis
- Quick and ease in survey, minimizing human error
- Real time monitoring of survey activity

Participants will be encouraged to do the following exercise to Calculate the tariff requirement to recover the O&M cost for the Requirement of opex for scheduled emptying service

4.1 Activity 01 – Group Exercise

Group Exercise 1: Calculate the total septage to be collected per day from CITY X

FSSM Plan		
Sr. No.	Description	No.
Input Details		
A	Population	65,251
B	Total Households (HHs)	13,112
C	HHs having toilets with septic tanks	9,901
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 a year	300
I	No. of trips possible per emptying vehicle per day (trips/day/vehicle)	4

1. Number of tanks to be emptied in a day = _____ daily

- HHs toilets connected to septic tank / cleaning cycle for HHs = _____ annually
- HHs toilets to be cleaned daily = annual cleaning / number of working days = _____ daily
- CTs connected to septic tank / cleaning cycles for CTs = _____ daily

2. Number of trucks required = _____ nos.

- Number of tanks to be emptied in a day / Number of trips per day = _____ nos.

3. Volume of septage to be treated = _____ cu.m. / day

- Average volume of HHs and CTs septic tanks x Number of tanks to be emptied in a day = _____ cu.m. / day

Group Exercise 2: Caculate the tariff requirement to recover the O&M cost

2A. requirement of opex for schduled emptying service

Assumption

Fuel efficiency of a truck as 5 km/litre
Fuel cost is 70/litre
Avg. distance of septage disposal site is 15 km
Avg. repair and maintenance cost of an emptier truck is 2,000/month
Requirement of human resource is 2 per truck and salary is 10,000/person
Emptying service is provided 300 days a year

Calculation Guide

Fuel cost for scheduled emptying service No. of septic tanks to be emptied daily * 300 * Average distance * 2 * fuel cost / fuel efficiency	
Repair and maintenance cost of emptier trucks Number of emptier trucks required * 12 * 2000	
Establishment cost No. of emptier trucks required * 12 * No. of human resource * monthly salary	
Sub Total (1+2+3)	
Total annual O&M cost for scheduled cleaning (including 10% overhead charges such as insurance and other miscellaneous cost) Sub Total (1+2+3) * 1.10	

Group Exercise 2: Caculate the tariff requirement to recover the O&M cost
2B. Requirement of opex for septage treatment plant

Assumption

< 25 cu.m./day = ₹ 5,000 per month
25-50 cu.m./day = ₹ 10,000 per month
50-75 cu.m./day = ₹ 15,000 per month
> 75 cu.m./day = ₹ 20,000 per month
Avg. repair and maintenance cost is 10,000/month
Requirement of human resource in two shifts is 4 and salary is ₹10,000/month per person
Assume all the HHs as individual properties

Calculation Guide

Energy cost for septage treatment facilities Energy cost per month * 12	
Repair and maintenance cost of the plant 12 * 10,000	
Establishment cost No. of human resource * monthly salary * 12	
Sub Total (1+2+3)	
Total annual O&M cost for septage treatment plant (including 10% overhead charges such as insurance and other miscellaneous cost) Sub Total (1+2+3) * 1.10	

A. Annual O&M cost = 2A +2B = ₹_____

B. Per property tariff requirement for septage management = ₹_____
 (Annual O&M cost (A) / total number of properties) * Tax collection efficiency

- Consider tax collection efficiency = 70%

Note: Users may calculate differential tariff structure across the properties uses; properties with toilet facility v/s properties dependent on the community toilets etc.

4. Answer Key to Group Exercises

Answer key to group exercises 1:

Number of tanks to be emptied in a day	14
Number of trucks required	4
Volume of septage to be treated	70 cu.m.

Answer key to group exercise 2:

2A. Requirement of opex for scheduled emptying service

Sr. No	Particular	Cost (in)
1	Fuel cost for scheduled emptying service	17,64,140
2	Repair and maintenance cost of emptier trucks	96,000
3	Establishment cost	9,60,000
4	Sub Total (1+2+3)	28,20,140
5	Total annual O&M cost for scheduled cleaning (including 10% overhead charges such as insurance and other miscellaneous cost)	31,02,154

2B. Requirement of opex for septage treatment plant

Sr. No	Particular	Cost (in)
1	Energy cost for septage treatment facilities	1,80,000
2	Repair and maintenance cost of the plant	1,20,000
3	Establishment cost	4,80,000
4	Sub Total (1+2+3)	7,80,000
5	Total annual O&M cost for septage treatment plant (including 10% overhead charges such as insurance and other miscellaneous cost)	8,58,000

Total annual opex: ₹39,60,154

Per property tariff requirement for septage management = ₹ 211 per year

Activity 02 – Group Exercise and Discussion on Action Plan

In this session the participants will be divided in the groups. Individual group has to prepare the short term and long term FSSM action plan for the respective ULB and then present the plan. The presentations can be done by the mode of flipcharts or PowerPoints sliders as per the convenience of the participants in the group.

Annexure 1

Pre-Evaluation Form

Q.1 An Open Defecation Free town is one where

- All households have access to toilets.
- All waste water is safely treated.
- All waste water is safely contained.
- None of the above

Q.2 Waste water treatment can be ensured by *(multiple answers possible)*

- Laying underground drainage and setting up sewage treatment plants (STP).
- Safely collecting wastewater using underground drainage and taking it out of the city or disposing in surface water body.
- Collecting of septic tank effluent and treating it.
- None of the above

Q.3 Sanitation systems in urban India are:

- Predominantly underground sewerage and STPs.
- Predominantly septic tanks and pit latrines.
- Predominantly open defecation.
- Predominantly small bore sewerage systems.

Q.4 Urban Local Bodies have a role in ensuring that septic tanks are built as per standards. Is this statement true?

- No, it is up to the household.
- Yes, as it is linked to building plan permission process.
- No, it's a responsibility of the Central Government.
- No, it's a responsibility of the State Government.

Q.5 What is the per capita cost of a centralized sewerage system for a city of 100,000 population?

- Less than 1000
- Less than 5,000
- Less than 10,000
- Above 10,000

Q.6 Do you think that the Manual Scavenging Act of 2013 applies to the manual emptying of septic tanks?

- No. It is only applicable to emptying of dry latrines.
- The Act is not relevant to waste treatment.
- No. It is only applicable to cleaning of sewers and drains.
- None of the above

Q.7 Waste water from a toilet is termed as:

- Grey water
- Blue water
- Black water
- None of above

Q.8 Is partial cleaning of waste water possible by disposing it in *kutchha* drains and *nallas*?

- No cleaning is possible as it further lowers the quality of waste water.
- Drains and *nallas* are like septic tanks. If their design is improved, they can partially clean waste water.
- All *kutchha* drains need to be converted to *pucca* drains for them to partially treat and clean waste water.
- If *kutchha* drains can be converted in to *pucca* drains, it is possible.

Q.9 Is a single pit considered as a sanitary latrine?

- Yes
- No
- May be
- Do not know

Q.10 A septic tank must be emptied

- Regularly (2-3 years)
- Only when it gets full and starts overflowing
- Every month
- Never

Q.11 The largest source of central government funding for septage and sewerage for a state government is from

- Swachh Bharat Mission Urban
- AMRUT
- Central Finance Commission
- Smart City Mission

Q.12 Following are characteristics of septage:

- Black in color
- High BOD, COD, TSS
- Well digested
- All of the above

Q.13 "Black Water" consists of...

- Urine
- Faeces
- Flushing water
- All of the above

Q.14 Which activities generate 'grey water'?

- Bathing
- Washing utensils
- Laundry
- All of the above

Q.15 The current discharge standards laid down by the Central Pollution Control Board (CPCB) mandates BOD to be less than

- 30 mg/L
- 30 gm/L
- 10 mg/L
- None of the above

Q.16 Having 'access to safe water supply' means

- Access with respect to distance.
- Adequate per capita availability of water.
- Good quality of water.
- All of the above

Q.17 Decentralized treatment system can be implemented at which level?

- Household level
- Community level
- Ward level
- All of the above

Q.18 What are the types of wastewater treatment processes?

- Physical treatment processes
- Biological treatment processes
- Chemical treatment processes
- All of the above

Q.19 Select the most important criteria for choosing a centralized system

- Population to be covered
- Area to be covered
- Population density of area
- All of the above

Q.20 What leads to eutrophication of water bodies?

- BOD
- COD
- Nitrates
- Phosphates

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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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