Sanitation Capacity
Building Platform

TRAINING MODULE ON PREPARATION OF DETAILED PROJECT REPORT

FOR FAECAL SLUDGE AND SEPTAGE MANAGEMENT

PART A: PRESENTATION SLIDES

ECOSAN SERVICES FOUNDATION

National Institute of Urban Affairs

TRAINING

ON

PREPARATION OF FAECAL SLUDGE AND SEPTAGE MANAGEMENT (FSSM) DETAILED PROJECT REPORT (DPR)

Presentation Slides

TITLE
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CONTENT
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CONTACT
National Institute of Urban Affairs
1st and 2nd floor Core 4B,
India Habitat Centre,
Lodhi Road, New Delhi 110003, India
Website: www.niua.org, scbp.niua.org

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About Sanitation Capacity Building Platform

National Institute of Urban Affairs (NIUA) is a national nodal institute that works closely with the Ministry of Housing and Urban Affairs (MoHUA), Government of India. The Sanitation Capacity Building Platform (SCBP) anchored by NIUA aims to build local capacity for planning, designing and implementing non-sewer decentralized sanitation solutions, with specific focus on Faecal sludge and septage management (FSSM) and waste water.

SCBP is a partnership of various research organizations and non-profit institutions (CPR, BORDA/CDD, CEPT, CSTEP, UMC, CSE, CPR, WASHi, iDECK, Dasara, Ecosan Services Foundation, AIILSG). The platform works in in partnership with national nodal training institutes working for Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Swachh Bharat Mission (SBM), with universities and research organizations and all stakeholders in the urban sanitation space. SCBP is supported by a grant from the Bill and Melinda Gates Foundation (BMGF).

Training on Preparation of Detailed Project Report (DPR) for Faecal Sludge and Septage Management

An Advanced Training Module

AGENDA

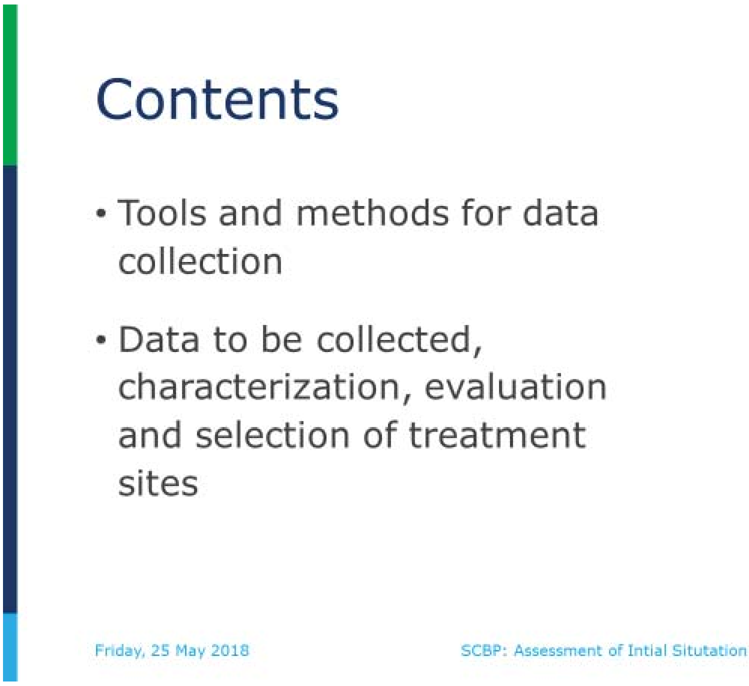
Day 1	
Time	**Session**
09.30 -10.00	Registration
10.00 -10.45	Getting to know each other
10.45 -11.00	**Coffee break**
11.00 -11.45	Planning of Integrated Faecal Sludge Management
11.45 -12.30	Assessment of Initial Situation
12.30-13.15	**Lunch**
13.15-14.00	Faecal Sludge Quantification and Characterization
14.00-14.45	Methods and Means for Collection and Transport of Faecal Sludge
14.15-15.00	**Coffee break**
15.00-16.00	Group Work - Collection and Transportation
16.00-16.30	Stakeholders Analysis

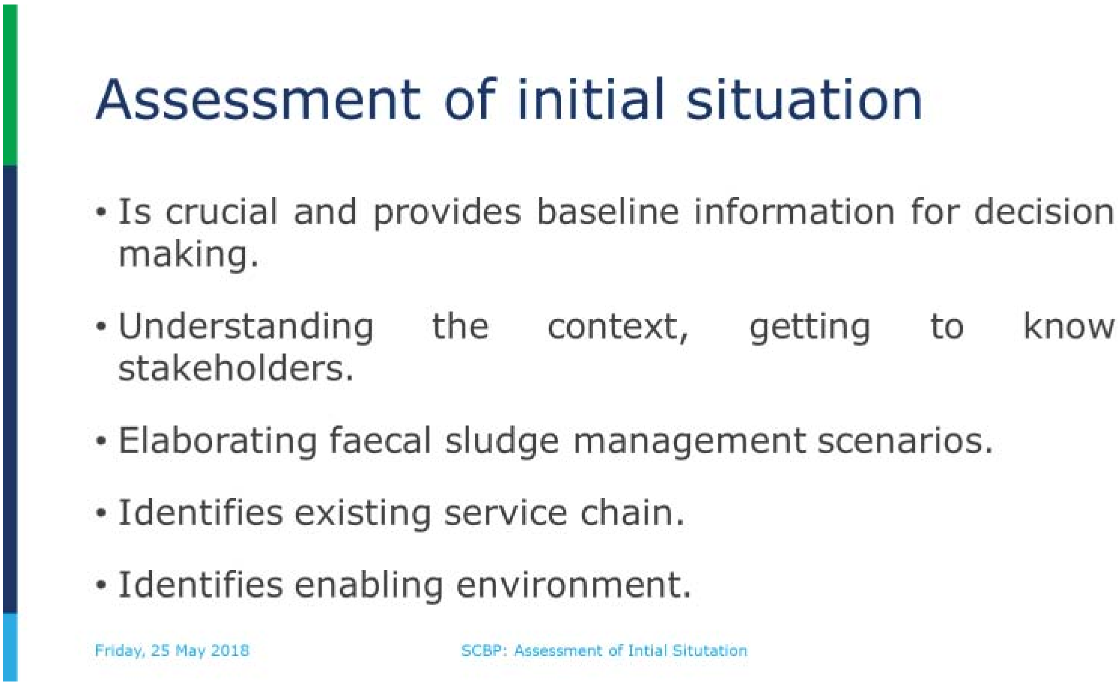
Day 2	
Time	**Session**
10.00-10.45	Faecal Sludge Treatment - 1
10.45-11.00	**Coffee break**
11.00-12.00	Faecal Sludge Treatment - II
12.00-13.00	FSSM approach with PMC - 3S India / Saraplast India Pvt. Ltd.
13.00-14.00	**Lunch**
14.00-15.15	Designing of FSTP Components
15.15-15.30	**Coffee break**
15.30-16.30	Designing of FSTP Components (continue)

Day 3	
Time	**Session**
09.00 -13.00	Site Visit -
	a) DTS & CW, COEP, Pune
	b) STP Sludge Management, Facility at Mhatre Bridge, Pune
	b) Anaerobic digestor, Hotel Waste SWM Facility, Swargate, Pune
13.00 -14.00	**Lunch**
14:00 -15:00	Financial aspects in FSSM
15.00 -15.15	**Coffee break**
15.15 -16.00	Closing Session and Distribution of Certificates

1 Module

1.1 Assessment of Initial Situation





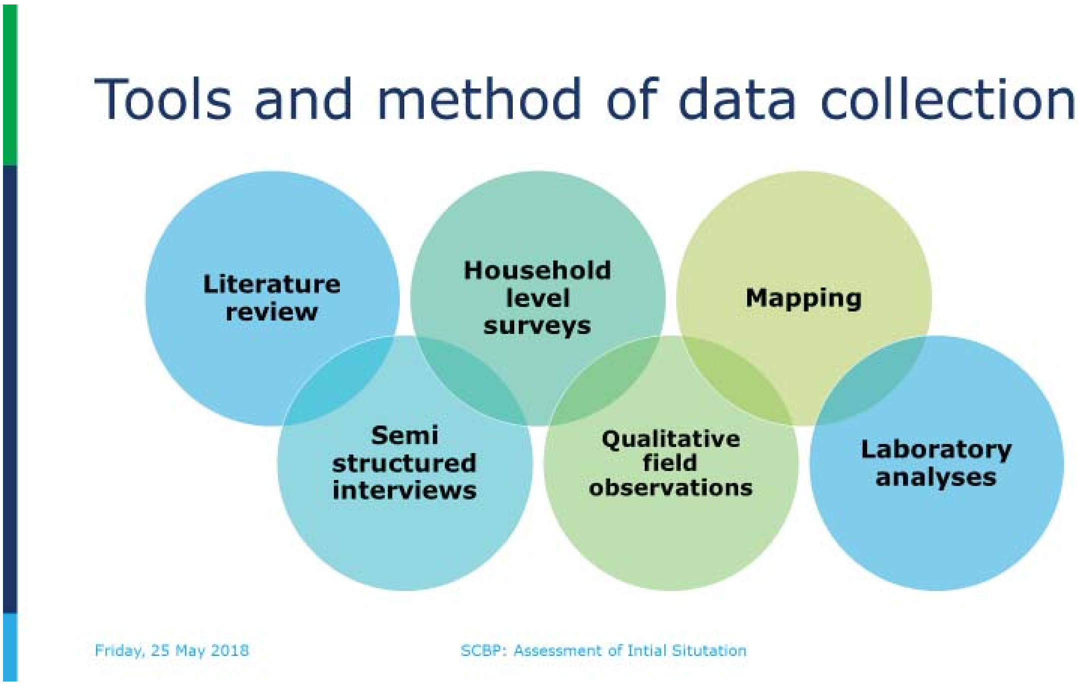
The main goal of the assessment of initial situation are to set the scene, understand the context, get to know the stakeholders and provide enough information to start elaborating the FSM scenarios.

Elaborating faecal sludge management scenario through the data collection step by step during exploratory investigations, preliminary studies and feasibility study.

Existing service chain – types of latrines, formal or informal sludge emptying sector, organisation of the systems and links between the stakeholders

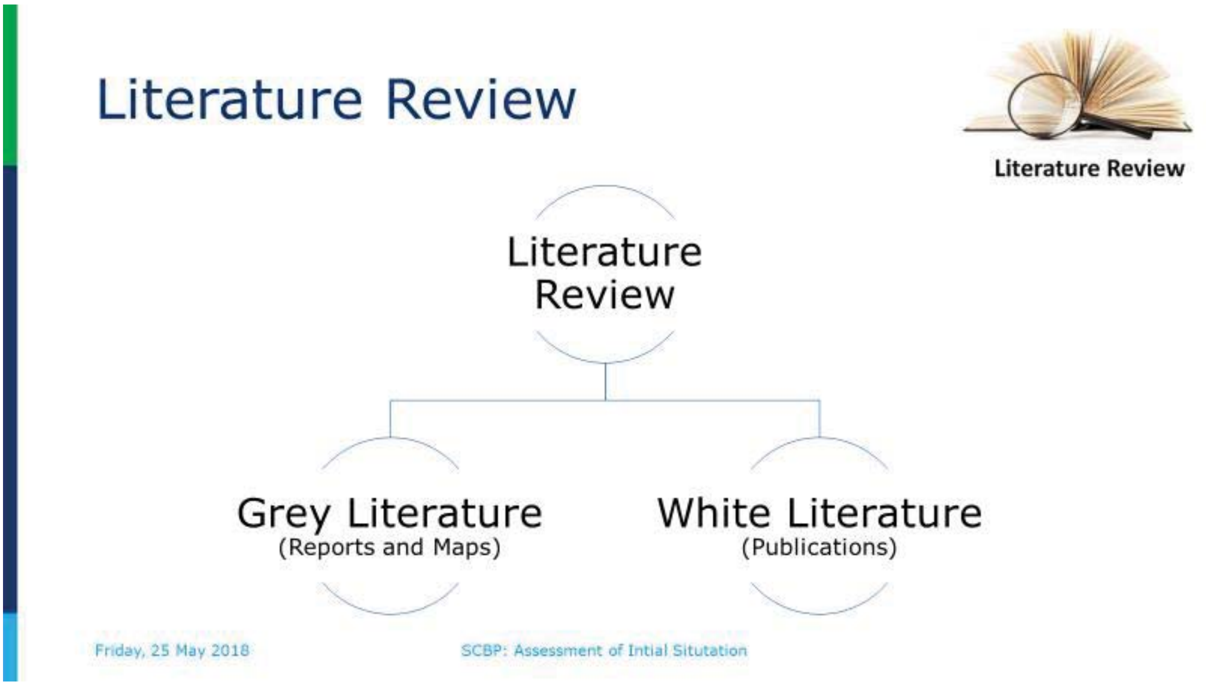
Enabling environment – government support, the legal and regulatory framework, institutional arrangements, skills and capacity, financial arrangements, socio-cultural acceptance.

1.1.1 Tools and methods for data collection

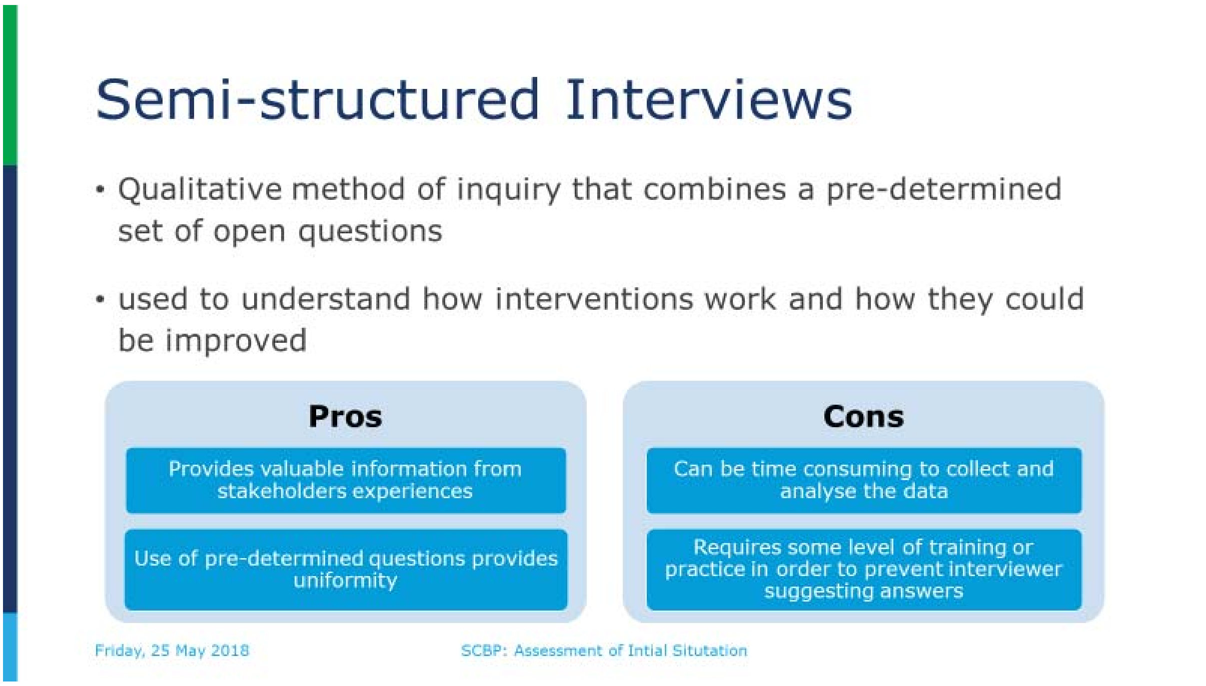


Collecting good quality, useful data is often not an easy process, especially in contexts where data is scarce, not collected or analyzed properly, hidden or manipulated for political or personal reasons.

Different tools and methods for data collection for the assessment of initial situation, a) Literature review, b) Household level surveys, c) Semi Structured Interviews, d) Qualitative field observations, e) Mapping, f) Laboratory analyses



Literature review consists of searching for data that already exists. Two types of literature are grey literature i.e. reports and maps and white literature i.e. publications. The main sources of information are government agencies as well as non-governmental agencies and international organisations.



Semi-structured interviews are one way to structure discussions aimed at collecting information. Those are conducted with a fairly open framework which allows for focussed two-way communication. Interview guide for FSSM stakeholders Link

Household Level Surveys

- What is the purpose of data to be collected and its expected use?
- Is the information available elsewhere?
- Stick to only the necessary questions, so as not to overburden the persons being surveyed
- Try to view the questions through the respondent's eyes wording is important
- The response or information obtained is only as good as the question is

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Household level surveys are a way of collecting information systematically, so that data collected from different sources can be easily compared and analysed quantitively e.g. Using statistics. In FSM, data is collected to assess the practices, perceptions and sanitation status. It allows the quantification and characterisation of the FS to be treated. Household level survey is very important in the case of scheduled desludging management.

SaniTab Tool

- To create database for Onsite sanitation system
- Mobile application developed by CEPT University, India
- Stakeholders - ULB's, Consultants
- Quick and ease in data collection and minimizes the human errors
- Real-time Monitoring

http://www.fsmtoolbox.com/view-all-tools/?

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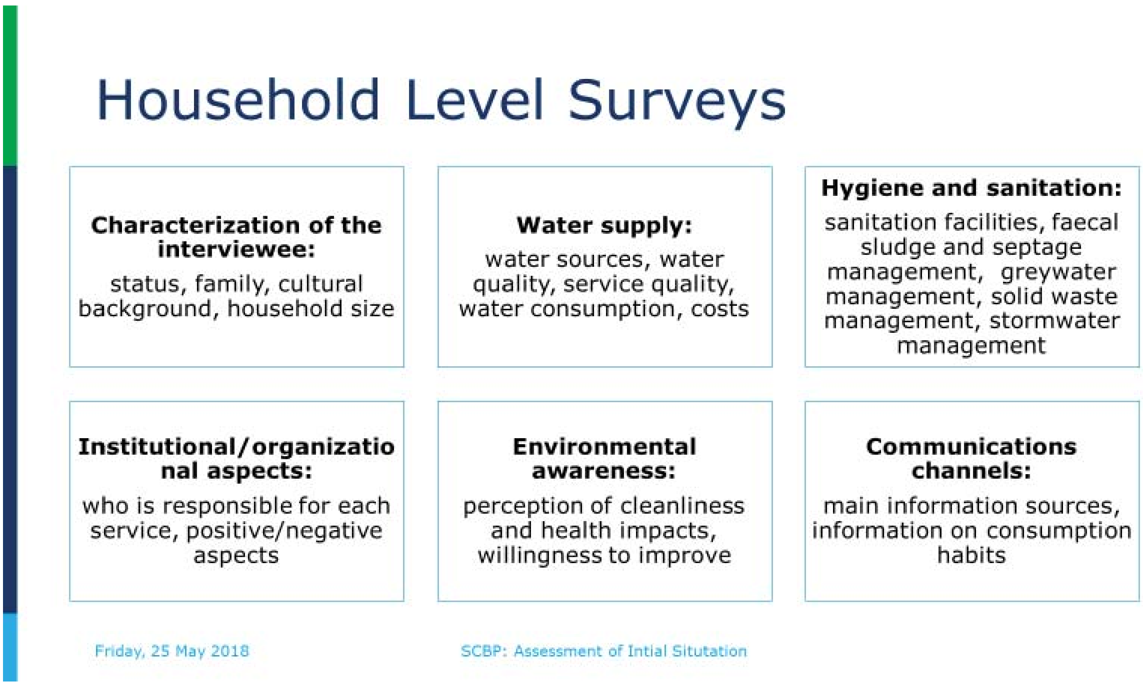
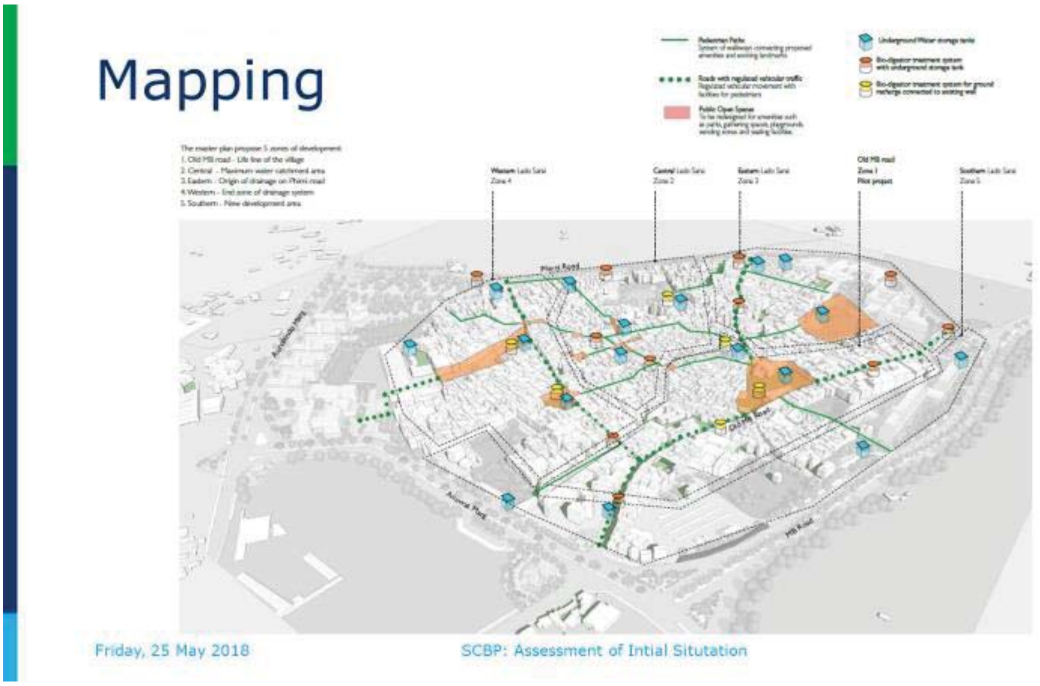
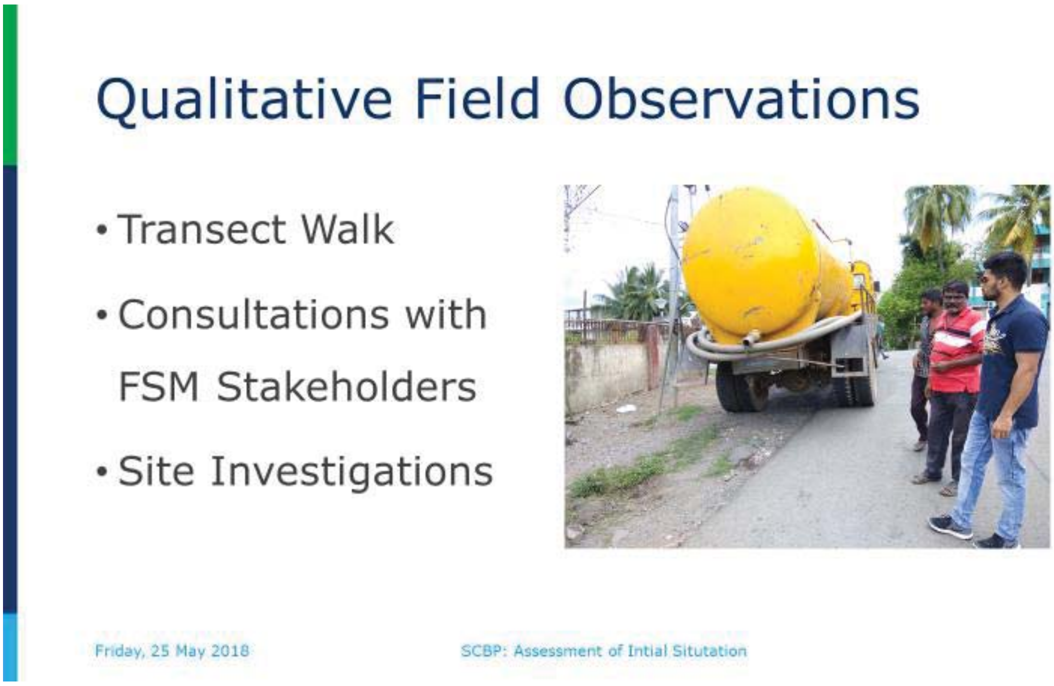
Key Features:

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, survey at scale. For more information, Link

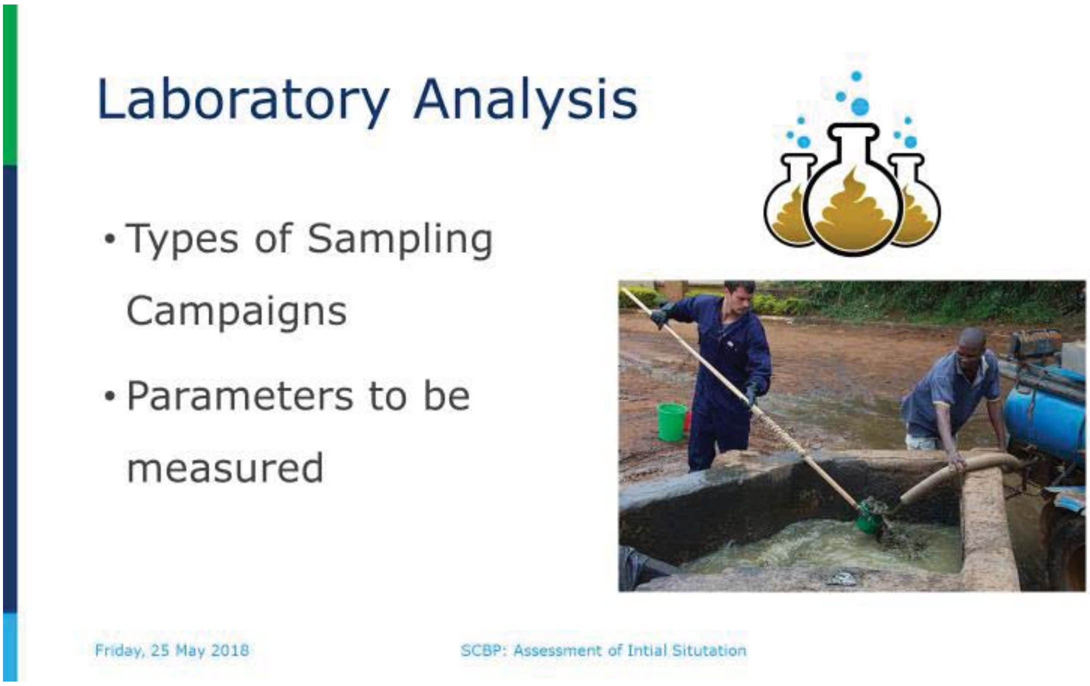




Mapping is essential for a clear and extensive analysis of the existing situation, when is comes to understanding the city structure and identifying the treatment sites. It is easier with the democratisation of satellite images and geographical information system (GIS).

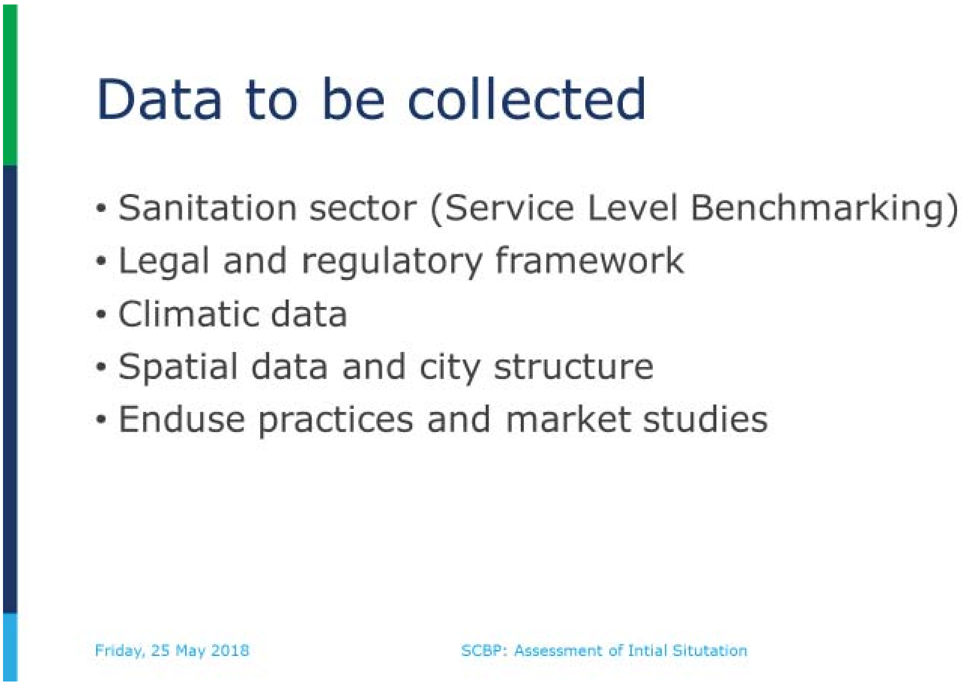


Qualitative field observations are a powerful to expose the all the stakeholders to reality, to understand the reality better, to cross-check the available information by observing and discussing with people and to built trust on-site with the main stakeholders. It includes, field visits, transect walks, one-to-one semi-structed interviews and focus groups with community members.



It is necessary to carry out the sampling campaigns and analyses to characterise the faecal sludge on site specific basis. Sludge characteristics vary significantly between and even within the cities.

1.1.2 Data to be collected and Selection of treatment sites



Data to be collected

Scheduled Desludging

- Household Level Survey
- Consultations with mechanical service providers (public or private)

On-demand desludging

- Consultations with Households or Community
- Profile of mechanical service providers

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Sanitation Sector (existing services data)

Latrines and On-site treatment	Water Availability
	Sanitation facilities
	On-site treatment
Waste Collection and Conveyance	Existing sewerage infrastructure
	Faecal sludge and septage collection services
Offsite wastewater treatment	Wastewater Treatment
	Discharge or enduse

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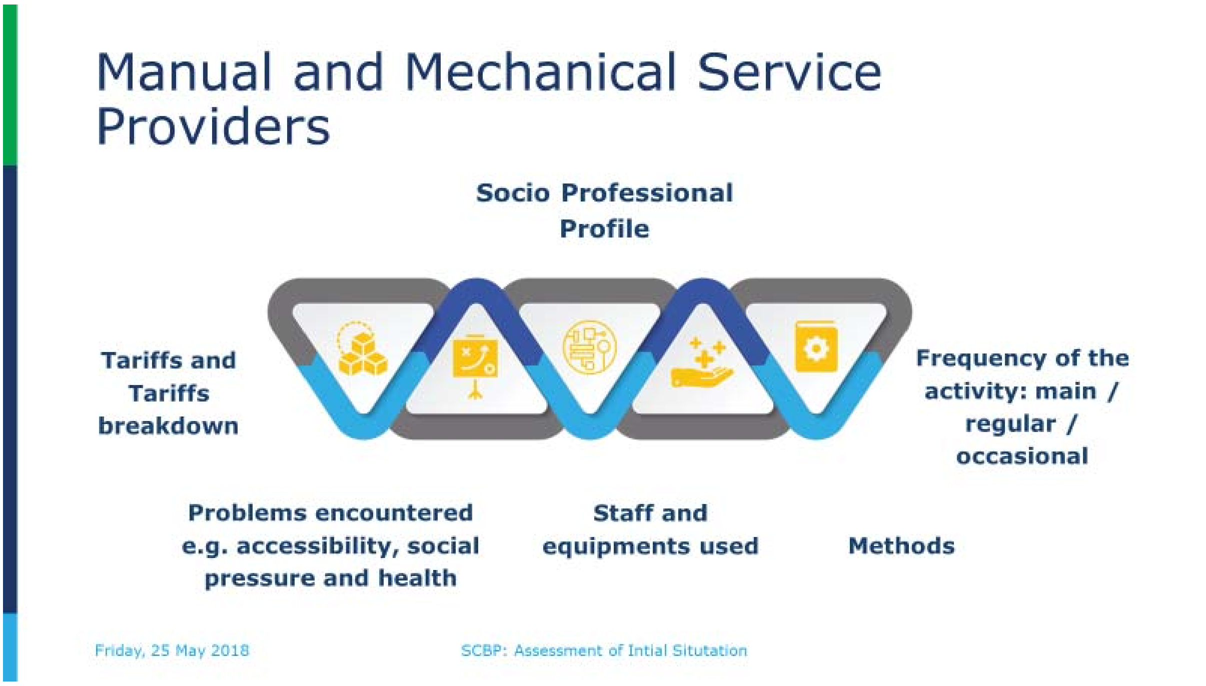
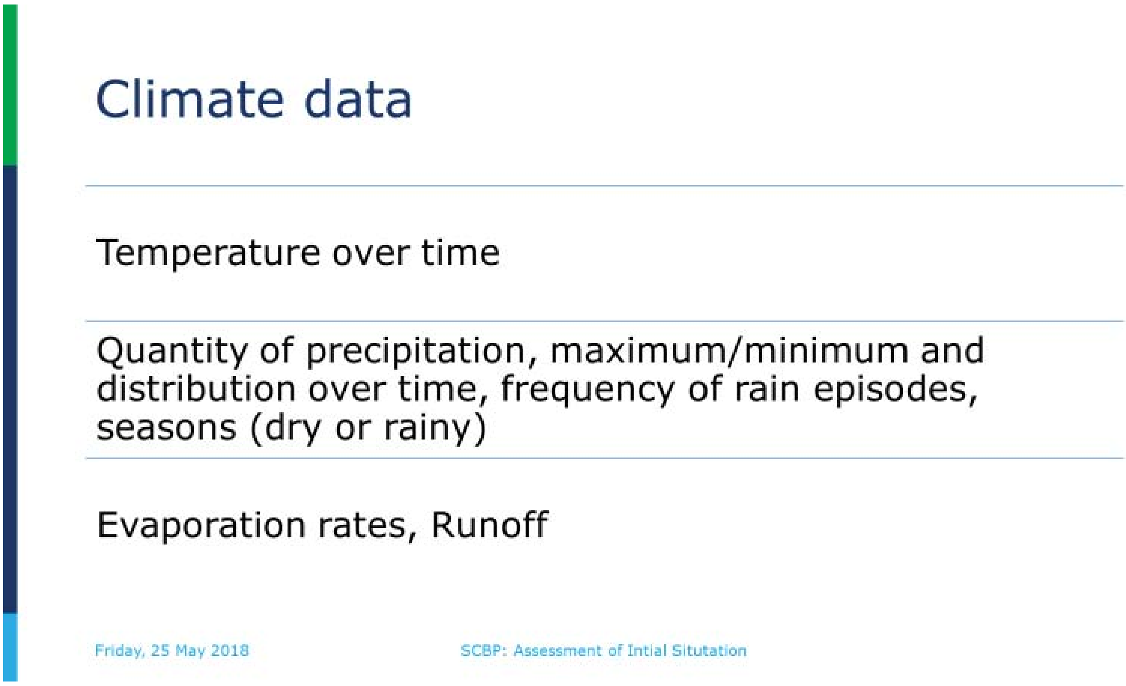
Information required,

- Sanitation stakeholders and their roles
- Collection/transport/treatment/disposal facilities: sewered or non-sewered areas, emptying services, emptying modes, disposal sites, tariffs, solid waste management, enduses and resource recovery initiatives
- Analysis of institutional framework
- Analysis of the legal and regulatory framework

- Financial analysis of the existing situation i.e. the financial flows between the existing FSM stakeholders.





Climate is the key factor for the selection of treatment options, i.e. the amount of rain and its distribution over time. It affects a FSTP in two ways,

- Directly, as it affects sludge dewatering
- Indirectly, as it affects the filling rate of latrines, the emptying frequency and the quantity and characteristics of sludge to be treated in the FSTP.

It is crucial to understand how a city is organised and around which features. Factors like population density, socio-economic stratification, types of housing, topography, accessibility, traffic, the presence of existing sewer lines, and the quality of service provision often influence the sludge emptying patterns. These also have an influence on the selection of locations for treatment sites and transfer stations.

Identification of sites

Criteria	Conditions
Average transport distance for mechanical service provider	Acceptability and affordability for service providers, as defined during interviews
Accessibility	Ease of access
Surface area	> 0.3 ha
Land ownership and price	Guarantee to be able to buy, at a reasonable price
Neighbourhood, potential for urbanisation	Risk of future access
Topography	No risk of flooding
Soil type	Free soil (unconsolidated)
Groundwater table	> 2m
Opportunities for disposal	Must have end use possibilities or disposal

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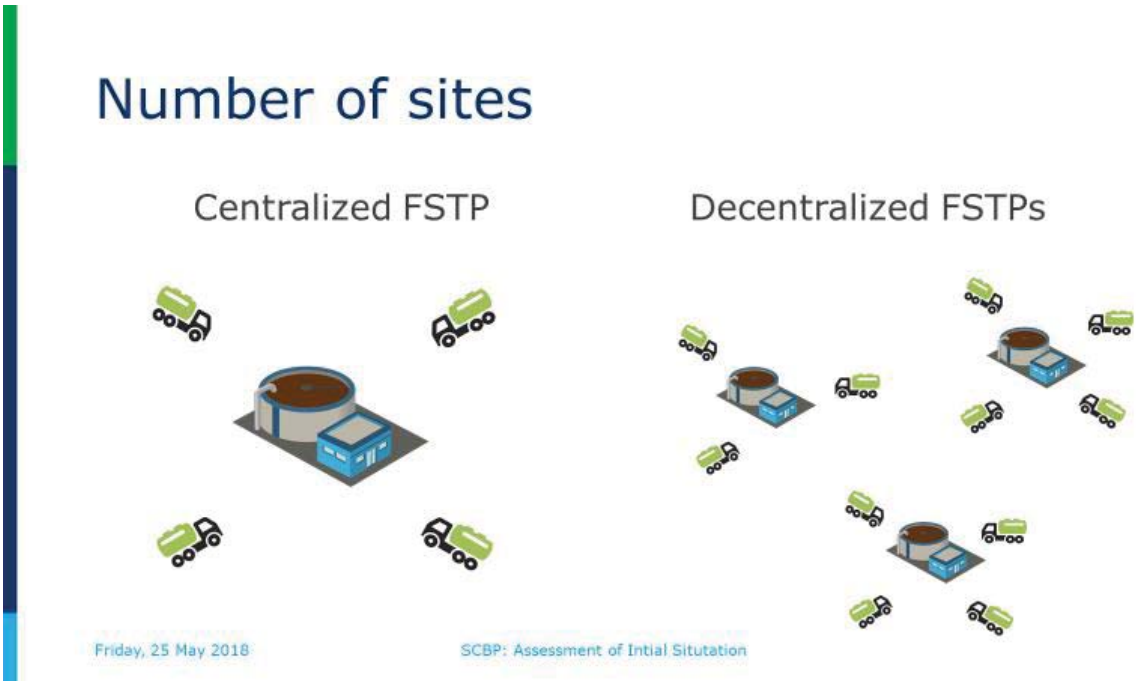
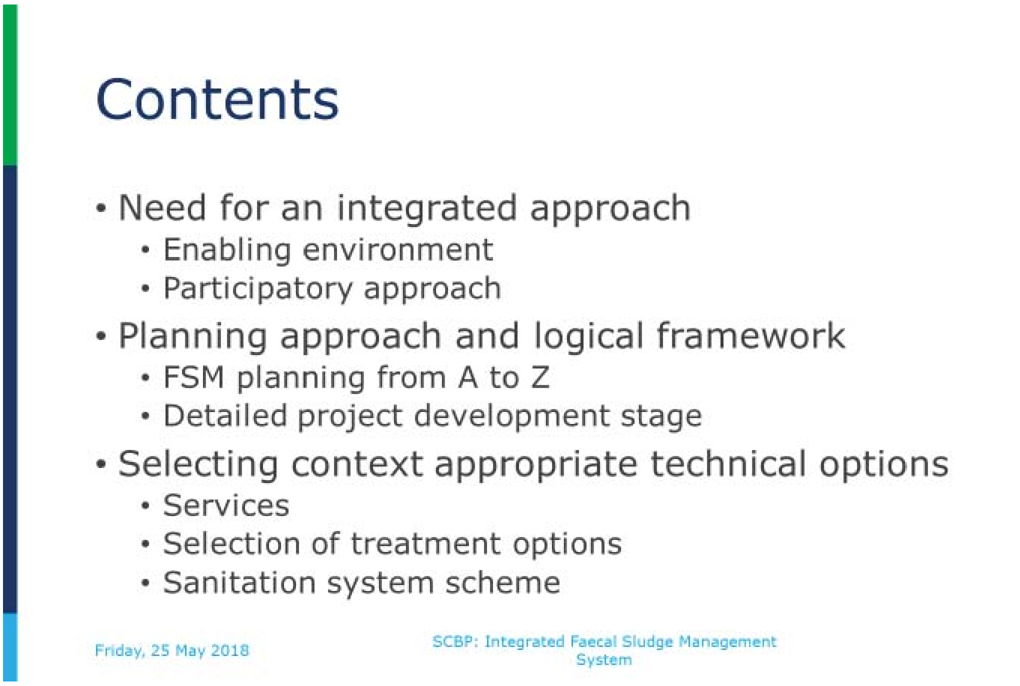
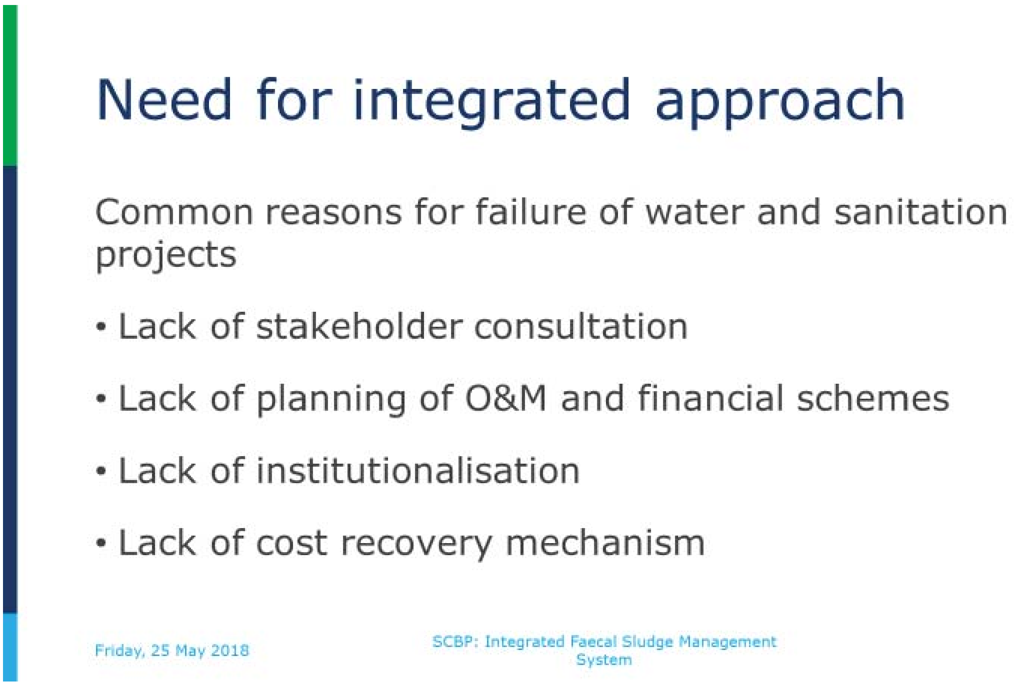


FS treatment can be optimised through levels of decentralisation, as most of FSTPs are made up of relatively low-cost and modular treatment technologies. The selection of sites could be a better match for the logistics of collection and for transport companies and could lead to lower prices for emptying services.

1.2 Integrated Faecal Sludge Management





Examples of failed projects:

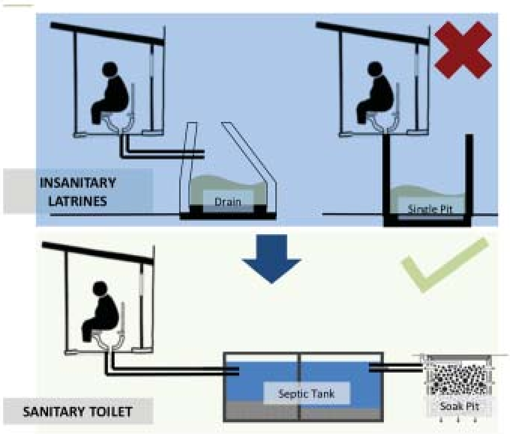
1. A FSTP constructed 15km from the city centre. No sludge was received as the collection and transport of sludge became expensive and as levied on the households.

2. Lack of O&M led to total breakdown of FSTP. Lack of definition of roles and responsibilities. Instead of taking simple actions, stakeholders allowed the situation to deteriorate.
3. A co composting facility closed because no financial analysis was carried out beforehand. O&M cost of the facility and the market demand for the compost and sale of the compost could not balance.
4. Large donors did not coordinate among their projects, leading to patch work action instead of a sound city wide sanitation plan.

1.2.1 Steps for city-wide FSM planning

Step 1:Proper Design of Toilets

A All insanitary latrines to be converted to sanitary toilets with twin pits/ septic tanks.



Source: Guidebook for ULBs to implement septage management plan, SMM, UDD, GoM

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Step 1:Proper Design of Toilets

B The design and construction of septic tanks should be as per Swacha Bharat Mission, 2014.

C Notices to be issued to all property owners whose septic tanks do not meet the standard design guideline

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Step 2: Desludging of Septic Tanks

- **A** Desludging / emptying of septic tanks should be undertaken by mechanical devices like suction emptier trucks / vacuum tankers, as per the Government of India act on the Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993
- **B** ULBs can also license existing septic tank operators in their city to operate their services

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Step 2: Desludging of Septic Tanks

- **C** It is essential for the employees engaged in the activity of septic tank emptying to use protective gear like gloves, boots, face mask etc.
- **D** ULBs should adopt pre-determined scheduled septic tank desludging services. The city can be divided into zones and then a quarterly desludging service plan for a given year can be developed.

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Step 2: Desludging of Septic Tanks

E ULBs should either provide the emptying services themselves or enter into appropriate management contracts with private agencies.

The contracts can be structured in the following two ways:-

a) The ULBs own the emptying truck and contract out the cleaning and emptying services to licensed contractors. The contractors can work according to the scheduled septic tank cleaning plan
b) The contractors can invest in procuring emptying trucks as well as operate them.

Step 3:Treatment and Reuse/Disposal of Septage

A As per the CPCB Norms Septage collected from the septic tanks or pits should not be disposed without any treatment.

B If STP is not available in the city or nearby that can receive the septage, then ULB should plan for new septage treatment facility.

Step 3:Treatment and Reuse/Disposal of Septage

E ULBs should consider the involvement of private sector parties for activities related to operation and maintenance of treatment facility. To assign a contractor;

- Defining the operational role of the Contractors
- Ascertaining Investment and Ownership of Asset
- Determining the Source of Revenue
- Finalizing the Payment Structure
- Deciding on Contract Length and Value
- Mitigating and Allocating Risks

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Step 3:Treatment and Reuse/Disposal of Septage

C Input quality of the collected septage should be tested by the operators at the treatment facility for checking presence of any metal or traces of industrial waste.

D Septage can be reused , if it meets the parameters mentioned in Guidelines for Septage Management, then ULB should plan for new septage treatment facility.

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Measures for planning septage treatment facility

Distance of treatment site

Land availability

Reliability of Electricity

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Measures for planning septage treatment facility

Neighborhood

Geological parameters

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Step 4: Monitoring FSM Systems

- **A** Recordkeeping and manifest forms should be an integral part of a comprehensive septage management program.
- **B** The completed document or documents with signatures of the household/property, suction truck operator and treatment plant operator should be submitted to the local government for their records and this should be linked to payment of operators.

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Step 4: Monitoring FSM Systems

- **C** GIS should be used to be plan the route of suction emptier trucks and tracking these for regular record keeping.
- **D** An MIS system to monitor the services at property / household level needs to be developed using SaniTab or as suggested in Guidelines for Septage Management of the state

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Step 4: Monitoring FSM Systems

E Consumer grievance redressal system for faecal sludge management should also be set up as a part of urban local body record keeping systems and helpline numbers to be shared with residents as a part of monitoring and record keeping systems for faecal sludge management.

Step 5: Awareness Generation and Capacity Building

A Awareness generation activities should be carried out at the beginning of introducing a scheduled service in all wards and then repeated periodically over the three year cycle.

B Municipal Commissioners/ Chief Officers, Engineers, Sanitary Inspectors, Health Officers, and Sanitary Workers should be well trained in safe septage management and its best practices.

Planning approach and framework

Standard project phase	Outcome
Exploratory study	Inception report *Overview of the situation, facilitators are identified.*
Pre feasibility studies	Pre-feasibility report • *Enabling environment is described.* • *Orientation of the process towards realistic option.* • *First contact with stakeholders.*
Feasibility study	Feasibility study report • *Process leaders knows what needs to be treated.* • *Appropriate site is selected.* • *Scenarios are elaborated.* • *System scenarios are evaluated and optimised.* • *Stakeholders are consulted and agreement is secured.*

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Exploratory study: First contact with the field. Main objectives: Identify FSM stakeholders, get and overview of the situation and identify facilitators.

Pre-feasibility study: The preliminary studies consist of a detailed assessment of local context.

Feasibility study: The feasibility study consists of an in depth analysis of the situation, leading to system scenarios. At the end of the feasibility study, the results are discussed with the different stakeholders and formally validated.

Planning approach and framework

Standard project phase	Outcome
Detailed project development	Detailed project document • *The action plan is written.* • *The whole system is described in detail* • *The action plan is validated by all stakeholders.* • *Roles and responsibilities of stakeholders are redefined according to the action plan.*
Implementation	• *FSM is transferred to corresponding stakeholders.* • *Capacity building.* • *State of art FSTP is constructed.* • *FSTP is officially transferred to the city authorities / private company.*
M&E	• *The system is monitored to ensure sustainability.*

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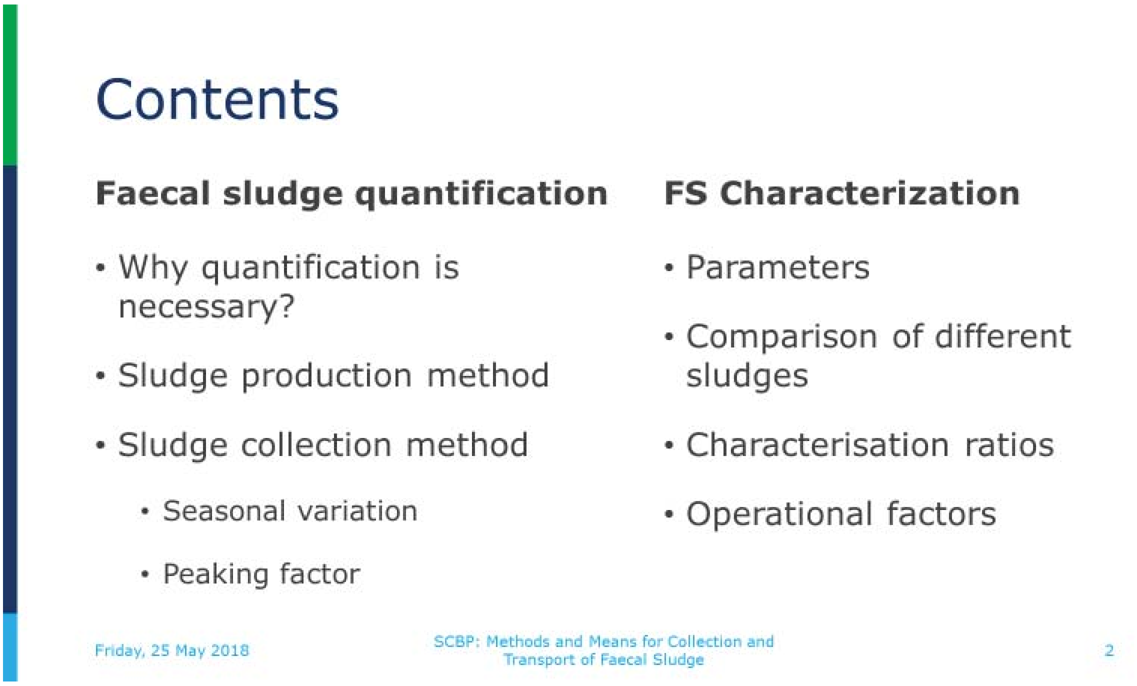
Detailed project development: This phase aims to define in practice the modalities of implementation of the validated scenario. It ends with a workshop that presents and validates these modalities.

Implementation: This is the implementation phase, ending up with the official delivery of a working system.

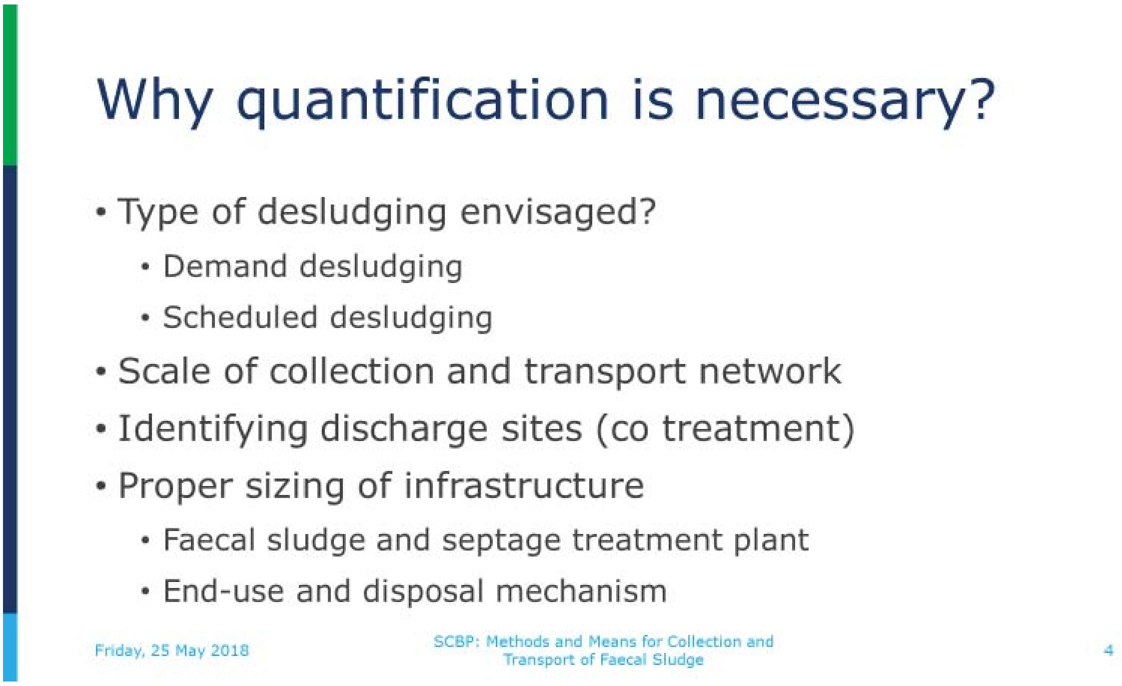
Monitoring and evaluation: The system is monitored to ensure its sustainability.

1.3 Quantification and Characterization of Faecal Sludge

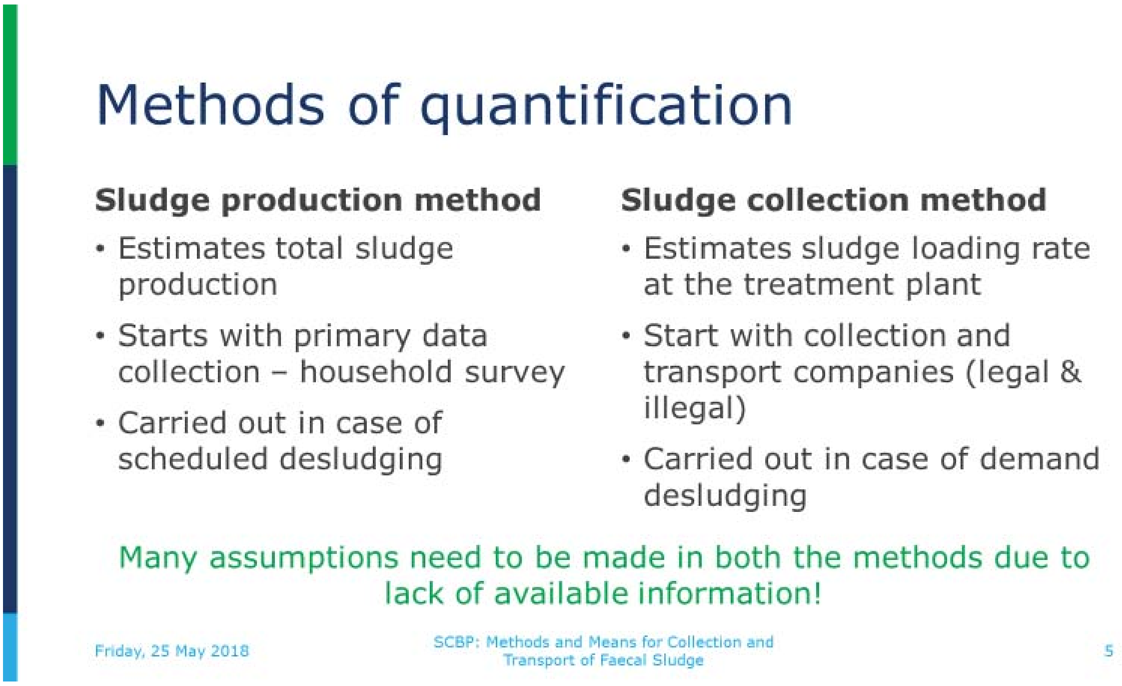


The quantities of FS generated and the typical FS characteristics are difficult to determine due the variety of onsite sanitation technologies in use, such as pit latrines, public ablution blocks, septic tanks, aqua privies, and dry toilets. The quantity and characteristics of FS also depends on the design and construction of the sanitation technology, how the technology is used, how the FS is collected, and the frequency of collection.

1.3.1 Quantification of Faecal Sludge



Deriving accurate estimates for the volume of FS produced is essential for the proper sizing of infrastructure required for collection and transport networks, discharge sites, treatment plants, and enduse or disposal options.



Sludge production method

- Number of users
- Location
- Types and number of various onsite systems
- FS accumulation rates ~ 230 L/capita * year
  - Varies from 190 L/capita * year to 380 L/capita*year
- Population of socio-economic levels

Challenges faced!

- Faeces production vary significantly on dietary habits.
- Not just the quantity but quality of the faecal sludge also vary.
- Volume of urine excreted also change depending on liquid consumption, physical activity and climate.
- Scarcity of data: onsite sanitation systems built informally.
- Not all what is collected reaches the treatment plant.

Sludge collection method

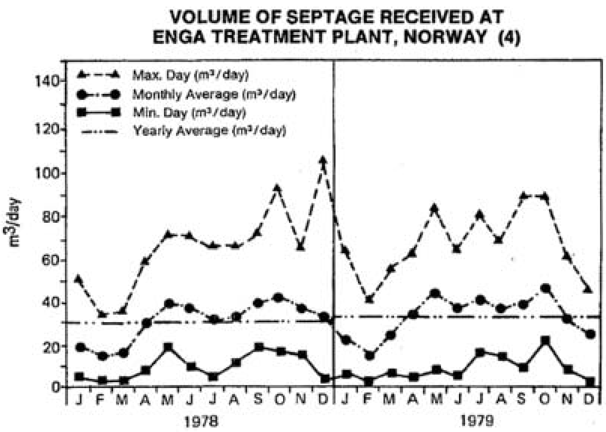
Factors affecting the collection

- Acceptance and promotion of FSM
- Demand for emptying and collection services
- Availability of legal discharge or treatment sites

Volume estimates

- Interviews, site visits, and a review of internal records of FS C&T companies
- Number of collections/day, Volume of FS /collection,
- Average emptying frequency at the HH level,
- Estimated proportion of the population that employ the services of C&T companies

Seasonal variations

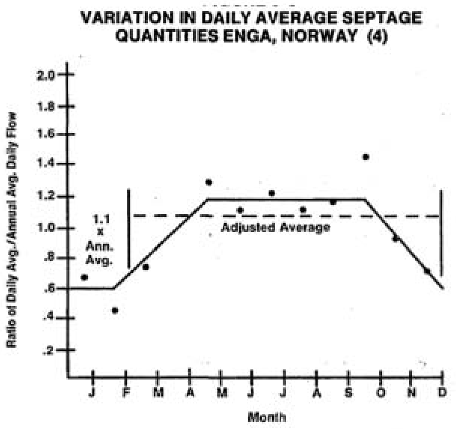


Source: USEPA Handbook on Septage Treatment and Disposal

- Desludging demand increases during high ground water tables, extended rainfall or snowmelt.
- Some desludging takes place all round the year (hotels, schools, restaurants, community sanitation blocks, public sanitation blocks)

Peaking factors

- Peaking factor is the ratio of the maximum to the average quantity received over a period of time.
- Peaking factor can range from 1.5 to 4.0 in some cases.
- Data needs to be collected and analysed to know the peaking factor.



Source: USEPA Handbook on Septage Treatment and Disposal

Challenges faced!

- Number of discharge location or demand for the septage.
- In case of discharge at STP, affordability of discharge fee.
- A large informal sector is working in the business of "septic tank cleaning".
- Not all what is collected reaches the treatment plant.
- Identification of new legal discharge point might increase the frequency of the desludging.

1.3.2 Characterisation of Faecal Sludge

Parameters

- Solid Concentration (TS, TVS, TSS, VSS)
- Chemical Oxygen Demand (COD)
- Biochemical Oxygen Demand (BOD)
- Nutrients (TKN, NH_3-N, Total P)
- Pathogens
- Metals

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Comparison of septage and sewage

Parameter	Septage	Sewage	Ratio of septage to sewage
TS	40,000	720	55:1
TVS	25,000	365	68:1
TSS	15,000	220	68:1
VSS	10,000	165	61:1
BOD_5	7,000	220	32:1
COD	15,000	500	30:1
TKN	700	40	17:1
NH_3-N	150	25	6:1
Total P	250	8	31:1
Grease	8,000	100	80:1

Source: USEPA Handbook on Septage Treatment and Disposal

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Characteristics of Faecal sludge from different sources and WWTP sludge

Parameter	FS source: Public toilet	FS source: Septic tank	WWTP sludge	Reference
pH	1.5-12.6			USEPA (1994)
	6.55-9.34			Kengne *et al.* (2011)
Total Solids, TS (mg/L)	52,500	12,000-35,000	–	Koné and Strauss (2004)
	30,000	22,000	–	NWSC (2008)
		34,106		USEPA (1994)
	≥3.5%	<3%	<1%	Heinss *et al.* (1998)
Total Volatile Solids, TVS (as % of TS)	68	50-73	-	Koné and Strauss (2004)
	65	45	-	NWSC (2008)
COD (mg/L)	49,000	1,200-7,800	-	Koné and Strauss (2004)
	30,000	10,000	7-608	NWSC (2008)
	20,000-50,000	<10,000	500-2,500	Heinss *et al.* (1998)
BOD (mg/L)	7,600	840-2,600	-	Koné and Strauss (2004)
	-	-	20-229	NWSC (2008)

Source: FSM Book, 2014

Characteristics of Faecal sludge from different sources and WWTP sludge

Parameter	FS source: Public toilet	FS source: Septic tank	WWTP sludge	Reference
Total Nitrogen, TN (mg/L)	-	190-300	-	Koné and Strauss (2004)
			32-250	NWSC (2008)
Total Kjeldahl Nitrogen, TKN (mg/L)	3,400	1,000	-	Katukiza *et al.* (2012)
NH_4-N (mg/L)	3,300	150-1,200	-	Koné and Strauss (2004)
	2,000	400	2-168	NWSC (2008)
	2,000-5,000	<1,000	30-70	Heinss *et al.* (1998)
Nitrates, NO_3^- (mg N/L)	-	0.2-21	-	Koottatep *et al.* (2005)
Total Phosphorus, TP (mg P/L)	450	150	9-63	NWSC (2008)
Faecal coliforms (cfu/100 mL)	$1x10^5$	$1x10^5$	$6.3x10^4$-$6.6x10^5$	NWSC (2008)
Helminth eggs (Numbers/L)	2,500	4,000-5,700	-	Heinss *et al.* (1994)
	20,000-60,000	4,000	300-2,000	Heinss *et al.* (1998)
		600-6,000		Ingallinella *et al.* (2002)
		16,000		Yen-Phi *et al.* (2010)

Source: FSM Book, 2014

Characterisation ratios

Ratio (gm/gm)	Public toilets	Septic tanks	Medium strength wastewater
VSS:TSS	0.65-0.68	0.50-0.73	0.60-0.80
COD:BOD_5	5.0	1.43-3.0	2.0-2.5
COD:TKN	0.10	1.2-7.8	8-12
BOD_5:TKN	2.2	0.84-2.6	4-6
COD:TP	109	8.0-52	35-45
BOD_5:TP	17	5.6-17.3	15-20

Source: FSM Book, 2014

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Operational Factors

- Toilet usage
  - Washers & wipers
  - Inclusion – exclusion of grey water
  - Use of additives for reducing filling rates of onsite sanitation system.
- Storage duration
  - Type of technology
  - Toilet usage

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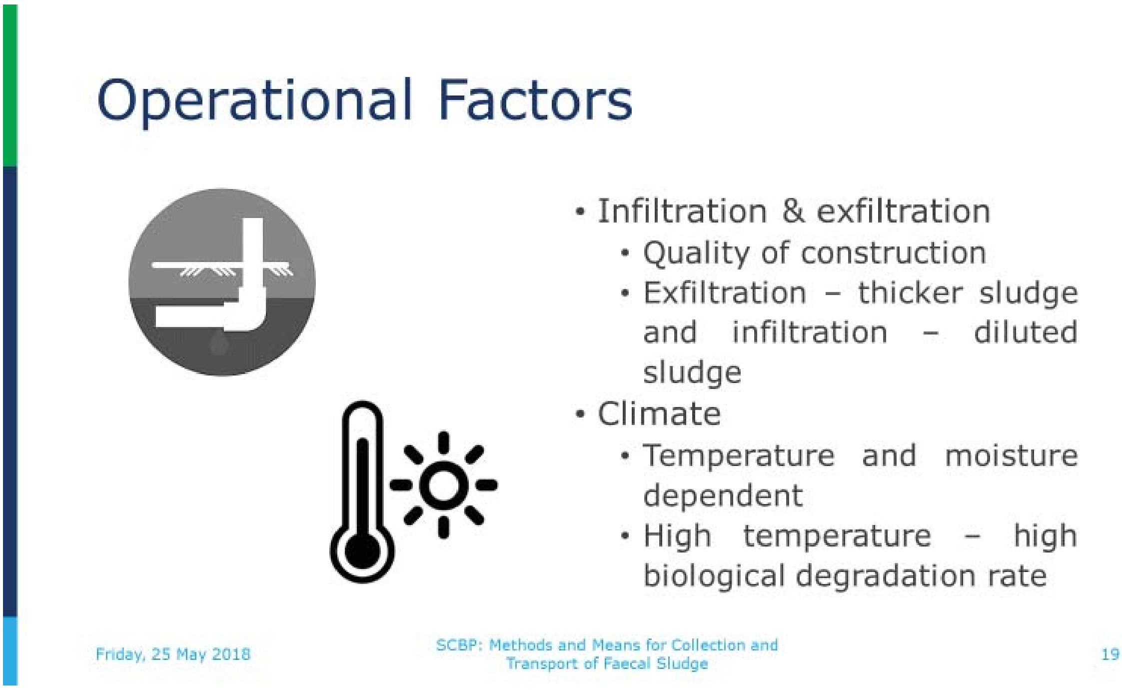
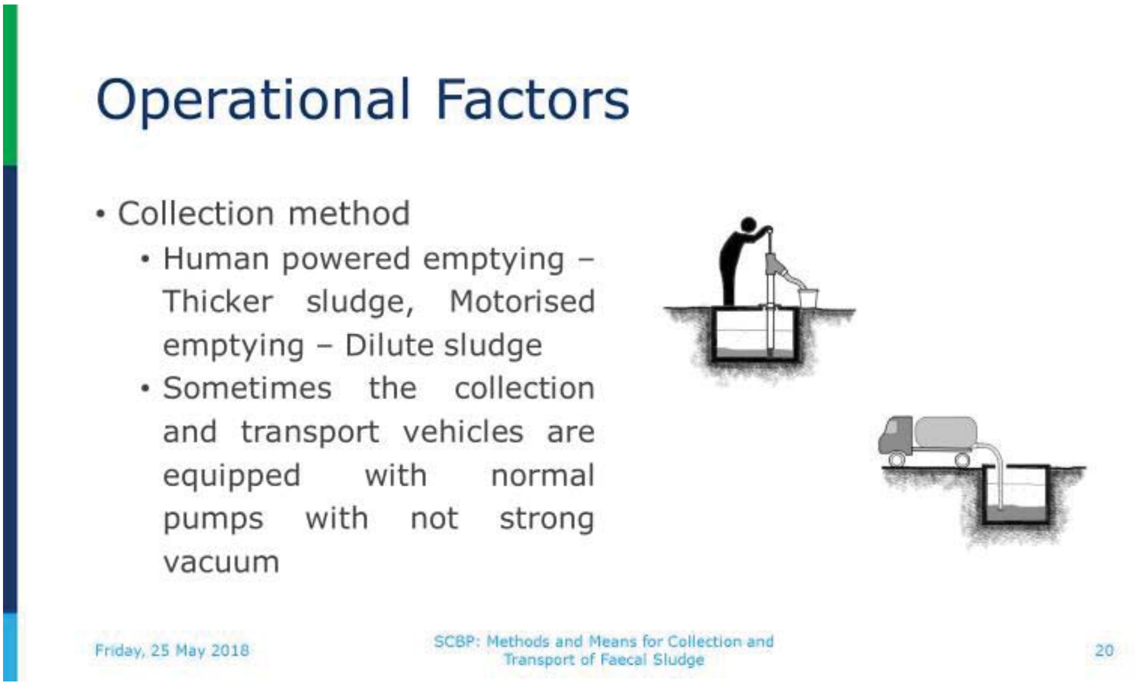
The filling rate and storage duration depends on the type of technology, quality of construction, toilet usage, and inflow and infiltration. The length of time that FS is stored in onsite containment systems before being collected and transported will greatly affect the characteristics due to the digestion of organic matter that occurs during storage



The concentration and volume of FS is also greatly influenced by inflow and infiltration of leachate into the environment from the system and / or ground water into the system. The filling rate of systems will be slower if there is more leaching, resulting in a thicker FS.

The permeability of containment systems is influenced by whether they are unlined, partially lined, completely lined, connected to drain fields or soak pits, and the quality of construction. If systems are permeable, the amount of inflow and infiltration will be influenced by the type of soil and the groundwater level.

Climate has a direct influence on FS characteristics, mainly due to temperature and moisture. Tropical countries may have one season of heavy rainfall, referred to as the wet season, while others have a bi-modal rainfall and/or dry season. Temperatures may be at their lowest during the wet season and at their highest during the dry season. Frequently the highest demand on collection and transport services occurs during the rainy season, as heavy rainfalls result in overflowing and flooding of onsite systems. Rates of biological degradation are also temperature dependent, and rates increase with warmer temperatures.



The FS collection method also influences its characteristics. FS at the bottom of containment systems that is too thick to pump will only be collected if it is manually emptied with shovels, or if water is added to decrease the viscosity and enable pumping.

1.4 Methods and Means for Collection and Transport of Faecal Sludge

Contents

- Roles and Responsibilities of Stakeholders in Faecal Sludge Collection & Transport
- Types of collection and transportation techniques
- Transfer Stations
- Occupational Health and Safety

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1.4.1 Roles and Responsibilities of Stakeholders in Faecal Sludge Collection & Transport

Roles and Responsibilities

Stakeholders in Faecal Sludge Collection and Transport Process

Collection & Transport

Service Providers

Customers

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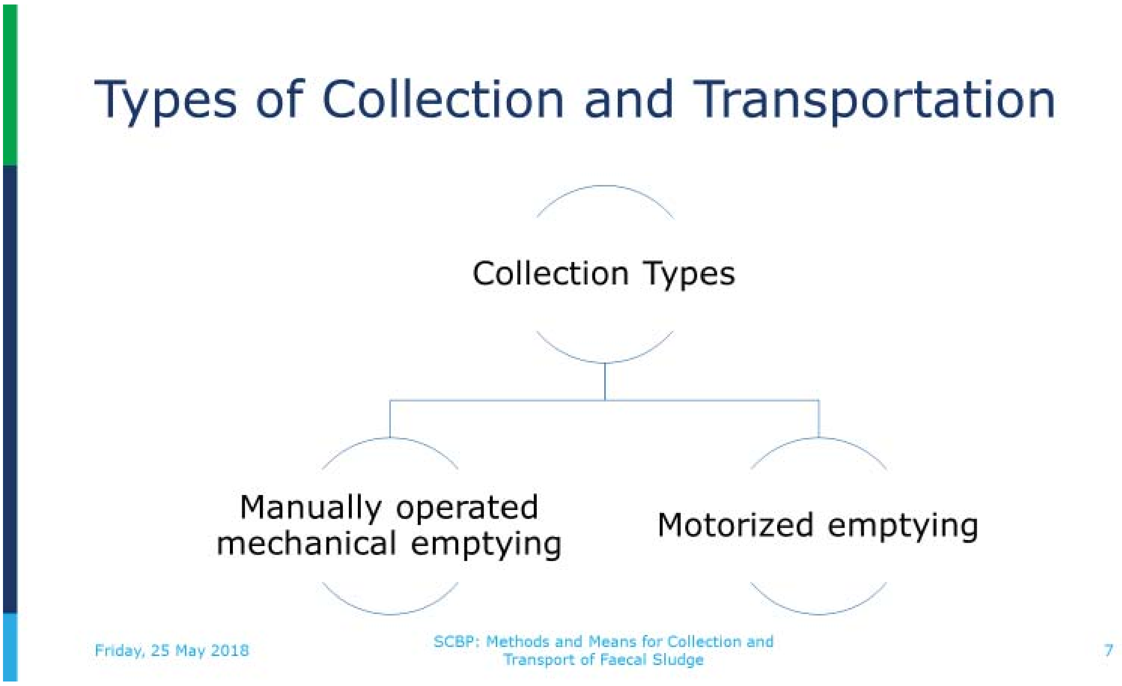
When emptying the FS from onsite systems, a number of tasks are performed in accomplishing the job.

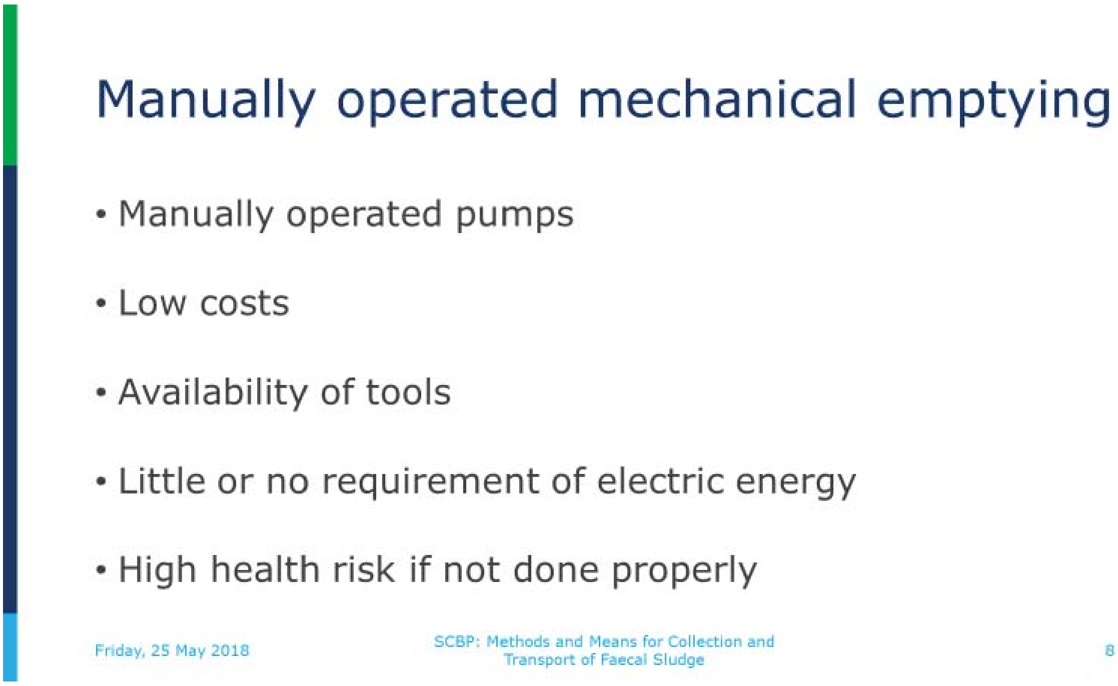
- interact with customers prior to removing FS to arrange logistics and inform them of procedures;
- share the standardised fee or negotiate one, depending on the business model;
- locate onsite sanitation systems that are to have sludge removed;
- determine the accessibility of the system once it is located;
- open the system to facilitate the process;
- collect the FS;
- evaluate the condition of the system post-collection;
- close and secure the system once the FS removal has been completed;
- clean up after the process is completed; and
- perform the final inspection and report any issues with the system to the customers after the service is completed.

1.4.2 Types of Collection & Transportation Techniques

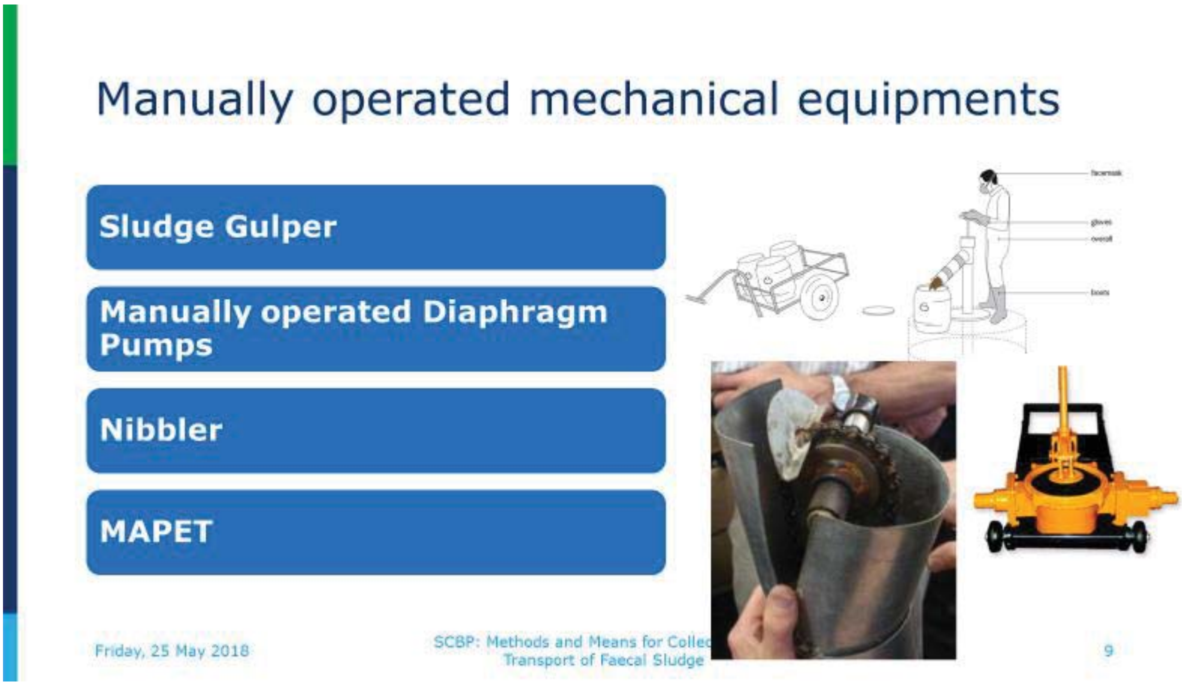


FS can be removed from septic tanks or latrines through the use of manual and mechanised techniques that may rely upon hand tools, vacuum trucks, pumping systems, or mechanical augers. The specific method utilised will be based on the type of onsite system, accessibility of the site, the type of equipment owned by the service provider, and the level of expertise. In India, we have Manual scavenging Act, 2013 as it restricts the manual handling of faecal sludge or septage by the person engaged or employed for the cleaning task.

Awareness of the properties of FS is necessary in order to understand the challenges faced in its collection and transport. These properties are primarily influenced by water content, sludge age, the presence of non-biodegradable material, and organic material.



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.



Sludge Gulper was developed in 2007 by the London School of Hygiene and Tropical Medicine (LSHTM). It is a low-cost manually driven positive displacement pump that operates along the same principles as that of direct-action water pumps. The Gulper has a simple design and can be built using locally available materials and fabrication techniques generally common in low-income countries. It consists of a PVC riser pipe containing two stainless steel 'non-return' butterfly valves. One valve, the 'foot' valve, is fixed in place at the bottom of the riser pipe and a second valve, the 'plunger' valve, is connected to a T-handle and puller rod assembly. As the handle is moved up and down, the two valves open and close in series and sludge is lifted up the riser pipe to exit the pump via a downward angled spout. A strainer is fitted to the bottom of the riser pipe to prevent non-biodegradable material from entering and blocking the pump.

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.

Nibbler was developed by the LSHTM. It is capable of collecting medium viscosity sludge using a continuous roller chain loop enclosed in a PVC pipe. The pipe can be inserted into the access hole of a containment structure or a pit latrine without the need to break any part of the structure. The chain is driven by manually rotating a double crank and sprocket located at the top of the pipe. Semi-circular metal discs loosely and horizontally attached to the chain at regular intervals scoop out the waste from the bottom of the pit and displace it to the top. Once at the top of the pipe, sludge is scrapped off the discs and into a Y-shaped connector, which guides the sludge into the container being used for onward transport. A vertical plate spanning the length of the pipe divides the downward and upward travel directions of the chain and discs.

Manual Pit Emptying Technology (MAPET) was developed and trialled in Tanzania (2012) which is a human-powered vacuum system for the collection and short-distance transport of sludge. MAPET is both the earliest and the most technically advanced equipment and manually driven mechanical collection system. It has two separate components, a pump and a 200 litres vacuum tank, each mounted on a dedicated pushcart. MAPET is able to pump sludge from a depth of 3 metres at a rate of 10 to 40 L/min depending on the depth and viscosity of the sludge.

Motorized emptying

- Pit Screw Auger
- Vacuum Trucks
- Vacutug

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Pit Screw Auger

Performance	Purchase/ Operating Cost	Challenges
• Can handle liquid sludge and a small amount of non-biodegradable waste • flow rates of over 50 L/min. pumping head of at least 3m (difficulty emptying from variable depths)	• Capital Cost: INR 45,000 – INR 50,000 • Operating Cost: Unknown	• The fixed length of the auger and riser pipe • Unsuitable for use with dry sludge and large quantities of non-biodegradable waste • Difficult to clean after use • Difficult to manoeuvre due to weight and size

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Pit screw augers (SAS) are based on the Archimedean screw design. Motorised SAS are currently under development with prototypes mimicking certain aspects of commercial motorised soil augers. They consist of an auger placed inside a plastic riser pipe and protruding by approximately 5 to 15 cm from the bottom end of the pipe. An electric motor is mounted on top of the riser pipe where it connects to the auger. To operate, the riser pipe is placed in the FS and as the auger turns, FS is picked up by cutting blades at the bottom of the auger and lifted up the riser pipe along the auger flights. A downward angled spout at the top of the riser pipe allows material to be discharged into a collection container. Weighing between 20 and 40 kg, motorised SASs can be operated by one person. Flow rates are estimated to vary between 40 to 50 L/min and it may be suitable for pumping high viscosity FS and semi-solids.

Pit Screw Auger

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Vacuum Trucks

- Vehicle equipped with motorized pump and a storage tank often called as Vacuum Truck.
- Fast and efficient.
- Capacity 3 – 12 m^3
- Cost of 3 m^3 vacuum truck: 8 – 12 lakhs.

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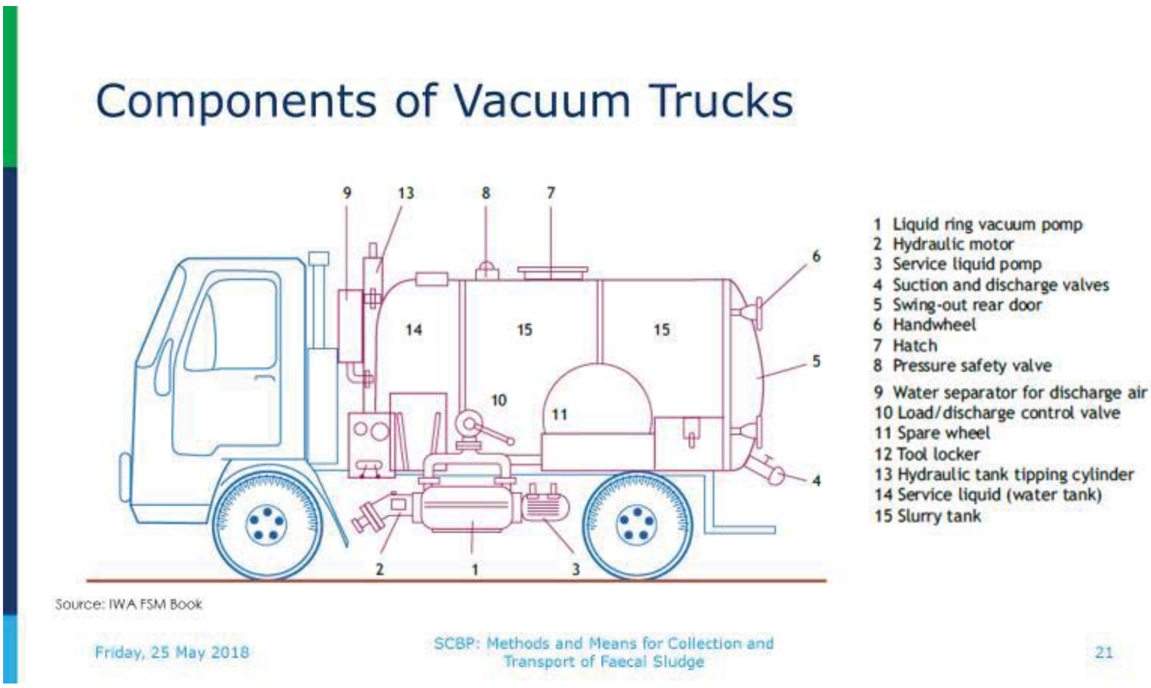
Vacuum pumps are sized based on lift elevation, pumping distance, volume of sludge to be removed, and volume of the tank. When designing collection and transport systems, local manufacturers should be consulted in order to determine what equipment is available. Product specifications must be checked to verify that the proposed truck is adequate for the need.



Components of Vacuum Trucks

Source: http://www.vacutrux.com

(A) Tank
(B) Skid w/ slope to rear
(C) Ladder step assembly
(D) Ramp
(E) Primary check valve
(F) Dome hatch
(G) Lifting lugs
(H) Sight glass
(I) Rear door
(J) Load port (with riser and deflector)
(K) Rear aluminium modules
(L) Mud flaps
(M) Wire reinforced vacuum pressure hose
(N) Oil Catch Muffler
(O) Secondary moisture trap, pressure relief valve.
(P) Vacuum pump

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Vacuum Pumps

Vacuum pumps

- **Low volume sliding vane pump**
  - High vacuum, low air flow; suitable for low viscosity sludge
- **Liquid ring pump**
  - Air drag
  - Air bleed
  - Plug drag

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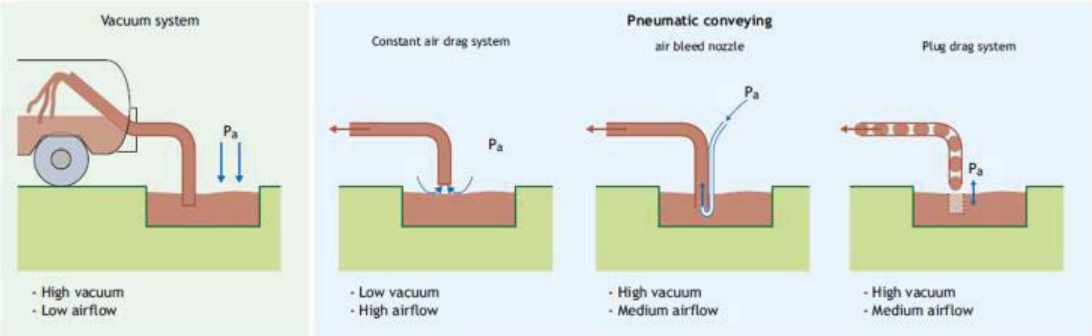
Vacuum Types



Advantages and Disadvantages

Advantages	Disadvantages
• 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 un-sewered areas	• Cannot pump thick, dried sludge • Garbage in pits may block hose • 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 • Improper discharge of the collected sludge could generate public health and environmental problems

Vacutug

- Sludge is more than 90% water.
- Water is heavy and occupies volume
- Costly to transport
- Dewatering trucks: SLUDGE – water = SOLIDS
- Effluent is put back into the containment
- Increased capacity of transport
- Yet to be launched in India

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Types of Vacutug

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

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Types of Vacutug

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Accessibility!

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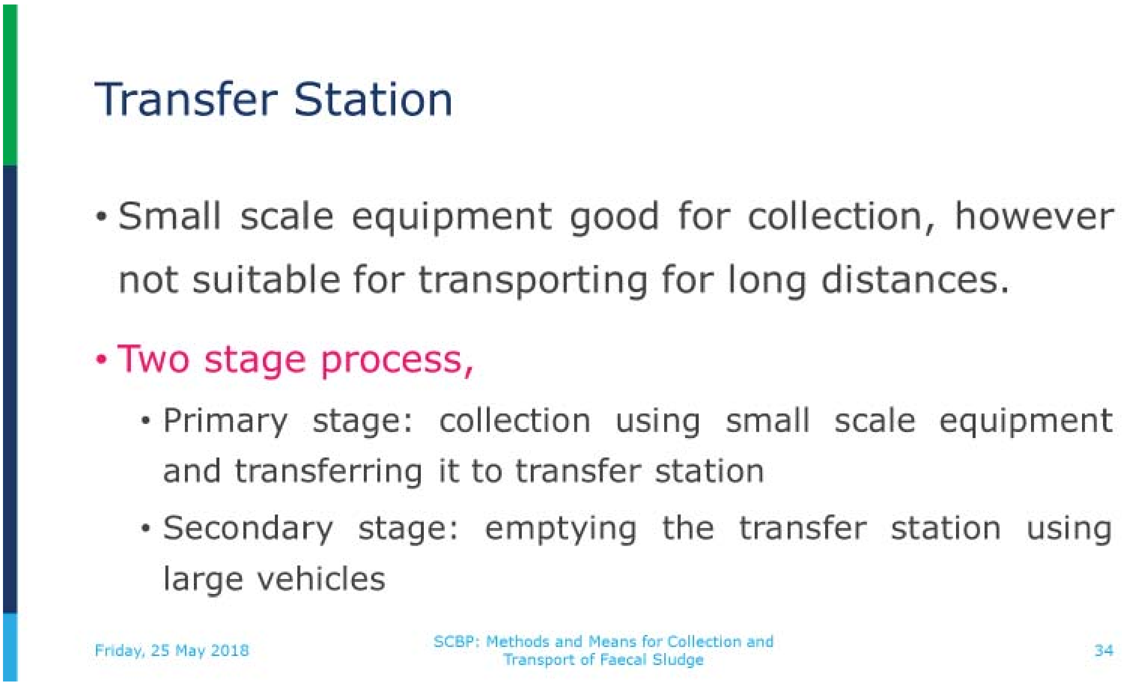
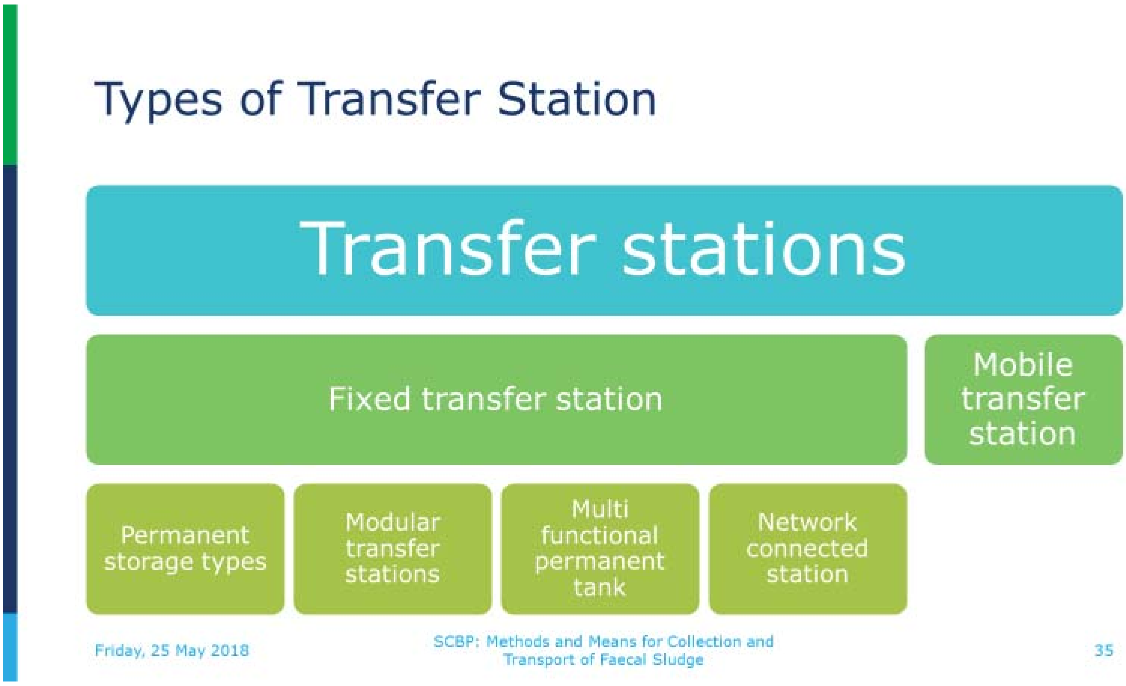
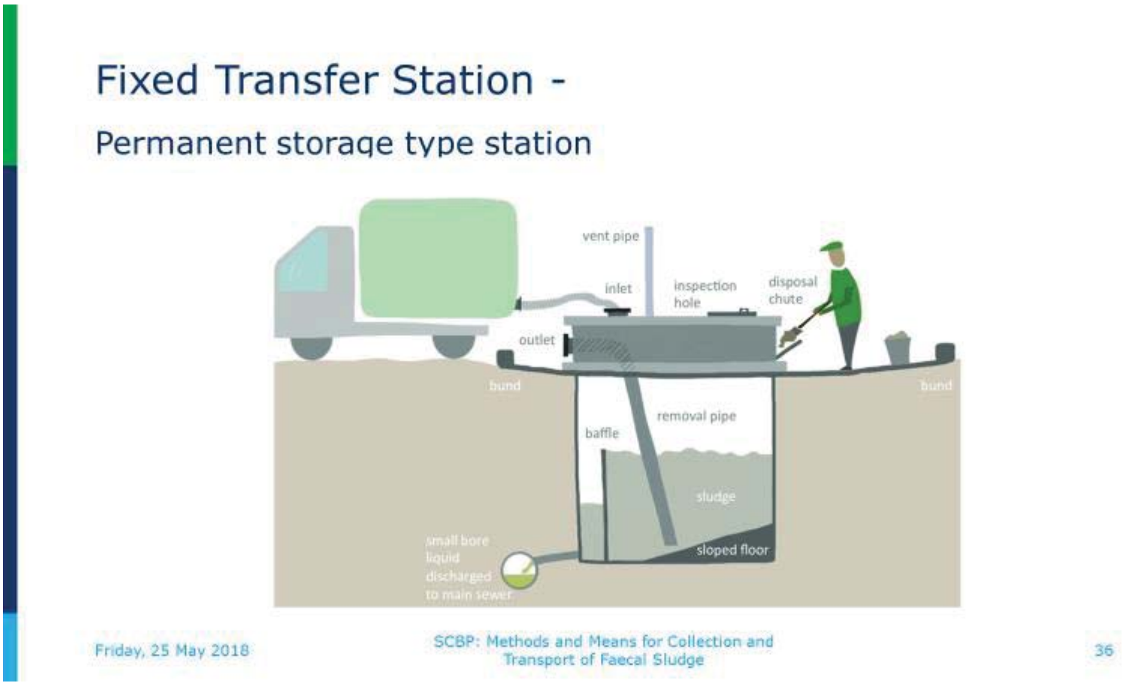
1.4.3 Transfer Station

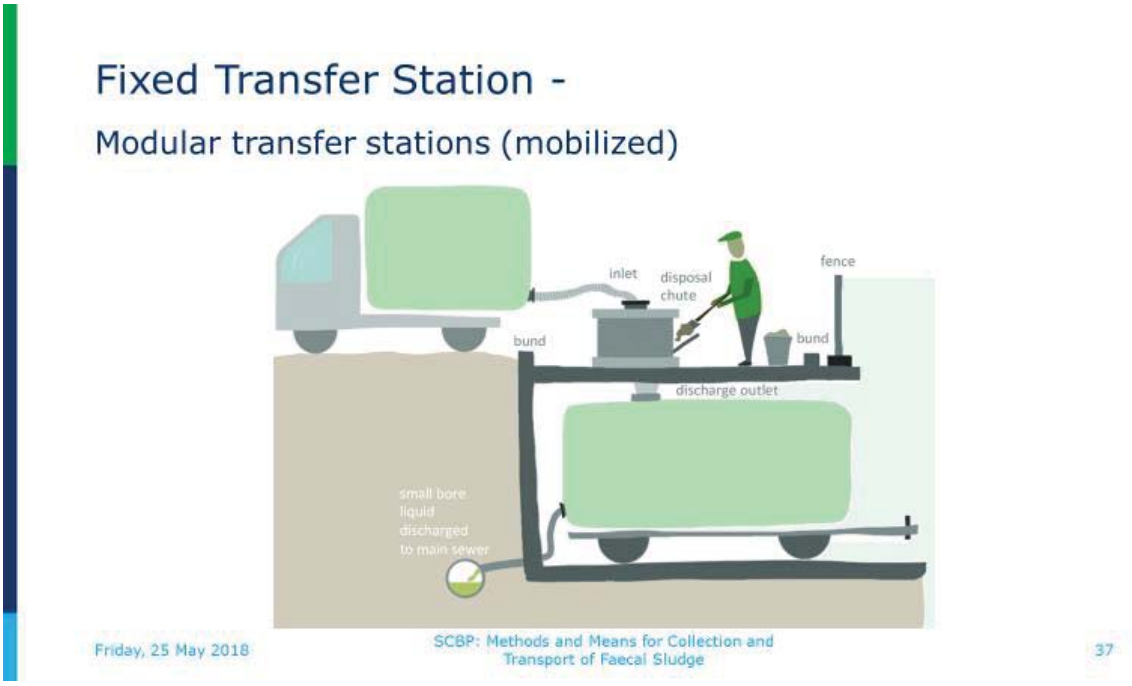






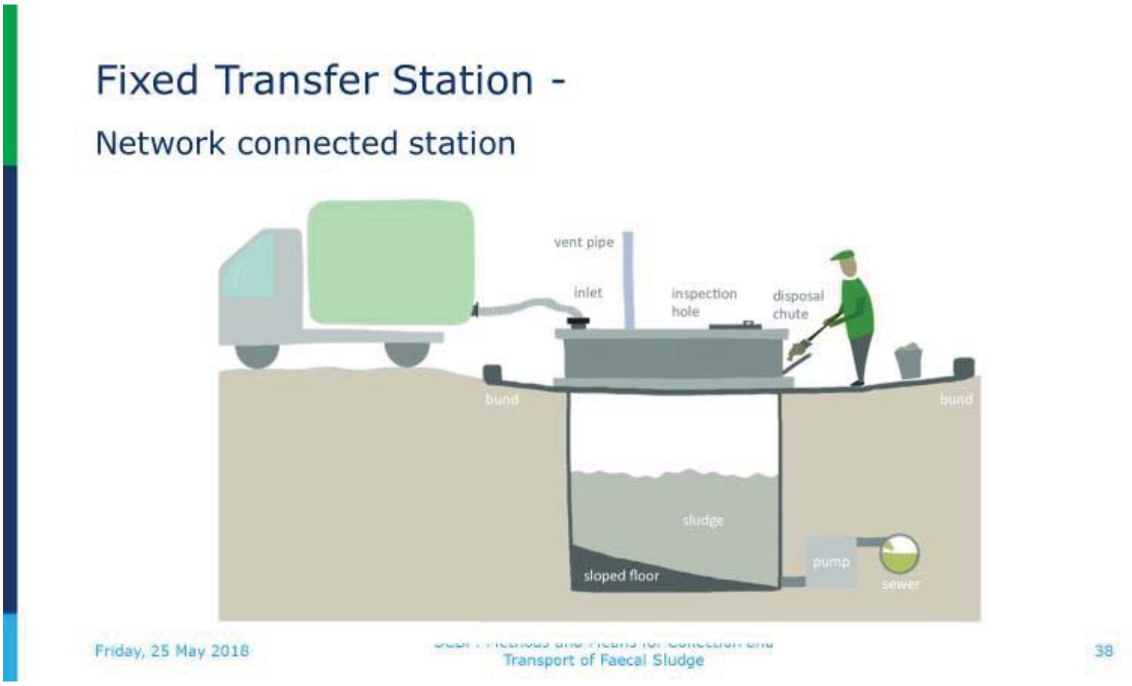
Permanent storage tanks are constructed as vault-like concrete structures, these tanks are designed to provide storage capacity for FS over a short period of time without capacity for treatment. An example of such tank is the underground holding tank (UHT) in Ghana with capacities of approximately 23 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.



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

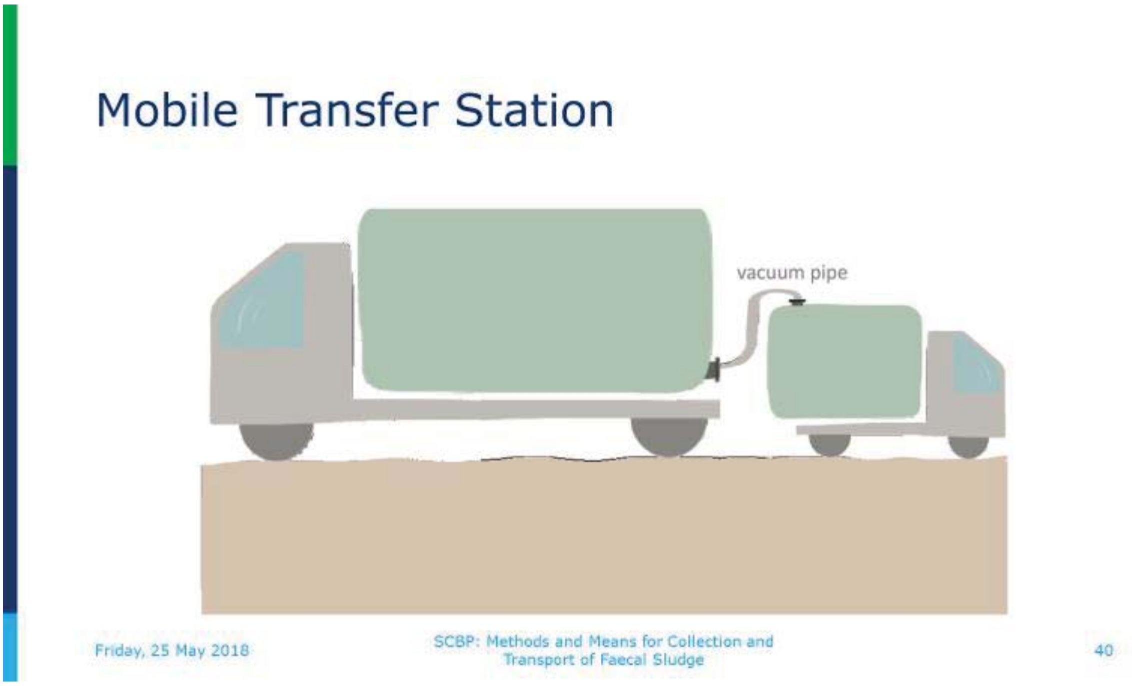
- small sized (e.g. 200-litre metal drums, McBride, 2012);
- medium-sized (e.g. Intermediate Bulk Containers (IBCs) made of plastic liner and metallic frame, 500 – 3,000 litres);
- large-sized (e.g. customised metallic tanks or skips, >2,000 m3 (Macleod, 2005; Strauss and Montangero, 2002)



Network-connected station provide direct or indirect access to the sewerage network, if one exists, for the secondary transport of FS and/or its liquid effluent. Utilities and asset owners rightfully discourage the use of manholes for sludge disposal as it can lead to increased blockages in the network due to the low water content of the

FS and also high BOD loading at the wastewater treatment plant. However, illegal dumping into the network is not uncommon generally due to a lack of alternative facilities and the ease of access.

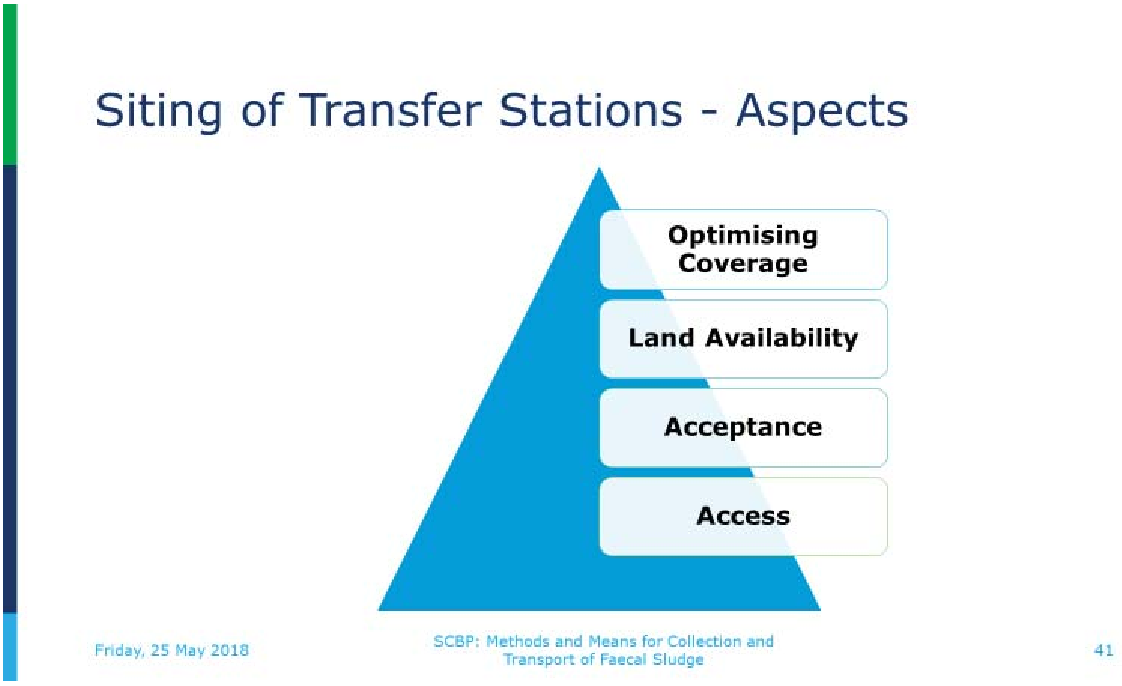
Multi-functional permanent tank in addition to providing storage capacity, it can also accept fresh FS from a public toilet, and/or provide partial sludge treatment. This latter design feature could include processes such as dewatering (settling tanks, drying beds, geotubes - ERE Consulting Group and 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 by-products (e.g. liquid effluent or biogas) could be used if further treatment is provided.



Mobile transfer stations consist of easily transportable containers providing temporary storage capacity at any point near the structure being emptied - essentially a tank fitted on a wheeled chassis. Examples of such transfer stations include motorised collection vehicles, or tanker trailers pulled via a truck or tractor.

The stations are sited in any area where multiple trips by small-scale transport equipment are required. The main advantage of these stations is that they sidestep the complex and often lengthy procedures required for siting fixed stations in high-density settlements. They can also double as secondary transport containers once full as they can be easily driven or towed to the final disposal site.

If towed, the motorised vehicle towing the container is capable of performing other related or unrelated duties thus allowing for cost savings and potential for increased revenue. Such systems have reportedly been used in places such as Maseru, Lesotho (Strauss and Montangero, 2002).



Optimising coverage

The coverage of transfer stations needs to be sufficient to meet the demand generated by sludge collection using small-scale equipment, while at the same time minimising the overall cost of primary transport. In order to determine the appropriate coverage of transfer stations, their sizing, and their proximity to one another, the cost of primary and secondary transport methods being used need to be taken into account. The provisional use of mobile stations may assist in optimising coverage by allowing the evaluation of the suitability of potential locations over a period of time without committing to the construction of a fixed station.

Land availability

The process of finding suitable land space and obtaining the relevant permission for transfer stations can be difficult and time consuming. This can sometimes involve lengthy negotiations with multiple governmental agencies and land owners, particularly when siting within informal settlements. Due to their non-permanent nature, mobile stations could potentially mitigate such challenges, or alternatively consideration could be given for the use of modular transfer stations with small footprints. However, it should be noted that without adequate legal assurances, service providers could be required to remove such stations by dissatisfied landowners.

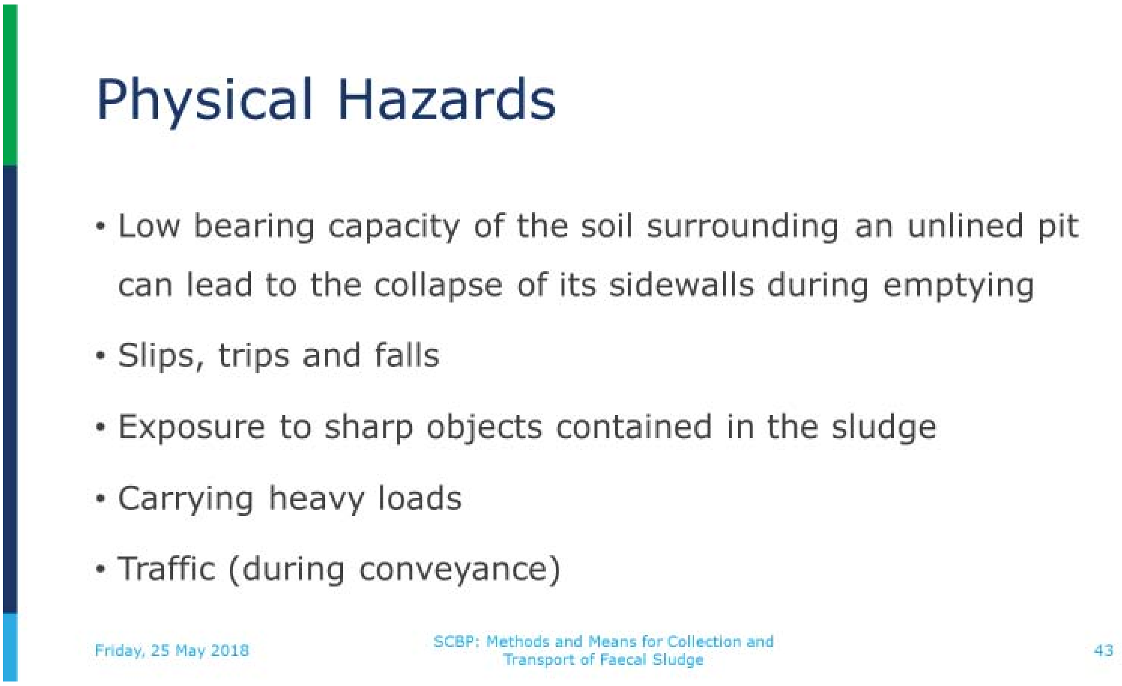
Acceptance

It is not uncommon for communities to reject the siting of a transfer station in close proximity to their homes. This so-called 'Not-In-My-Back-Yard'(NIMBY) effect can be challenging in densely populated informal settlements where there is little, if any, open land. Early involvement of the communities in the siting process may therefore be necessary. Offering incentives such as combining transfer stations with other facilities like communal toilets and showers may help increase the level of acceptance.

Access

Depending on the type, access to a transfer station by primary and secondary transport vehicles or trunk sewers is necessary for proper operation. For instance, while siting a transfer station in the middle of a densely populated informal settlement would reduce the primary transport travel distance, it might not be accessible to larger vehicles used in secondary transport. It is thus necessary to ensure transfer stations are sited on roads large enough for access by secondary transport vehicles.

1.4.4 Occupational Health and Safety



Chemical Hazards

- Direct and indirect oral, nasal and dermal exposure to chemicals
  - hydrocarbons that are introduced as odour suppressants
- Working in confined spaces in the presence of harmful gases or in an oxygen depleted environment
  - methane
  - Ammonia
  - sulphur dioxide

Biological Hazards

- Direct and indirect oral, nasal and dermal exposure to multiple types of pathogens in FS
  - Bacteria
  - Viruses
  - Protozoa
  - helminthes

Preventive measures

- Personal Protective Equipment (PPE) - to avoid direct and indirect exposure (e.g. gloves, coveralls, rubber boots with a metal sole, safety glasses and safety masks)
- Develop and provide training on use of tools customised for local conditions and local containment systems in order to avoid direct contact
- Provide a training programme on standard operating procedures (SOPs) - proper use of PPE, tools and equipment

1.5 Stakeholders Analysis

Contents

- Stakeholders Analysis
- Stakeholders Engagement

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1.5.1 Stakeholders Analysis

Stakeholder analysis

- Process of identifying and characterising stakeholders, investigating relationship between them, and planning for their participation.
- Vital tool for understanding social and institutional context of the a project.
- Provides foundation for participatory planning, implementation and monitoring of the project.

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Identification of stakeholders

- Municipal authorities
- Regional and national authorities
- Utilities
- Traditional authorities and influential leaders
- Small scale FS business
- Organisations active in WASH
- Potential end users
- Households

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Characterisation of stakeholders

Stakeholders	Interests	Strengths	Weaknesses	Opportunities/ threats	Relationships	Impacts	Involvement needs
Stakeholder a							
Stakeholder b							
Stakeholder c							
...							

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Main interest: Consultation with stakeholders should be carried out in order to determine how each interest can be taken into account in the future FS systems.

Strength: Establish what the process leader can count on.

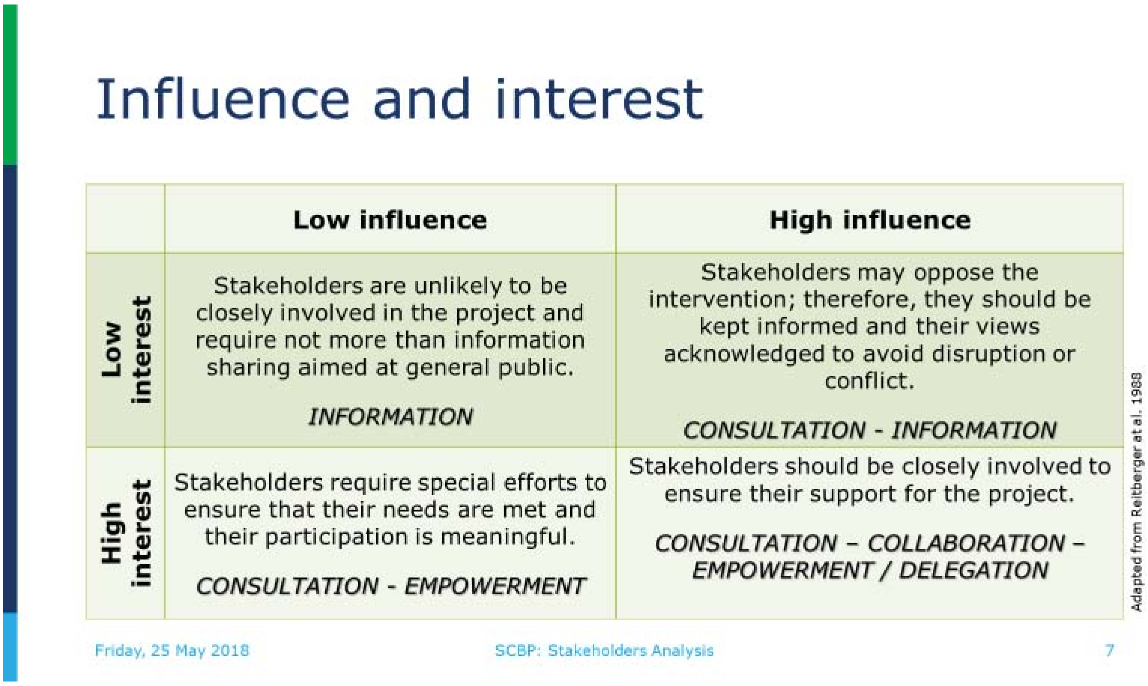
Weakness: Establish where information, empowerment and capacity building is needed.

Opportunities/threats: Characterise the potential positive (negative) perspective of the project.

Relationship between stakeholders: Hierarchy, friendship, competition or professional link. Good, bad can decide which working groups can be built.

Impacts: Type of impact of the project on the stakeholder determines the measure needed to maximise positive impact and mitigate negative impact.

Involvement needs: The action required, results mainly from identified interest, weakness and potential.


Influence and interest

	Low influence	High influence
Low interest	Stakeholders are unlikely to be closely involved in the project and require not more than information sharing aimed at general public. *INFORMATION*	Stakeholders may oppose the intervention; therefore, they should be kept informed and their views acknowledged to avoid disruption or conflict. *CONSULTATION - INFORMATION*
High interest	Stakeholders require special efforts to ensure that their needs are met and their participation is meaningful. *CONSULTATION - EMPOWERMENT*	Stakeholders should be closely involved to ensure their support for the project. *CONSULTATION – COLLABORATION – EMPOWERMENT / DELEGATION*

Adapted from Reitberger at al. 1988

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Influence: is the power that stakeholders have on the project i.e. control which decisions are made facilitate their implementation or effect the project negatively.

Interest: characterises stakeholders whose needs, constraints and problems are a priority in the strategy e.g. sludge service providers, end users, households and sanitation authorities.

1.5.2 Stakeholders Engagement

Participation levels

		Participation levels			
		Information	Consultation	Collaboration	Empowerment / delegation
Planning	*Launch of the planning process*	All stakeholders		Municipality, utilities	
	Detailed assessment of current situation		Key stakeholders[1]	Municipality, utilities	
	Identification of service options		Key stakeholders[1]	Municipality, utilities	
	Development of an Action Plan	All stakeholders	Endusers	Municipality, utilities, FS operators, NGOs	Empower weak and non-organised groups

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Information: Objective is to enable the stakeholders to understand the situation, the different options and their implications. This is one-way flow of communication.

Consultation: Objective is to have stakeholders' feedback on the situation, options, scenarios and / or decisions.

Collaboration: Objective is to work as a partner with the stakeholder on various aspects such as creating scenarios and identification of preferred solution.

Empowerment / Delegation: Objective is to build capacities of the stakeholders so that they can make informed decision, take responsibility of final decision making, and assume their roles and responsibilities in the FSM system.

Participation levels

	Participation levels			
	Information	Consultation	Collaboration	Empowerment / delegation
Implementation	Households, traditional authorities and opinion leaders	Endusers	Municipality, utilities, FS operators, NGOs	Empower and delegate to municipality, utilities, FS operators, NGOs
Monitoring & Evaluation	Key stakeholders	Households, FS operators, endusers	Municipality, utilities, selected NGOs	

Involvement tools

	Information	Consultation	Collaboration	Empowerment / delegation
Personal meetings	▪	▪	▪	▪
Focus groups		▪	▪	▪
Workshops	▪	▪	▪	▪
Site visits	▪	▪		
Media campaigns	▪			
Household surveys		▪		
Advocacy / lobbying	▪		▪	▪
Mediation		▪	▪	▪

Milestones and cross cutting tasks

Milestones

- Initial launching workshop.
- Validation workshop of selected options by all stakeholders.
- Validation workshop of the Action Plan.

Cross cutting tasks

- Raising awareness.
- Training and capacity building.

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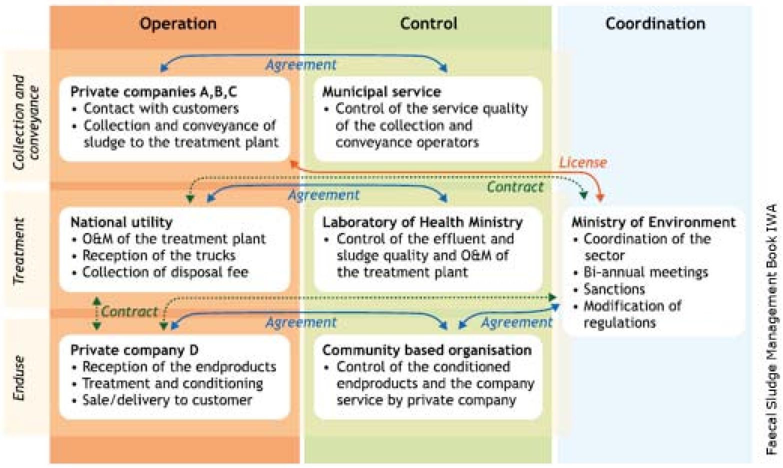
Roles and responsibilities

- Licences
- Contracts
- Partnership agreements



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Licences: Issued by authorities for services throughout the whole supply chain. Licence document should contain list of requirements, activities allowed and validity of the licence.

Contracts: Contracts can be signed between the stakeholders involved in the FSM supply chain for specific activities or services. (1) contracts linking a service provider to its customers (2) contracts linking two operators undertaking different activities in the supply chain (3) contracts between one operator and the authorities.

Partnership agreements: Agreements can be signed between two stakeholders to provide a collaborative framework for the institutional or technical management of any component of FS supply chain. Public private partnership where stakeholders from the public and the private sector collaborate to provide services to the population.

1.6 Faecal Sludge Treatment – I

Contents

- FS treatment Mechanisms
  - Physical mechanisms
  - Biological mechanisms
  - Chemical mechanisms
- Design of FS treatment plant
  - Selection of context appropriate combination of faecal sludge treatment technologies

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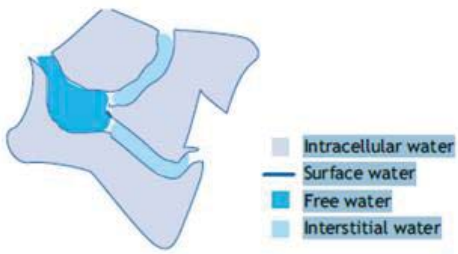
1.6.1 Faecal Sludge Treatment Mechanisms

1. Physical mechanisms

- Dewatering- the most important treatment objective.
- Water is heavy and expensive to transport!
- Water in FS is available in "bulk" or "bound" forms.



Source: Faecal Sludge Management, IWA

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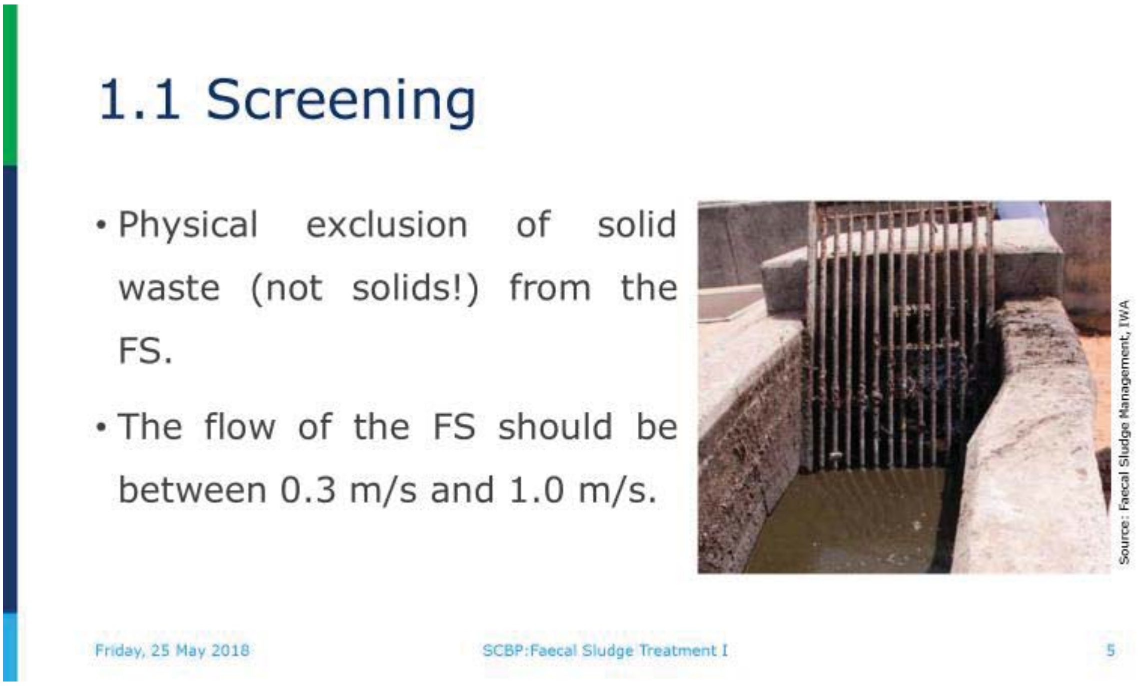
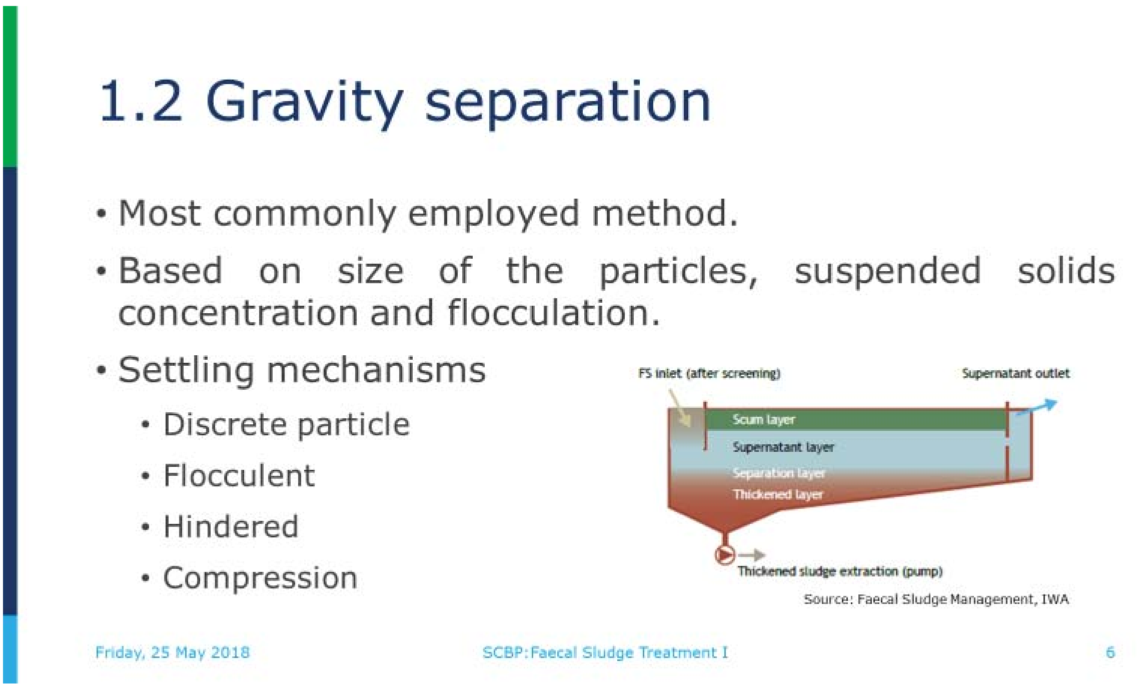
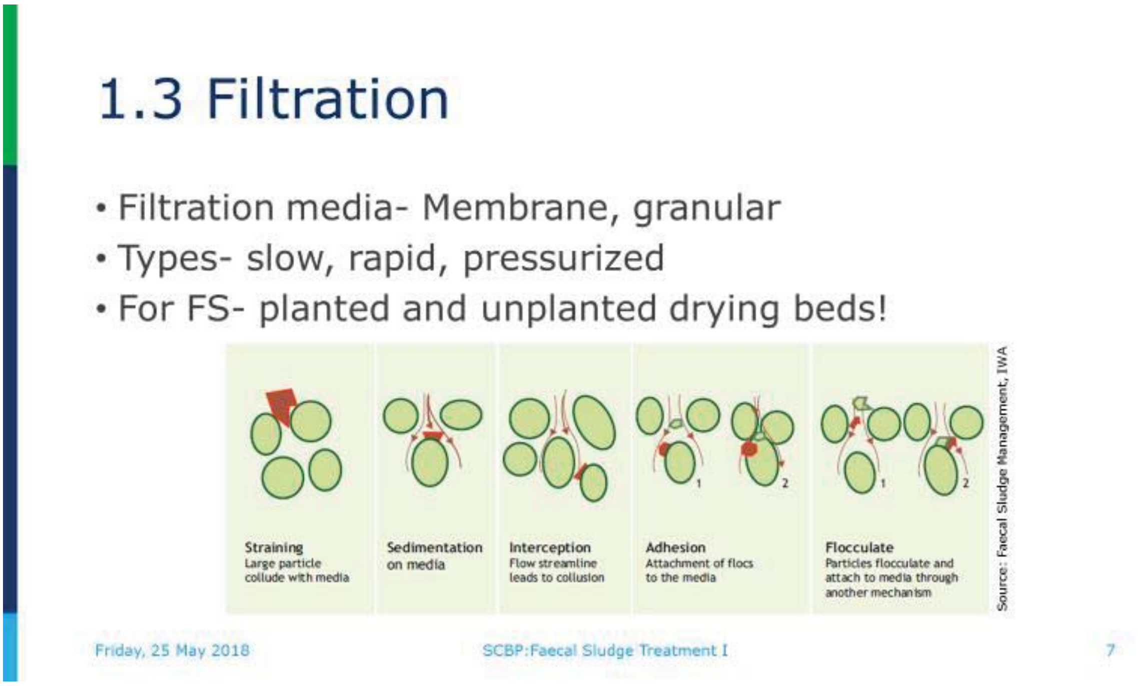


0.3 m/s ensures self-cleansing velocity in the channel leading to the screens.
1.0 m/s ensures that the solid waste is not pulled through the bars due to strength of flow.



Gravity is probably the most commonly employed method of liquid – solid separation in FSM. It can achieve the separation of suspended particles and unbound water. Particles that are heavier than water settle out under quiescent conditions at rates based on size of particles, suspended solids concentration, and flocculation.

The four types of settling mechanisms include discrete particle, flocculent, hindered, and compression. Discrete particle settling occurs in lower concentration waste streams when particles settle out individually without reacting with other particles. Flocculent settling occurs when particles join together and merge, increasing their mass and settling velocity. This is important for smaller particles that are held together through Van der Waals force, resulting in increased settling velocities. Hindered settling occurs in highly concentrated waste streams, where the particles settle out together as a 'blanket'. Compression occurs at the bottom of a settling tank when the sludge blanket is 'squeezed' by the weight of the solids from above, removing more liquid.



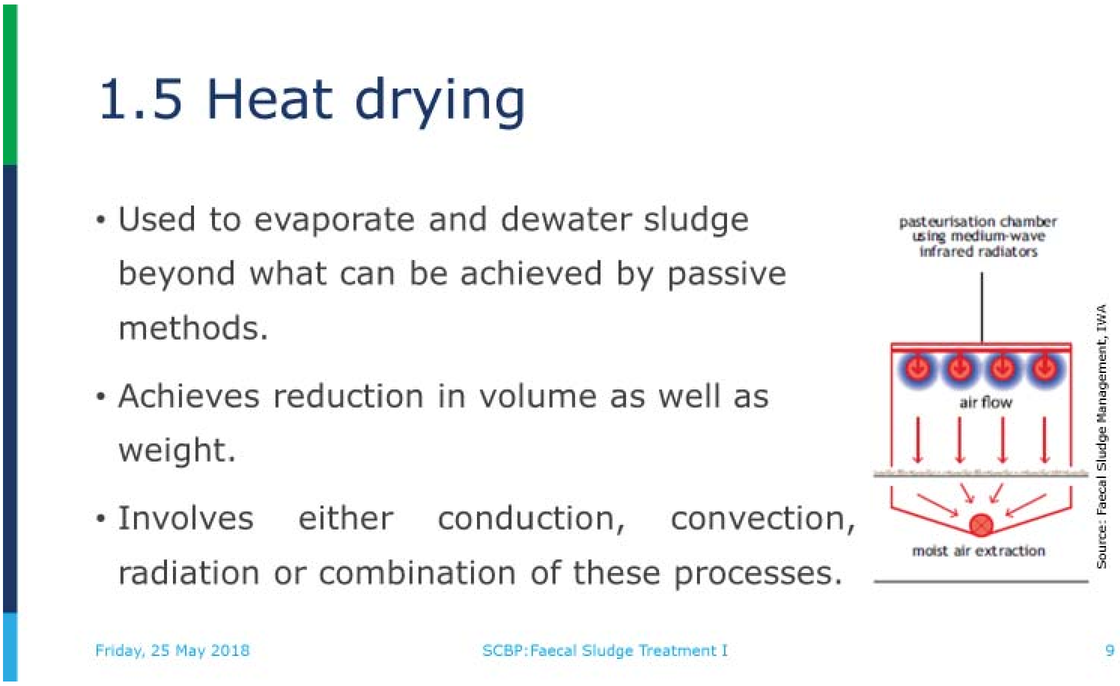
Filtration is also a commonly applied mechanism for liquid – solids separation in FSM. Several filtration media (e.g. membrane, granular) and types (e.g. slow, rapid, gravity driven or pressurized) are applied to water, wastewater and treated sludge (biosolids) processing.

In FSM the most common types are unplanted and planted drying beds. These processes use filter media to trap solids on the surface of the filter bed, while the liquid percolates through the filter bed and is collected in a drain or evaporates from the solids. In filter drying beds, slow filtration is occurring with filtration rates of 0.1-0.4 m/h, which requires less operations and maintenance than faster rates. The parameters that have the greatest impact on slow filtration efficiency are the characteristics of the influent, the type of filtration media, and the filter loading rate

In addition to physical mechanisms, chemical and biological processes also occur within the filter. Chemical processes include attraction processes that result in flocculation or adhesion to filter surfaces. Biological growth happens throughout the filter, but tends to be more intense near the surface, depending on the presence of oxygen, carbon sources and nutrient availability. This can also result in biological removal of nutrients and BOD occurring within the filter.

Evaporation occurs when water is released into the air as a vapour, and transpiration is the process by which plants release water vapour to the air as a part of their metabolic processes. Evapotranspiration is the combination of these two mechanisms. In addition to filtration, dewatering in drying beds is also occurring through evaporation, and with planted drying beds through evapotranspiration. For both mechanisms to occur, the surrounding environment needs to have an evaporative demand, which means that the air is not saturated.

The energy required for evaporation to occur is provided by solar energy (with losses due to convection). Thus, evaporation is strongly influenced by climate, and the available heat and moisture content of air are especially important. The surface from where the evaporation is occurring can also influence the evaporation rate (e.g. free-standing water versus water in sludge) (Musy and Higy, 2004). Important parameters are depth and total area of the drying bed. The larger the total mass of an object, the more energy that can be stored, increasing the heat requirement for evaporation. Wind speed also has an effect on the rate of evaporation, as it increases the replacement of saturated air with dry air.



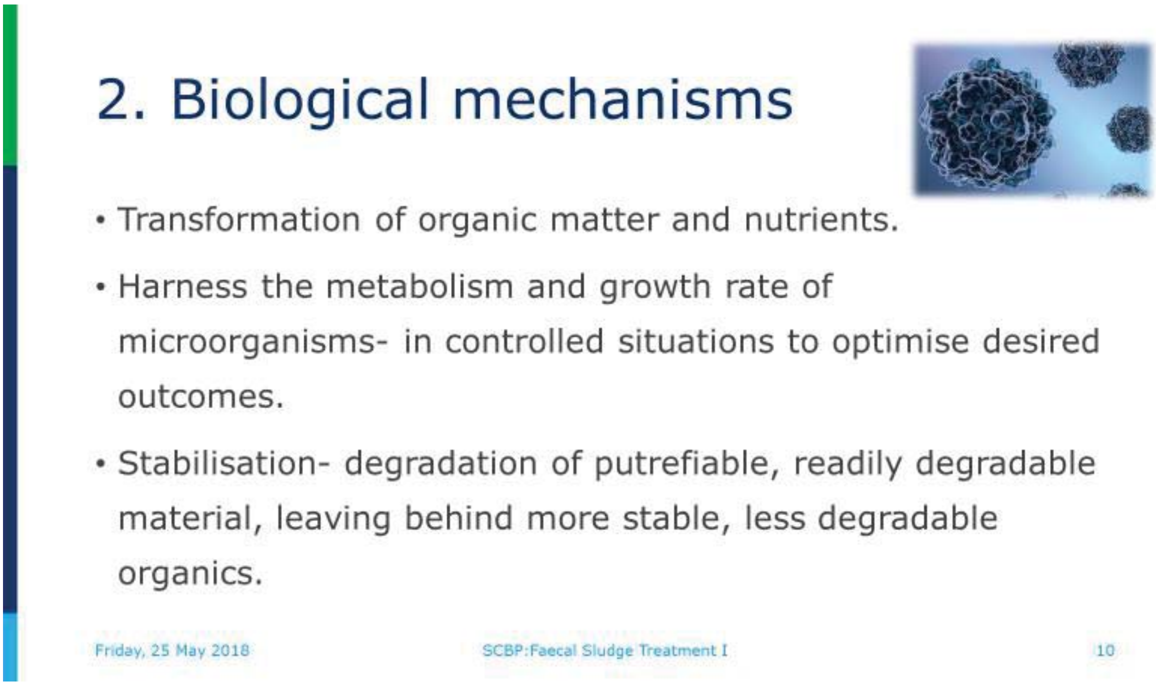
Heat drying is used to evaporate and dewater wastewater sludge (biosolids) beyond what can be achieved with other more passive, or conventional methods. Currently, heat drying is applied more for wastewater sludge processing than for FS, but this technology should be transferable, and further information can be obtained from manufacturers and pilot studies.

Heat drying achieves both weight and volume reduction, as water is lost in the form of vapour. The temperature of the sludge is increased through energy transferred from an external heat source, which allows the evaporation of free water at the sludge surface, at a rate that depends on the ambient air temperature, humidity, flow and pressure, and the exposed sludge surface.

It also called as Specific Heat Capacity. Measured in kJ/kg/^{0}C

Specific Heat Capacity of Water at 25^{0}C is 4.18 kJ/kg/^{0}C

For wastewater sludge it is reported to be 1.95 kJ/kg/^{0}C



This is important in order to reduce the oxygen demand, produce stable and predictable characteristics, reduce odours, and allow for easy storage and manipulation. ‘Stabilised’ organic matter does not have an exact agreed upon scientific definition, but in general refers to resistance to further biodegradation. Stabilised sludge consists of particles like cellulose, lignin, inorganic matter, and cellular matter of microorganisms that consumed readily degradable organics, whereas unstabilised sludge contains easily degradable compounds such as carbohydrates, proteins, and sugars. Volatile solids are used as a measure for stabilisation, as they are considered to be composed of readily degradable organic matter.

2.1 Aerobic treatment

- Aerobic environment refers to the presence of oxygen.
- Aerobic organisms reply on oxygen for their respiration.
- Aerobic treatment processes in wastewater treatment are activated sludge, sequencing batch reactors, trickling filters etc.
- Solubility of oxygen in FS is low, hence aeration can be energy intensive.

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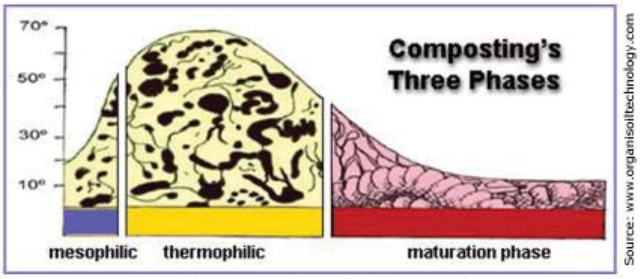
2.2 Composting



- Composting process is controlled using;
  - C:N = 20-30
  - Moisture content: 40-60%
  - Oxygen content: free pore space of 20% by volume.

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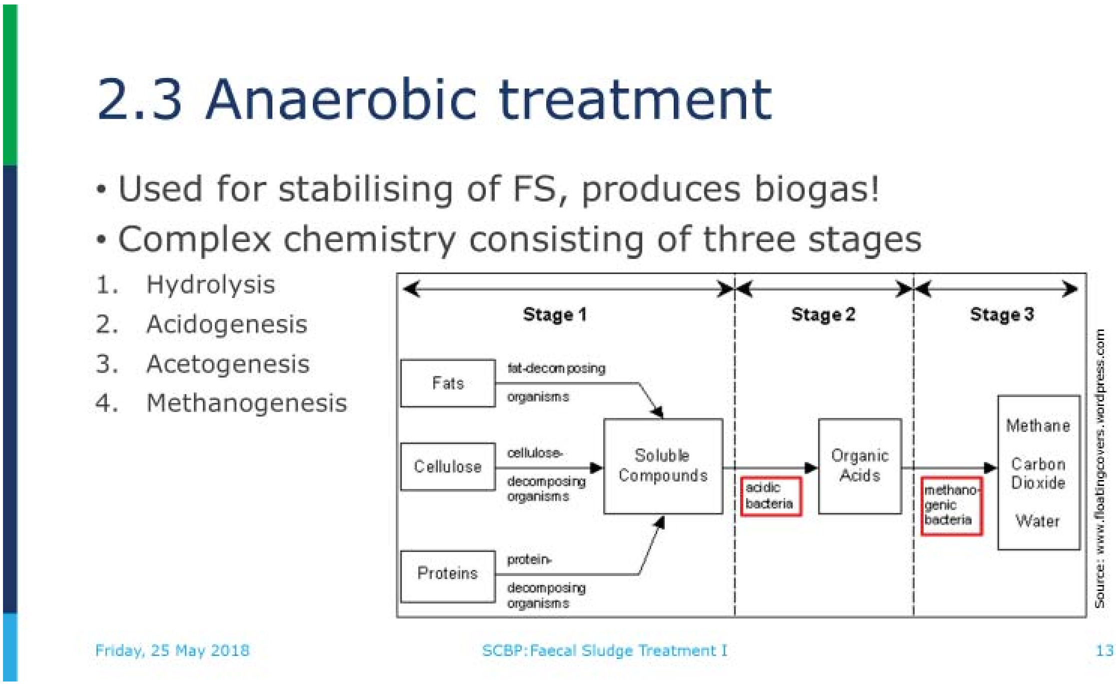
During the first phase, bacteria are growing rapidly while consuming readily degradable compounds (e.g. sugar, starch, protein). During this period, the temperature is also increasing due to the rapid rate of growth (due to exothermic catabolic reactions), which is faster than the rate at which heat can escape. In the second phase, thermophilic temperatures of 50-75°C are achieved and thermophilic bacteria become active, further decomposing the organic matter. During this phase pathogen reduction and inactivation of plant seeds (e.g. weeds) occurs as a result of the high temperatures. In the third phase, stabilisation is being reached as the last of the readily degradable substrates are depleted, bacterial activity slows down, and the temperature lowers.



Anaerobic digestion is a complex process characterised by hydrolysis, fermentation, acidogenesis, acetogenesis and methanogenesis. Hydolysis is an enzymatic process through which particulate matter and more complex organic compounds are degraded and become more bioavailable. At the same time, proteins, lipids, and polysaccharides are converted into amino acids, fatty acids, and monosaccharides.

During fermentation (or acidogenesis) acidogenic microorganisms further degrade amino acids, sugars, and fatty acids to methogenic substrates (e.g. H2, CO2, formate, methanol, methylamines, and acetate). Organic molecules are used as both electron donors and accepters. Therefore, methanogen archea can be characterised as chemoorganotrophs (Figure 3.7). During methanogenesis, one group of archea split acetate into methane and carbon dioxide, while another group produces methane through the use of hydrogen and carbon dioxide. Methanogenesis occurs more readily at mesophilic (30- 38°C) and thermophilic (49-57°C) temperatures.

2.4 Pathogen reduction

- Temperature: pathogens are inactive above 60°C
- Sorption: 50% helminth eggs separate during settling, up to 90% are retained in the sludge in drying beds.
- Dessication: dehydration reduces the activity of pathogens.
- UV: Solar/ UV radiation (300-400 nm) inactivates the pathogens.
- pH: Microorganisms survive and grow within range of 2-3 pH units

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3. Chemical mechanism

- To improve the performance of other physical mechanisms,
- To inactivate pathogens in FS,
- To stabilise the FS.

Addition of chemical increases the cost of treatment, hence "cost-benefit analysis" needs to be done!

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Chemicals can be mixed with FS to improve the performance of other physical mechanisms (e.g. addition of a cationic polymer to increase the flocculation and the settling efficiency), or to inactivate pathogens and stabilise FS. The addition of chemicals can represent a significant increase in the overall cost of treatment, and the benefits therefore need to be carefully weighed.

3.1 Alkaline Stabilisation

- Used for stabilisation of FS.
- Addition of lime;
  - Raises the pH to 12, ceases microbial activity.
  - Results in odour and pathogen reduction.
- Addition of quick lime;
  - Raises the temperature up to 60 ^{0}C.
  - Inactivates Helminth eggs too!
  - pH lowers down, hence excess Lime addition is needed.

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3.2 Coagulation and flocculation

- Removal of colloidal particles through gravity settling.
- Polymers can be natural or synthetic based chemicals.


Ferric Chloride


Alum


Lime

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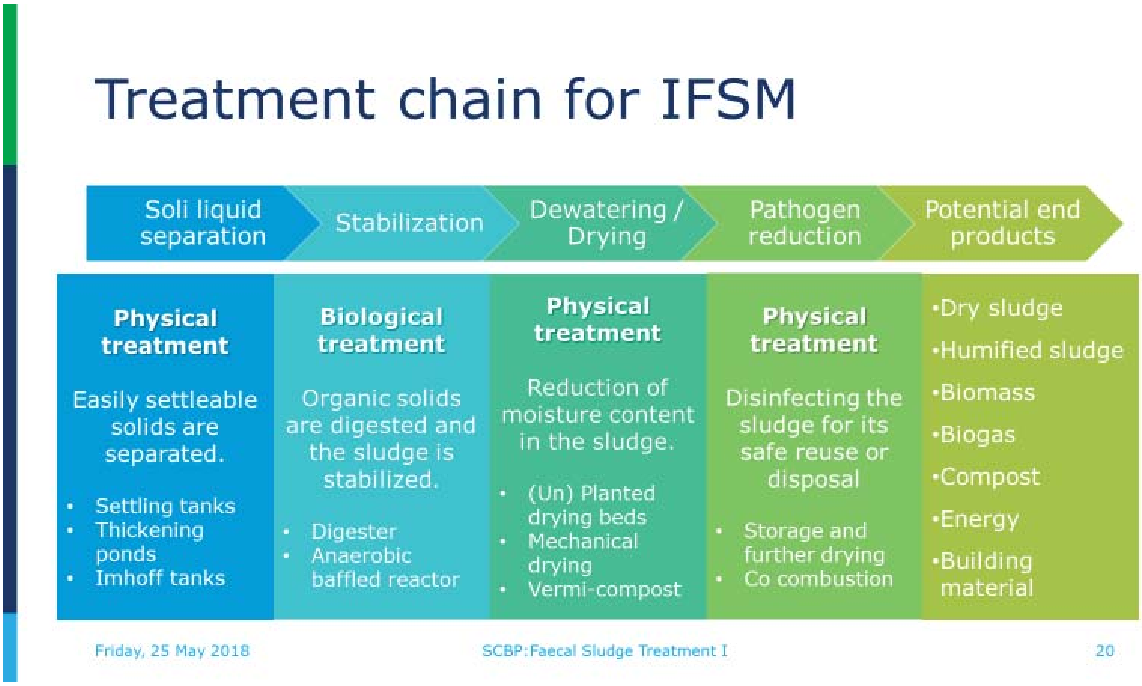
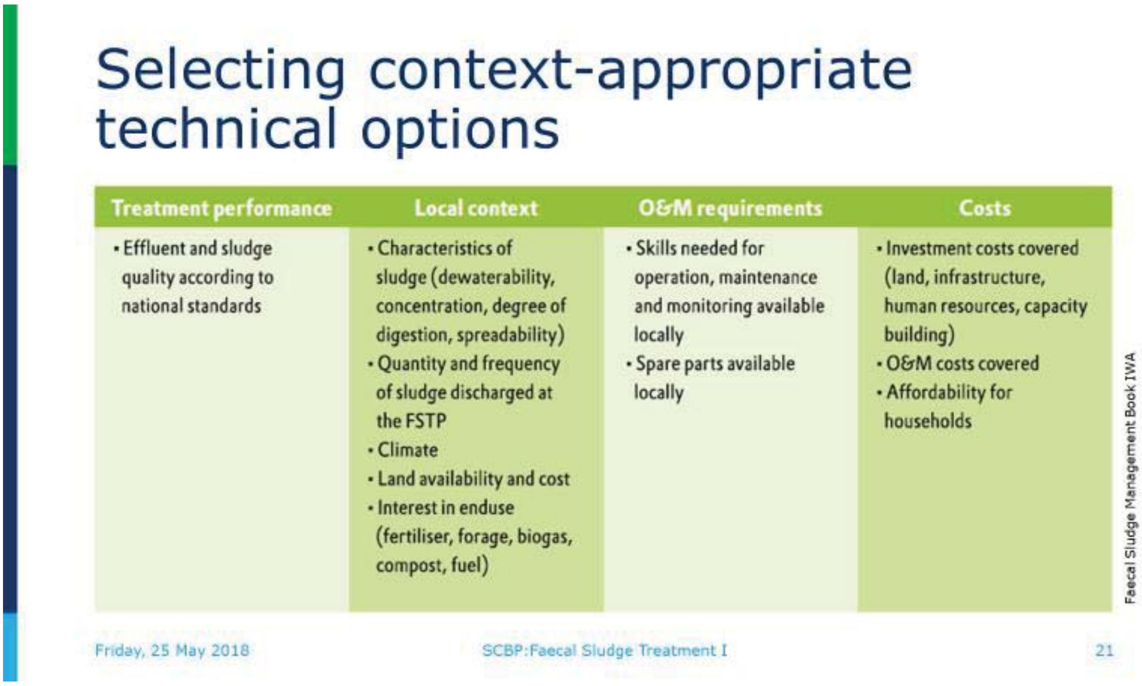
Colloidal particles that are not removed through gravity settling tend to be negatively charged, making them stable in suspension. In coagulation and flocculation additives are added that destabilise particles, allowing them to come in contact with each other, form larger flocs and settle, thereby achieving enhanced sedimentation. These additives are chosen based on the hydrophobic or hydrophilic characteristics of the particles, together with their surface charge.

Coagulation and flocculation are achieved by adding polymers that form a bridge between particles, or by adding potential determining ions (strong acid or base) that reduce the total surface charge.

1.6.2 Design of Faecal Sludge Treatment Plant





1.7 Faecal Sludge Treatment – II

Contents

- Co treatment in STP
- Deep row entrenchment
- Anaerobic Digestion
- Unplanted drying beds
- Planted drying beds
- Geotubes
- Mechanical dewatering
  - Centrifuge
  - Screw press
  - Belt press
  - Frame filter press
- Co composting
- Sludge incineration
- Thermal drying and pelletising

Co treatment in STP

- Limiting factor: Organic & hydraulic loading
- Application
  - At the Manhole Chamber before the inlet of STP
  - At the inlet of Screens of the STP
  - At the Sludge Management Process of the STP

Source: ESF/Dhawal Patil

Source: ESF/Dhawal Patil

Source: Faecal Sludge Management, IWA

Deep row entrenchment

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

Source: Faecal Sludge Management, IWA

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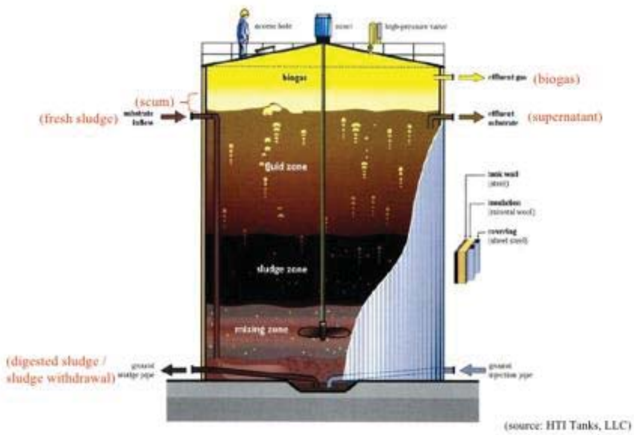
Deep row entrenchment consists of digging deep trenches, filling them with sludge and covering them with soil. Trees are then planted on top, which benefit from the organic matter and nutrients that are slowly released from the FS. In areas where there is adequate land available, deep row entrenchment 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.

Anaerobic digestion

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



(source: HTI Tanks, LLC)

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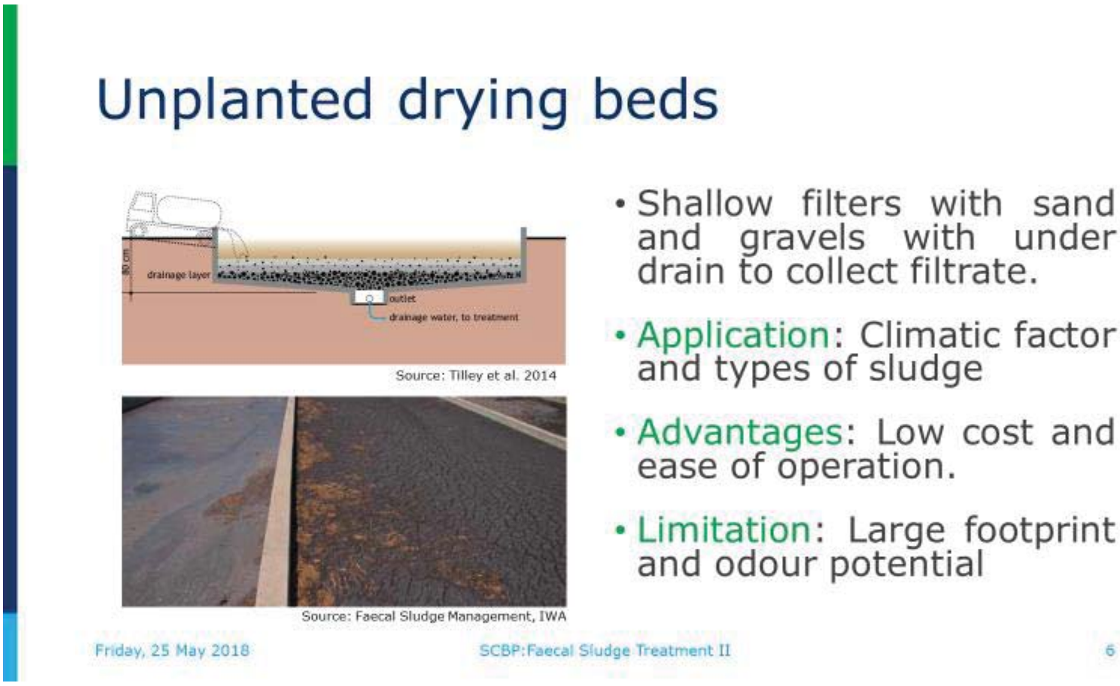
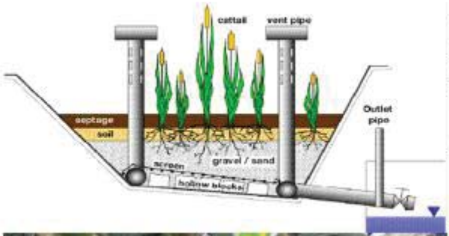
During anaerobic digestion, organic matter is converted into biogas and the remaining sludge is referred to as slurry or digestate. Biogas is a mixture of mainly methane and carbon dioxide and the digestate is relatively biologically stable and can be used as a soil conditioner.

Anaerobic digestion treats organic waste in airtight chambers to ensure anaerobic conditions. Anaerobic digestion has been widely applied in centralised wastewater treatment facilities for the digestion of primary sludge and waste activated sludge, typically with plug flow (PFR) or continuously stirred reactors (CSTRs). Anaerobic treatment technologies also include up-flow anaerobic sludge blanket (UASB) reactors, anaerobic baffled reactors (ABRs) and anaerobic filters. Anaerobic treatment is also well known and developed for industrial wastes and highly loaded wastewater treatment plants



Planted drying beds

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



Source: AIT, Thailand


Source: Faecal Sludge Management, IWA

Geotubes

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


Source: ESF/Dhawal Patil


Source: cementingproductsinc.com

Mechanical sludge treatment

- Belt filter, Centrifuge, Frame filter press and the Screw press.
- Mostly used for sludge generated in STP, transferable to FS and septage.
- Malaysia: centrifugation to dewater FS after screening and addition of flocculants.
- Advantages: Compactness, speed of the process.
- Limiting factors: investment costs, O&M costs, dependency on electricity.

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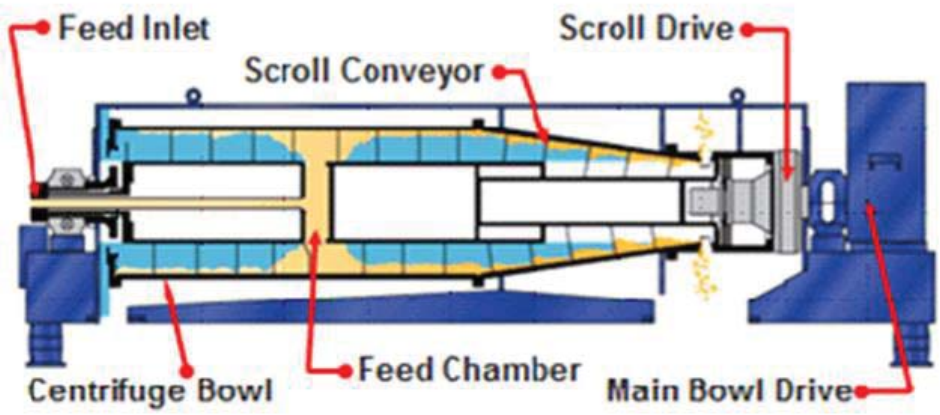
Centrifuge



Source: www.hiler-us.com

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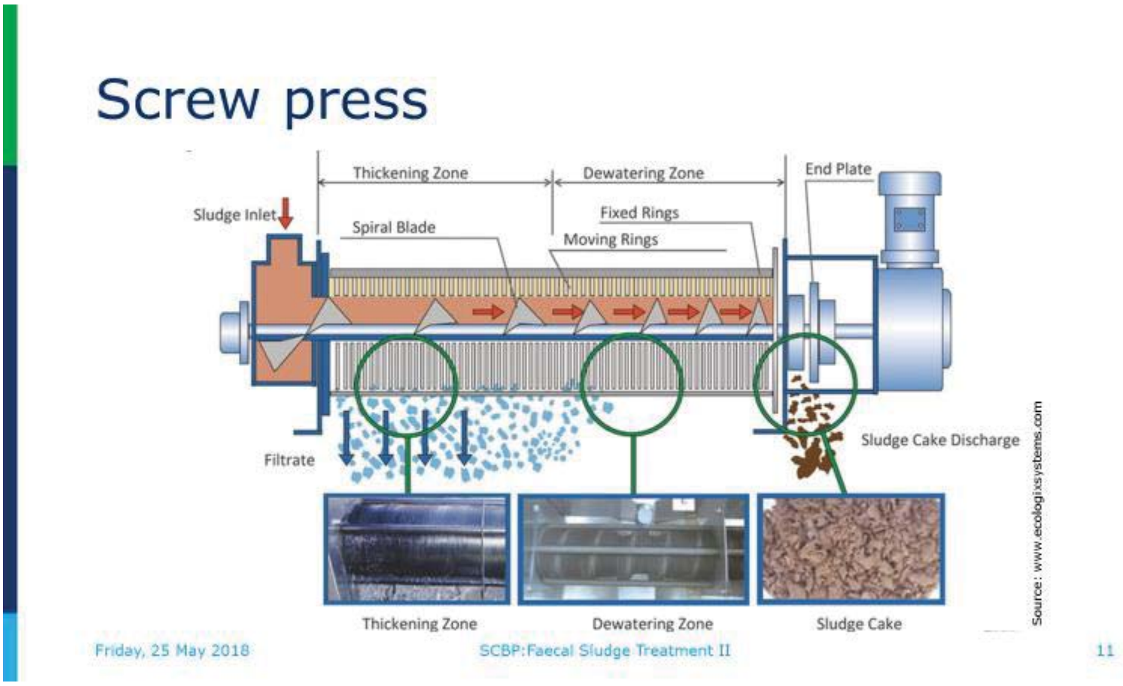
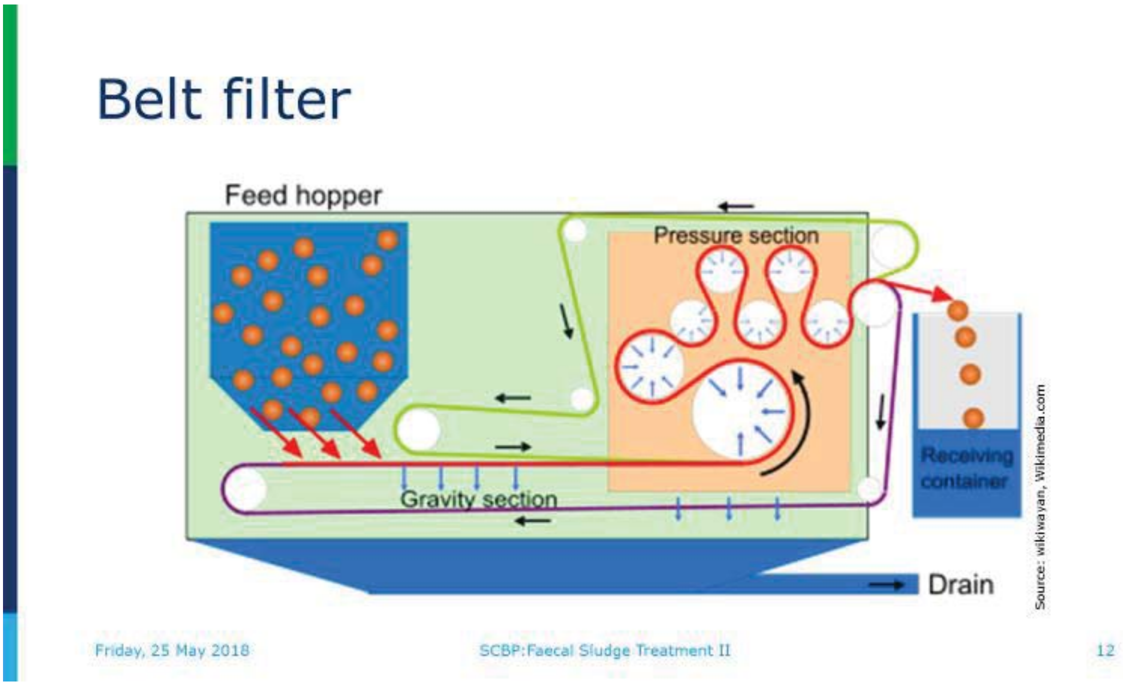
This technology dries the FS as it is squeezed outwards on the surface of a cylinder rotating around its horizontal axis, due to the centrifugal force. The flocculated sludge is injected into the middle of this cylinder, and the particles are pushed outward against the surface. An Archimedean screw transports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

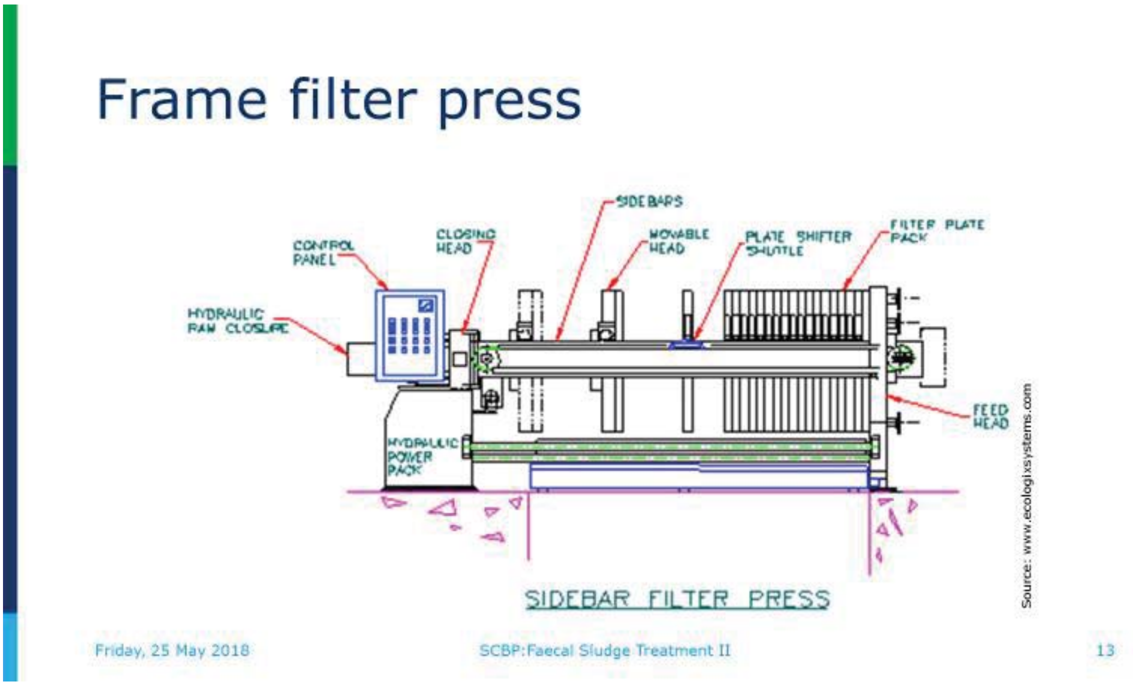


A screw press consists of a rotational screw placed in a perforated cylinder. The sludge is loaded at one end, it is pressurised due to a diminishing distance between the screw and the cylinder, and the liquid that is squeezed out is removed through the pores in the cylinder. The dewatered sludge is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



Belt filter 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:

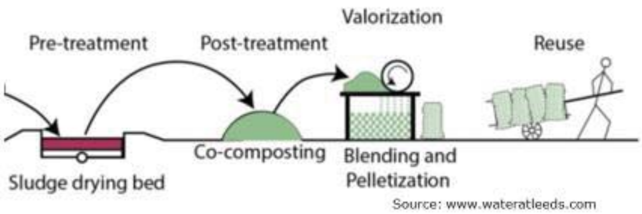
- a gravity drainage zone where the flocculated sludge is deposited and conveyed on a porous and mobile belt;
- a compression zone where a second belt is applied on the upper layer of the sludge, and compresses it to a pressure that can reach 7 bars; and
- a zone where the belts are separated and the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



This 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).

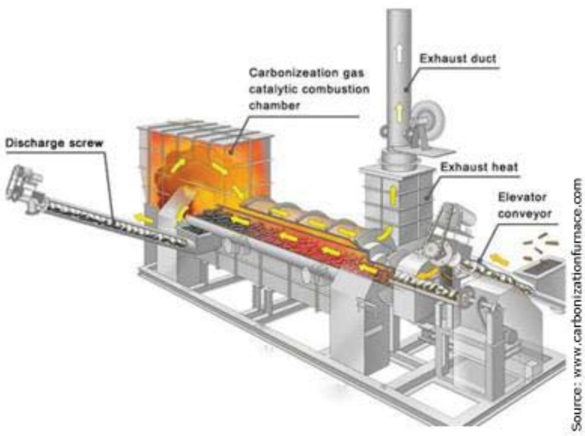
Co composting

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



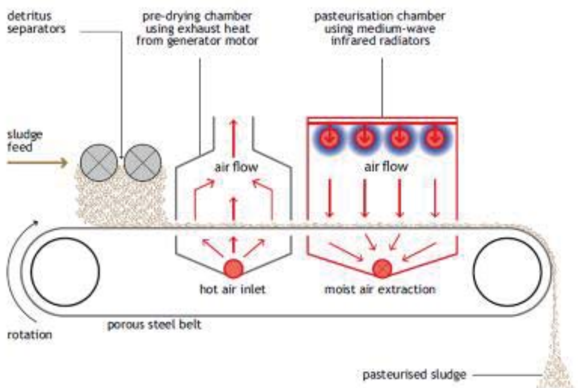
Sludge incineration

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



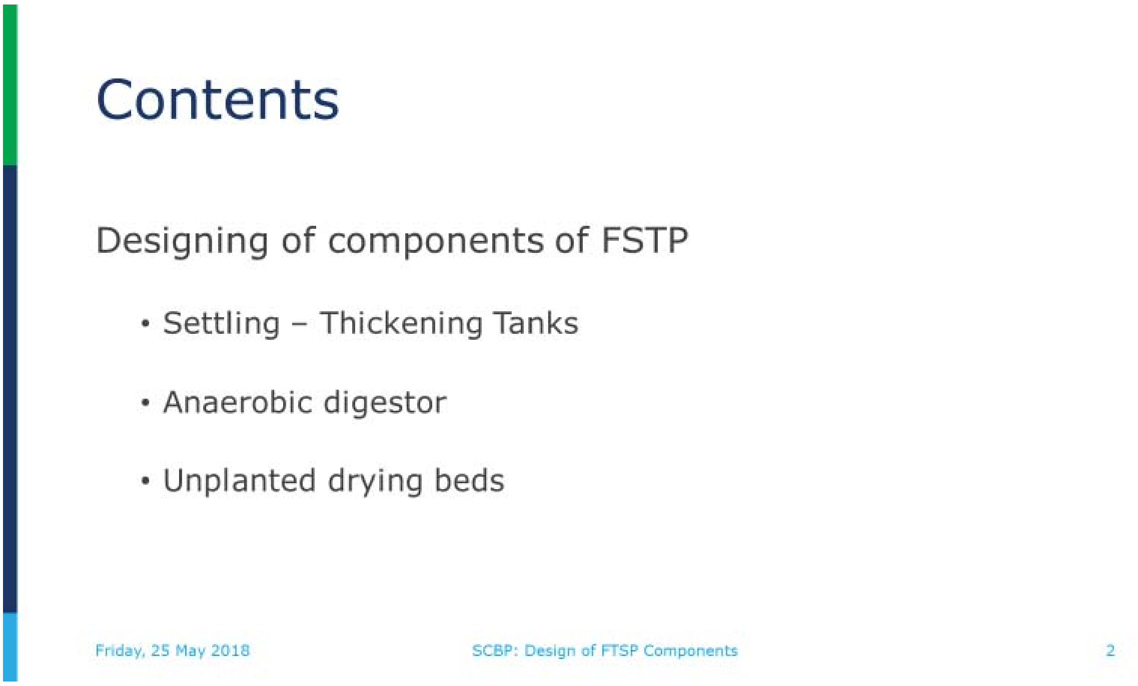
Thermal drying and pelletising

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

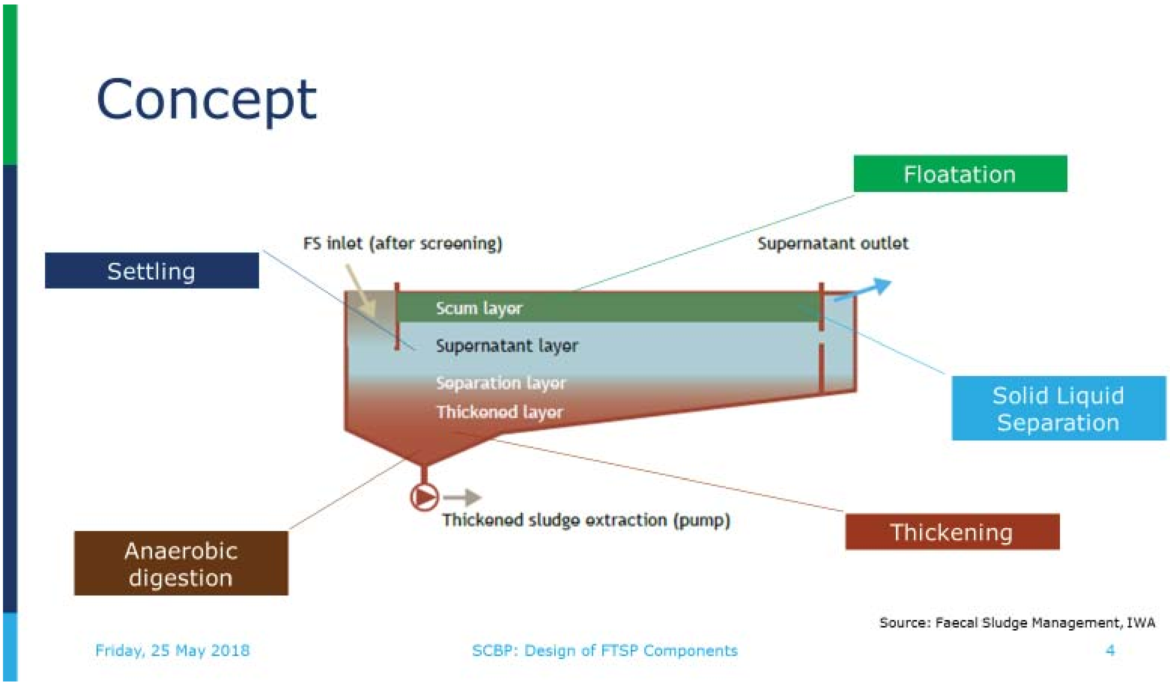


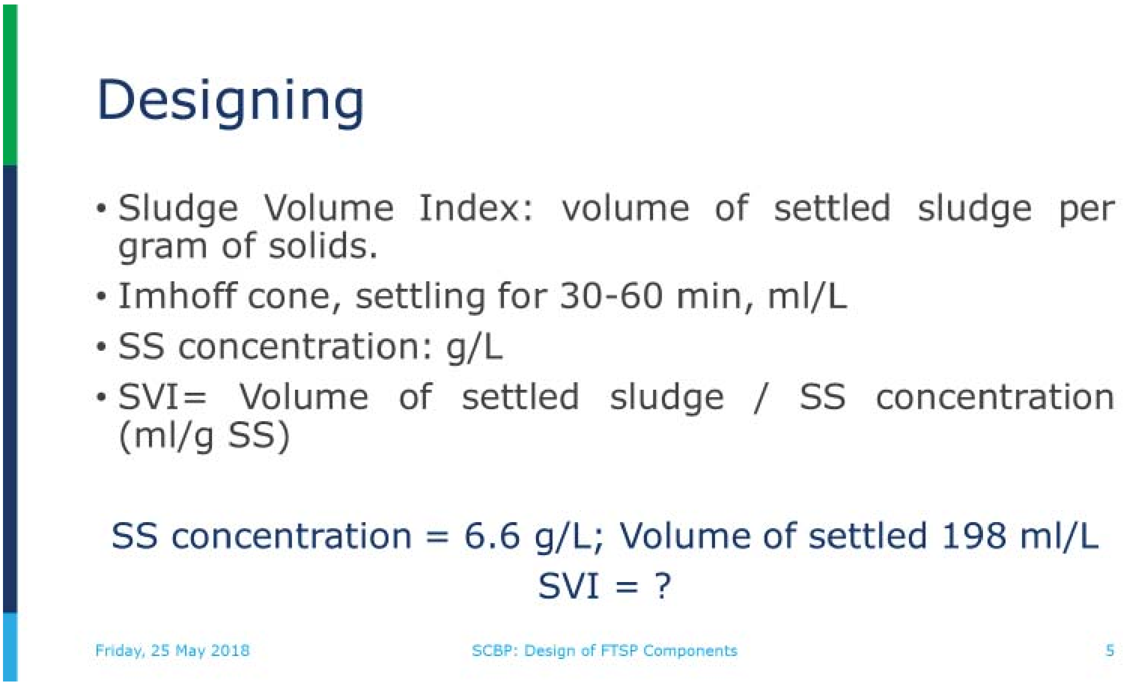
Source: Faecal Sludge Management, IWA

1.8 Designing of Faecal Sludge Treatment Plant (FSTP) Components



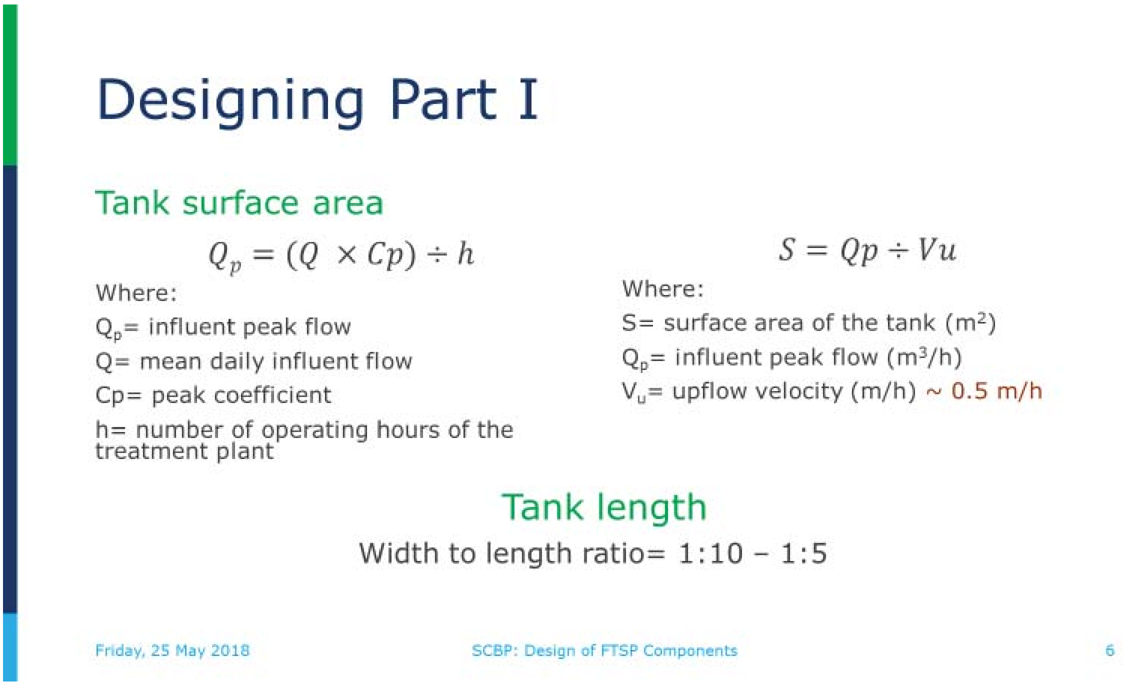
1.8.1 Settling-Thickening Tanks





SVI less than 100 ml/g SS achieves good solids-liquid separation in settling and thickening tanks.

Settling happened rapidly in first 30 min and then thickening can continue for up to 100 minutes.



Scum zone= 0.4 m (with one week loading, one week compaction and cleaning) 0.8 (with four weeks loading, four weeks of compaction and cleaning)

Designing Part II

Volume of thickened sludge

$$V_t = \frac{Q \times Ci \times e \times N}{C_t}$$

Where:

V_t= volume of thickened sludge storage zone (m^3)

Q= mean FS daily inlet flow (m^3/d)

C_i= suspended solids mean concentration of FS load (g/L) ~ 20 g/L

e= expected settling efficiency ~ 60-80%

N= thickening duration ~ 10-30 d

C_t= suspended solids mean concentration of thickened sludge after loading period (g/L) ~ 60-140 g/L

Depth of zones

Scum zone= 0.4 m - 0.8 m;

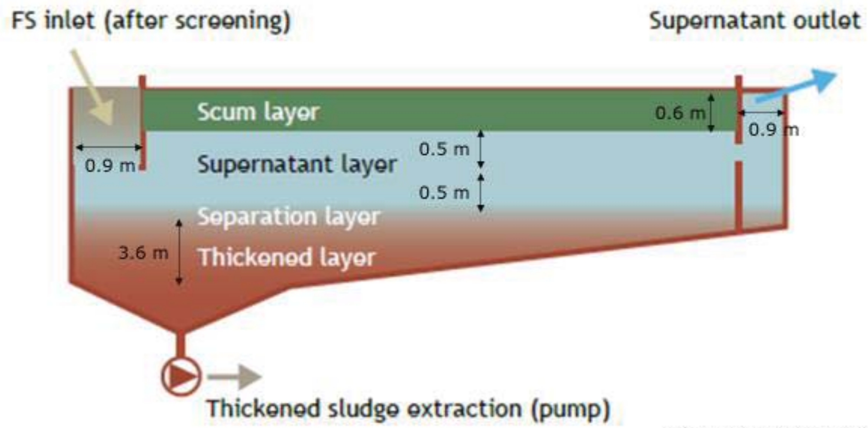
Supernatant zone= 0.5 m;

Separation zone= 0.5 m.

Volume of zones

Depth x Surface area of tank

Solution



Source: Faecal Sludge Management, IWA

Operation and Maintenance

- Start up period
  - Adjust load time
  - Asses the depths of zones
  - Optimise the compaction time
  - Sludge removal frequency
- Seasonal variation

  High temperature results into higher solid concentration in scum and increase in rate of digestion.

- Sludge removal
  - Pumps
  - Shovels
- Scum removal
  - Scrapper
  - Manual

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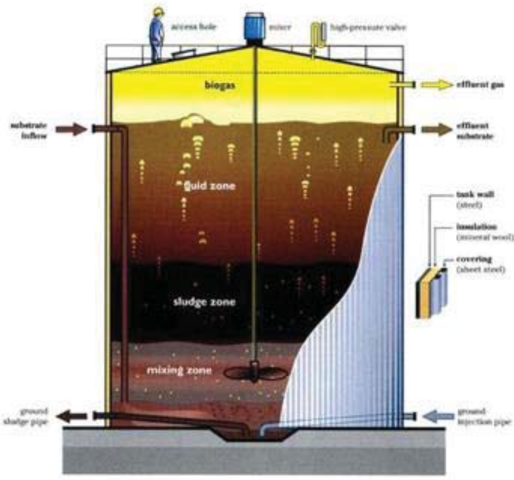
1.8.2 Anaerobic Digester

Concept

- Mixing zone: Incoming sludge is mixed with the stabilised sludge.
- Sludge zone: Stabilisation of the sludge takes place here.
- Liquid zone: Liquid separates from the stabilised solids.
- V_g, V_{sc}, V_l, V_{sl}



Source: www.humboldt.edu

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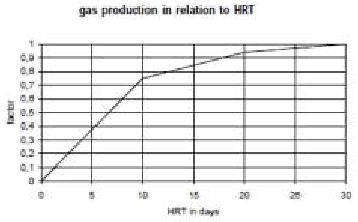
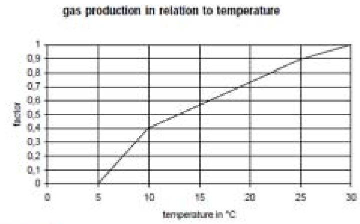
Design parameters

- Temperature of the reactor
  - Determines the reaction rate
  - Generation of biogas
- Hydraulic retention time
  - Solid settling
- $BOD_{removal}$
  - Sludge generation
- $COD_{removal}$
  - Biogas generation



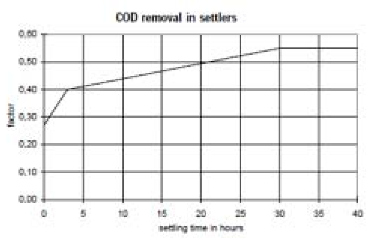


Source: Sasse L., 1988

Designing I

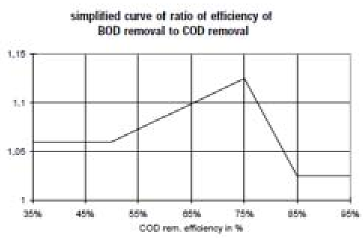
COD removal rate

$$= \frac{\frac{SettleableSolids}{COD} ratio}{0.6} \times f_{HRT}$$



BOD removal rate

$= \text{COD removal rate} \times f_{COD/BOD\ ratio}$



Designing II

Effluent COD (COD_{out})

$COD_{out} = COD_{in} \times (1\text{-}COD_{re.\ rate})$

Similarly,
calculate BOD_{out}

$BOD_{removed}$ in desludging frequency

$BOD_{removed}\ (gm) = (BOD_{in} - BOD_{out}) \times Q \times 30 \times N$

Where;
Q= daily influent flow (m^3/d)
N= desludging frequency (months)

Similarly,
calculate $COD_{removed}$

Designing III

Sludge Volume

$V_{sl}\ (m^3)$ = Specific Sludge Production x BOD removed

Where;
Vsl= Accumulated sludge volume (m^3)
Specific sludge production= 0.0045 L per gm BOD removed (ranges between 0.0035 ~ 0.005 L per gm BOD removed)

Liquid volume

$V_l\ (m^3) = Q \times HRT$

Where;
V_l= Volume of liquid to be retained (m^3)
Q= daily influent flow (m^3/d)
HRT= Hydraulic retention time 30 hours (ranges between 24 hr ~ 36 hr

Designing IV

Scum Volume

V_{sc} (m^3) = 20% x V_l

Where;

V_{sc}= Accumulated scum volume (m^3)

V_l= Volume of liquid to be retained (m^3)

Biogas Volume

V_g (m^3) = S_f x Biogas Yield x $COD_{removed}$

Where;

Vg= Accumulated gas volume (m^3)

Sf= safety factor 25%

Biogas yield= 0.35 L per gm $COD_{removed}$

Designing V

Volume of Digestor

V_{ad} (m^3) = V_g + V_{sc} + V_l + V_{sl}

Where;

V_{ad}= Volume of anaerobic digestor (m^3)

Dimensioning

Height of layers;

Gas= 0.6 m

Scum= 0.3 m

Liquid= > 1 m ~ 2-3 m

Sludge= > 1m

Diameter = $\sqrt{(V_{ad}/3.14 \; x \; H)}$

Optimising the design

- Heating the reactor to 30°C.
- Having homogenous mixing of sludge.
- Having conical bottom helps to increase the sludge height.
- Egg shaped reactor.

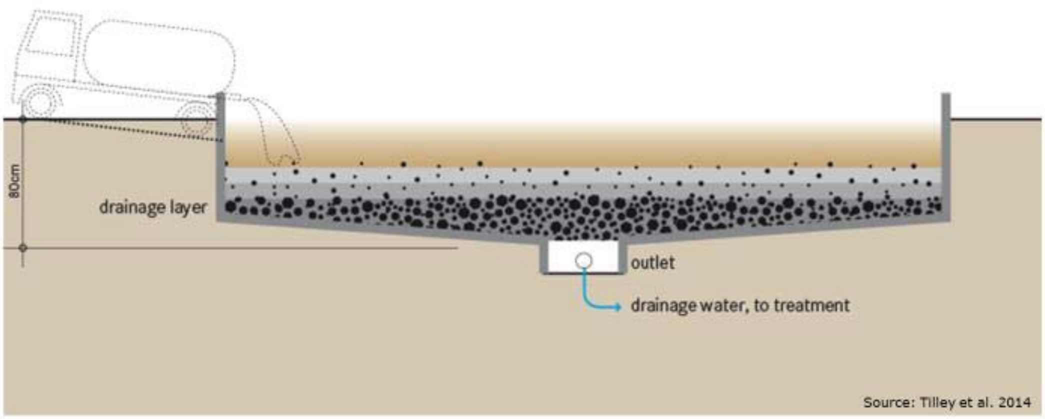
Source: www.sites.duke.edu

Operation and maintenance

- Maintaining the pH of the reactor.
- Maintaining the temperature of the reactor.
- Maintaining the moisture content.
- Periodic desludging.
- Removal of gas from the reactor.

1.8.3 Unplanted Drying Beds

Concept



Friday, 25 May 2018 SCBP: Design of FTSP Components 24

Design parameters

- Climate factors
  - Humidity
  - Temperature and wind
  - Rainfall
- Type of faecal sludge
  - Specific sludge resistance for dewatering
- Sludge loading rate
  - 100-200 kg TS/m^2/year
- Thickness of the sludge layer
  - 20-30 cm
- Number of beds
  - Depends on the area and SLR.

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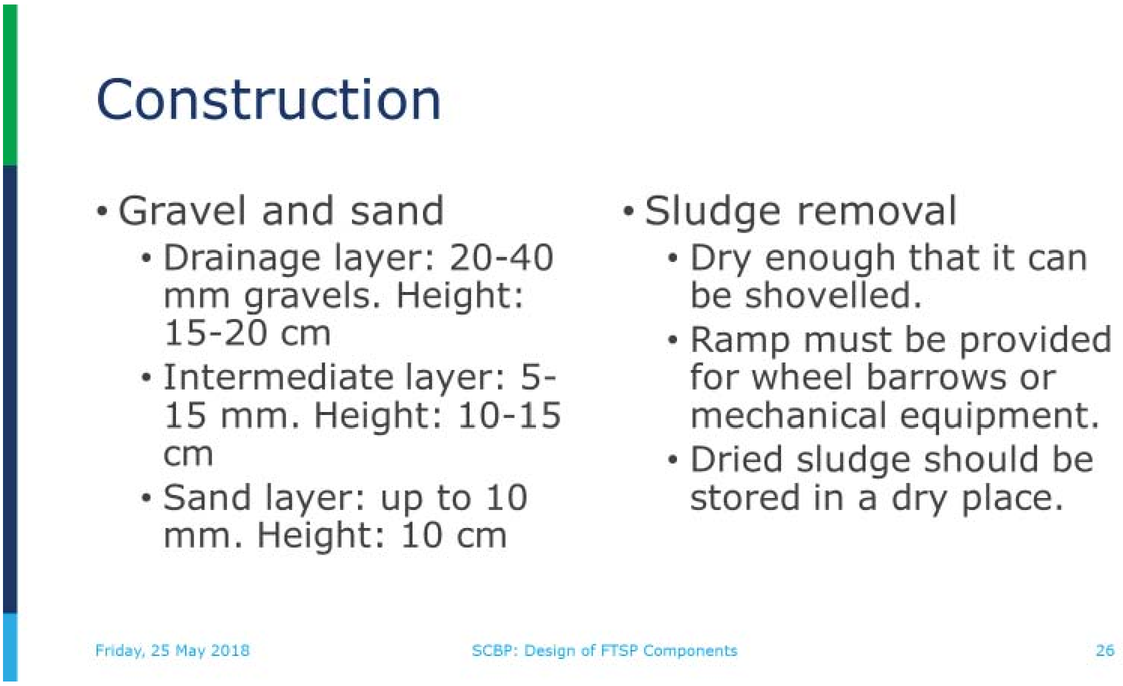
Poor conditions entail high humidity, low temperature, long periods of rainfall, and/or a large proportion of fresh FS. Optimal conditions comprise a low humidity, high temperature, a low amount of precipitation, and stabilised sludge.

A SLR of 300 kg TS/m2/year to be effective for dewatering thickened FS with 60 g TS/L, while about 150 kg TS/m2/year was estimated to be an effective rate for a FS with 5 g TS/L in the same climatic conditions.

For any particular sludge dried under the same weather conditions, found that an increase in the sludge layer of only 10 cm prolonged the necessary drying time by 50 to 100%.

If a layer of 20 cm is applied with a water content of 90%, the initial height before the water is drained-off will be much greater than 20 cm.



Design

Sludge loading

$$M = ci \times Q \times t$$

Where;

M= Sludge load in kg TS/year

c_i= concentration of FS in g TS/L

Q= flow in m3/day

t= no. of delivery days per year

Total area required

$$A = \frac{M}{SLR}$$

Where;

A= Total area required for drying beds in m^2

SLR= Sludge loading rate in kg $TS/m^2/year$

Design

Required drying bed area

$$a = \frac{Q}{SLH}$$

Where;

a= area of one drying bed in m2

SLH= Sludge loading height in m

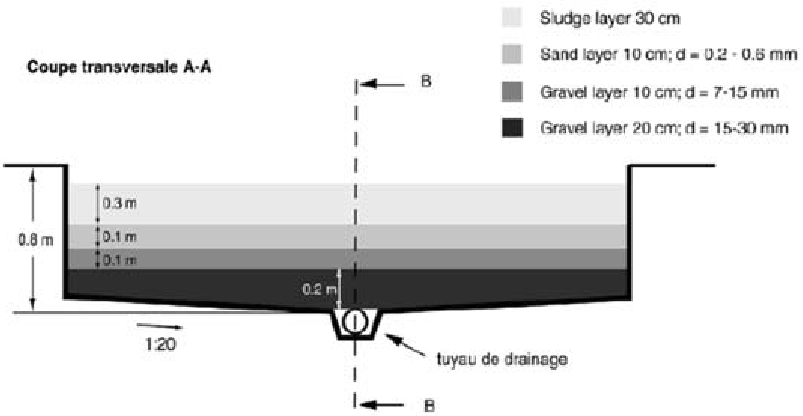
Number of beds required

$$N = \frac{A}{a}$$

Where;

N= number of beds required

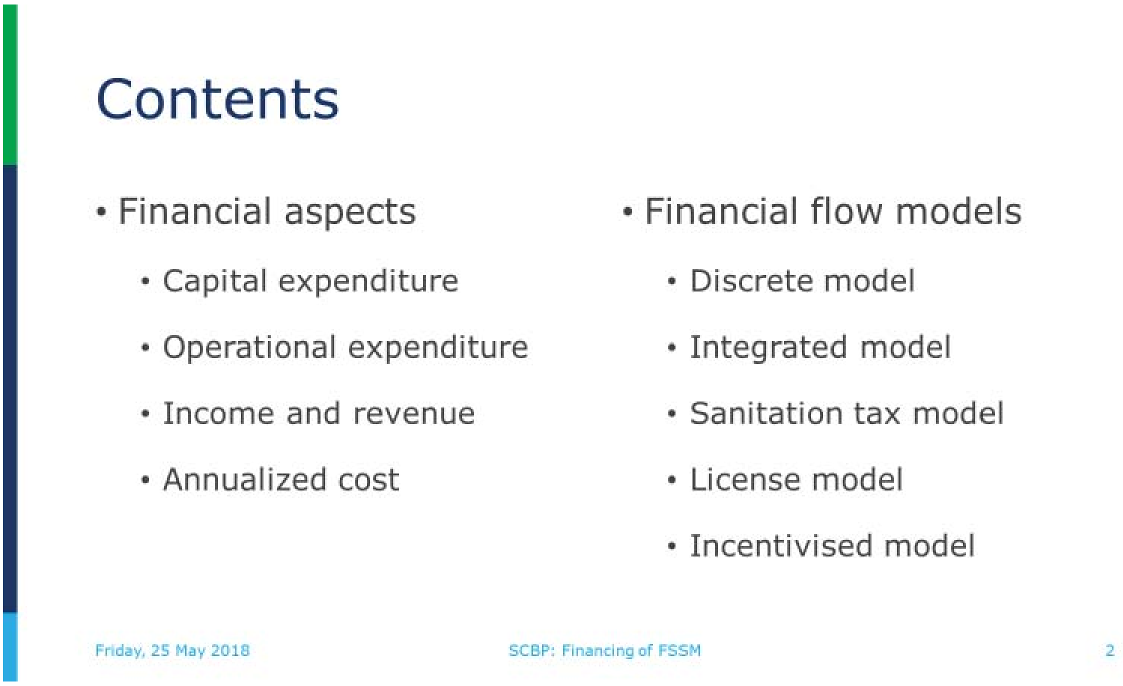
Height of layers & specifications



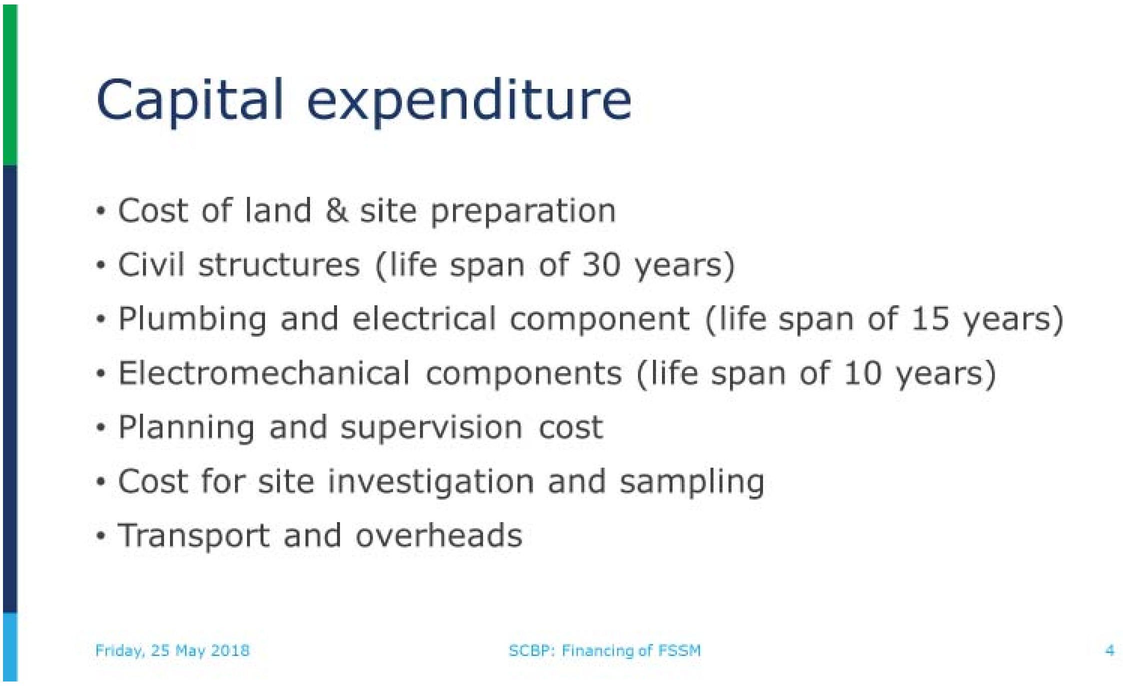
Operation and maintenance

- Pre-treatment of sludge before application.
- Maintaining the sludge loading rate and
- Maintaining the sludge loading height.
- Replacing the layer of sand after few cycles.
- Avoid rewetting of the dried sludge.

1.9 Financial Aspects of Faecal Sludge and Septage Management



1.9.1 Financial Aspects



Operational expenditure

- Direct costs
  - Expenditure to be borne in treating the faecal sludge and septage received at the treatment plant.
  - Cost of material for operation
  - Cost of power for operation
  - Cost of chemicals (if required any)
- Indirect costs
  - Expenditure to be borne even if faecal sludge and septage is not received at the treatment plant.
  - Human resource cost

Income and revenue

- Discharge fee
  - Fee collected from the collection and transport company to discharge faecal sludge and septage at the treatment plant.
- Budget support
  - Financial support provided by the government authority (ULB) to the company operating and maintaining the treatment plant.
- Purchase price
  - Revenue generated from the sell of end products such as soil conditioner, solid / liquid fuel, building material etc.

Annualized cost

$$Annual\ CapEx = CapEx \times \frac{(1+r)^N \times r}{(1+r)^N - 1}$$

$$Annualized\ Cost = Annual\ CapEx + OpEx - R$$

Where;
CapEx: Capital expenditure
r: Rate of interest (bank rate – inflation rate)
N: life span of the component

Where;
OpEx: Operational expenditure
R: Revenue

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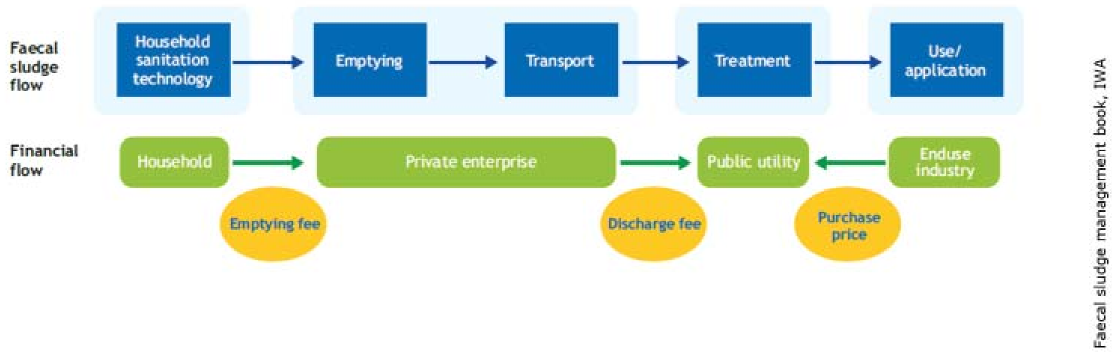
1.9.2 Financial Flow Models

Discrete collection and treatment model



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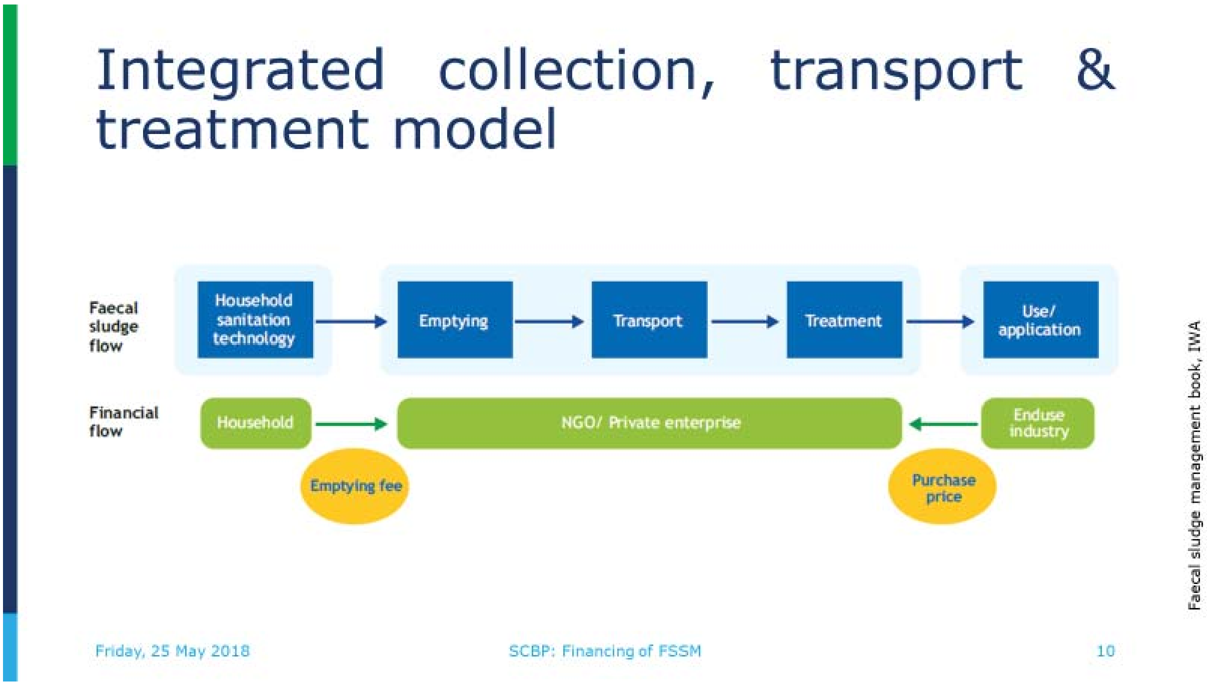
PROS

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

CONS

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

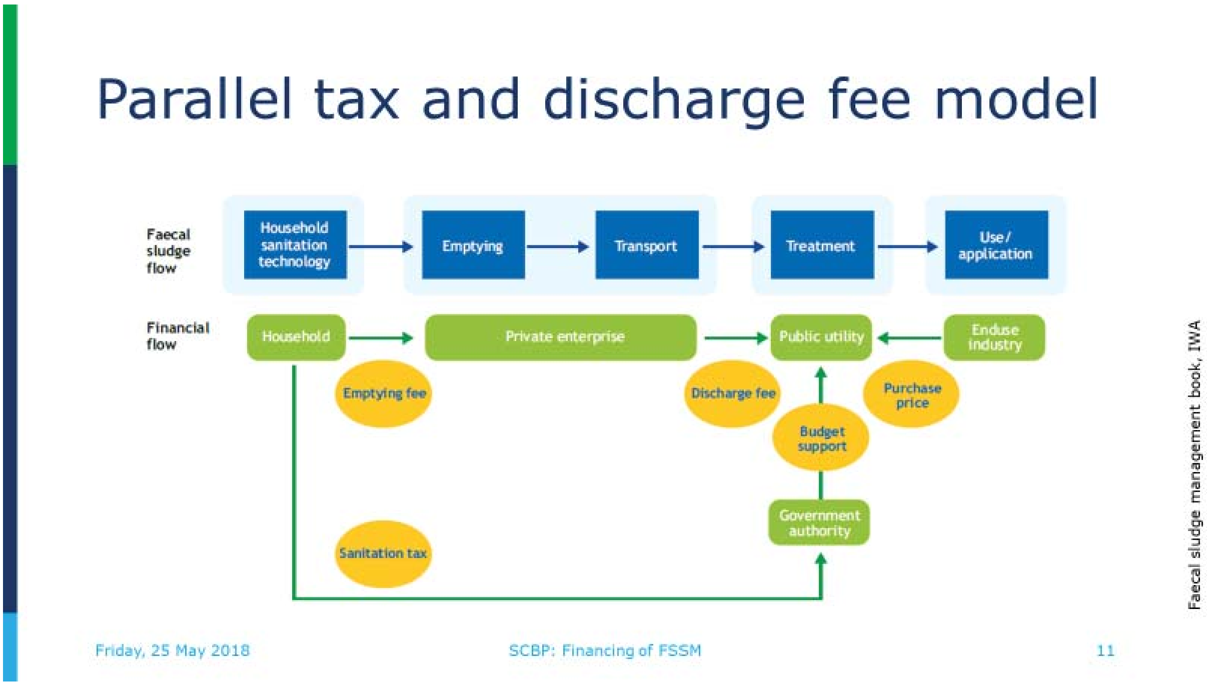


PROS

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

CONS

- High fees may be passed onto the household

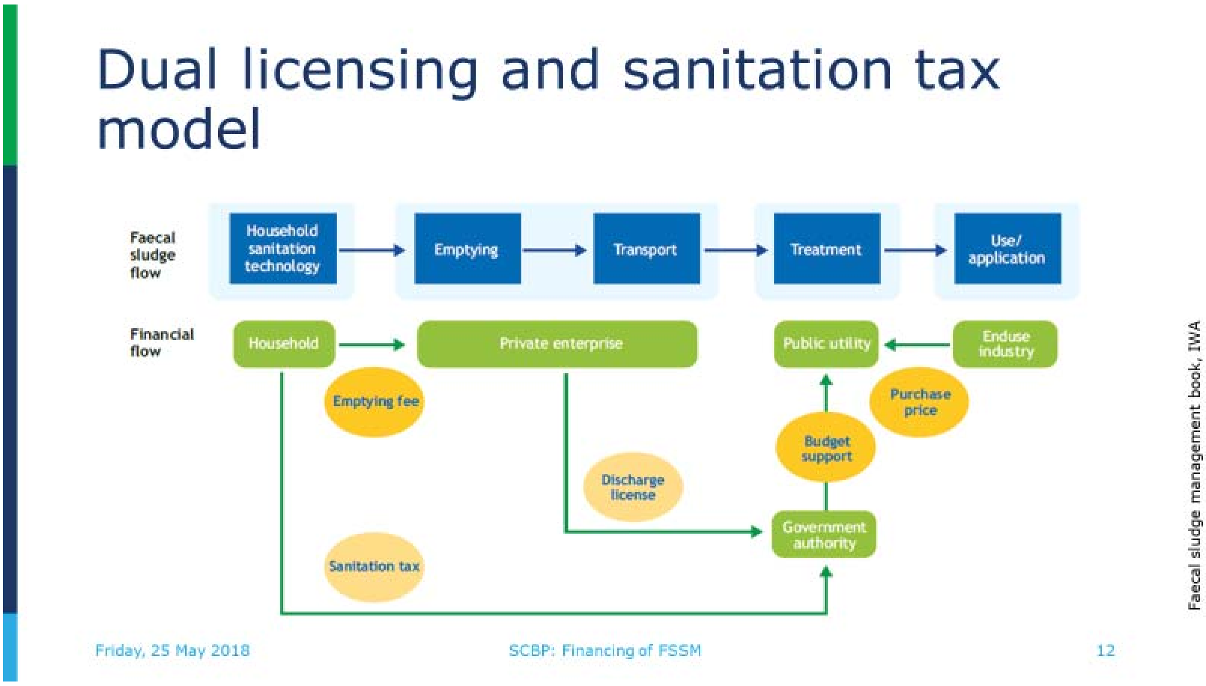


PROS

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

CONS

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

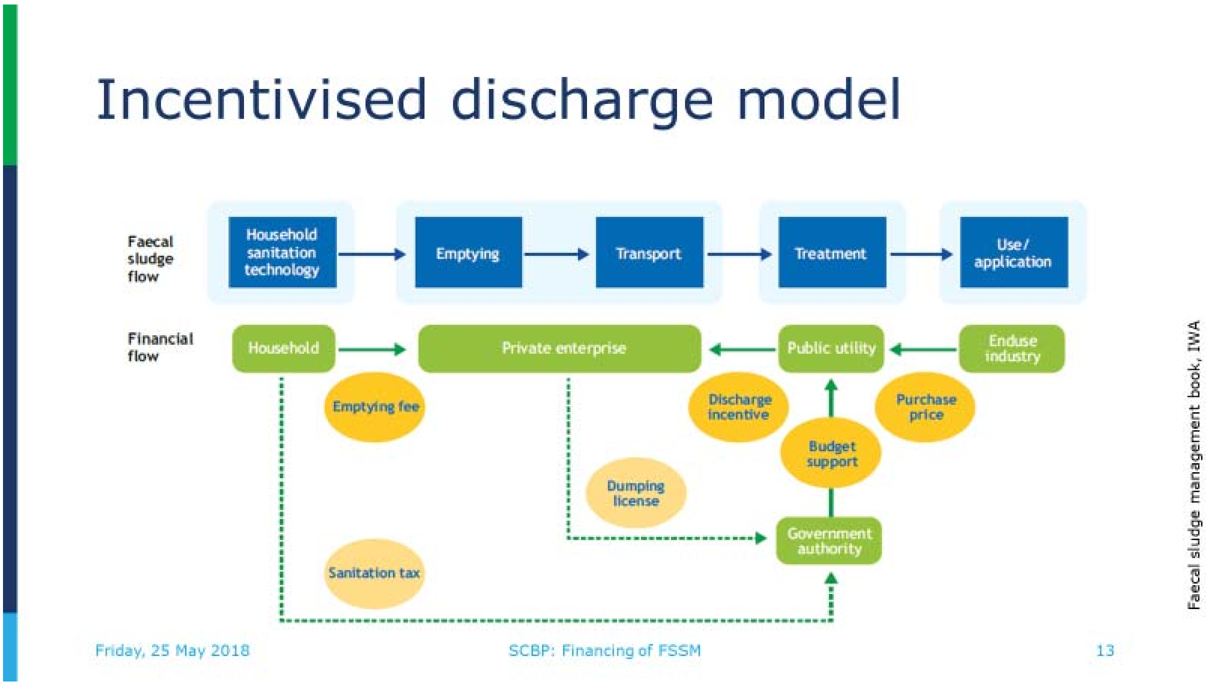


PROS

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

CONS

- The management of too many aspects of the service chain by one entity could prove difficult for a new business or NGO



PROS

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

CONS

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

2 Further Readings

I. STRANDE, L.; RONTELTAP, M.; BRDJANOVIC, D. (2014): Faecal Sludge Management - Systems Approach for Implementation and Operation. London: IWA Publishing URL

II. 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) URL

III. USEPA: Handbook on Septage Treatment and Disposal

IV. Ministry of Housing and Urban Affairs, Government of India: National Policy on Faecal Sludge and Septage Management (FSSM) (2017) URL

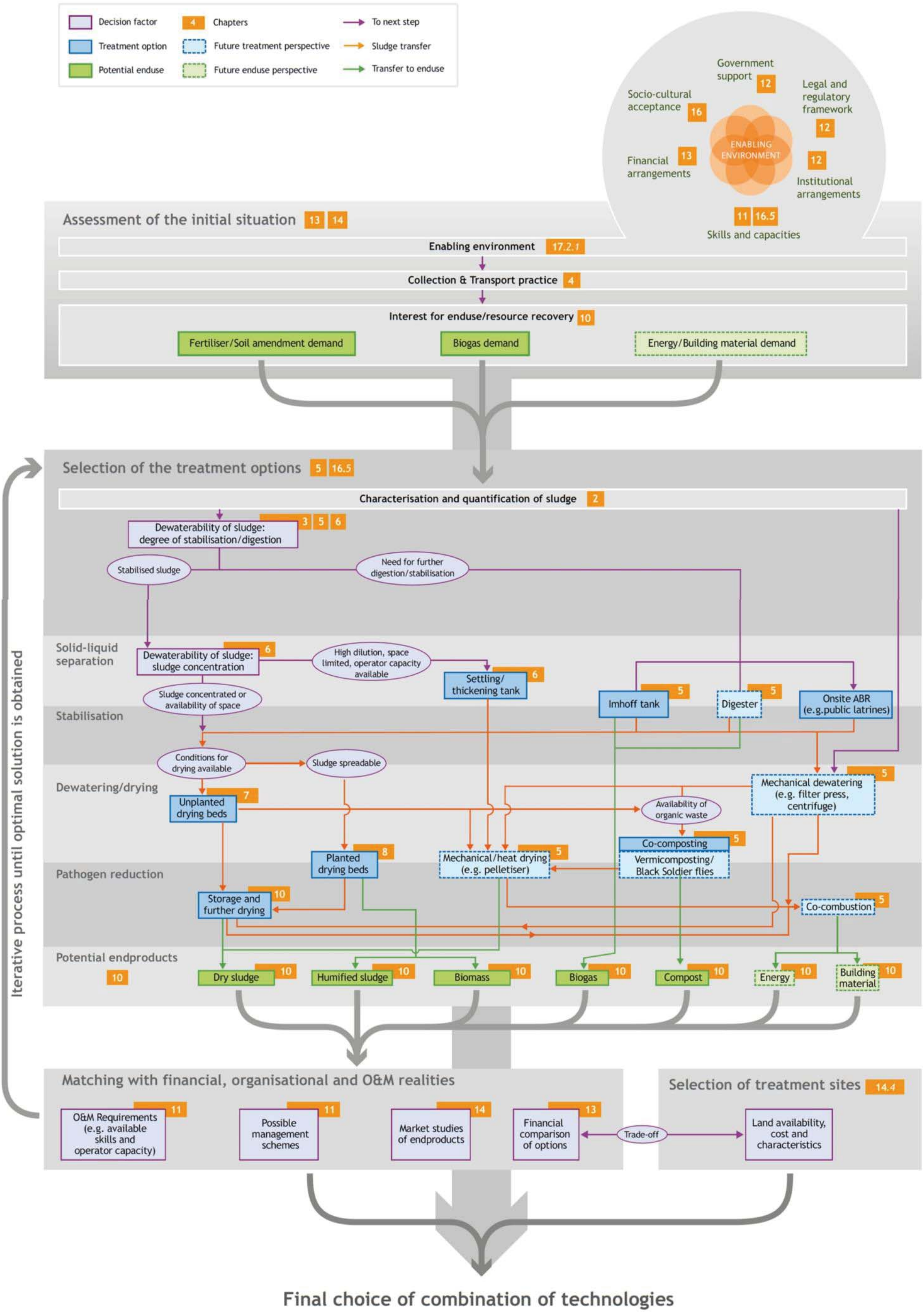
V. ROSS, I. et al, (2016): Faecal sludge management tools – data collection instruments. Washington D.C., World Bank Group URL

VI. Urban Management Centre: Standard Operating Procedure (SOP) for Faecal Sludge Management for Municipalities in Gujarat, Performance Assessment System, CEPT University

VII. SMM, Urban Development Department (February, 2016): Guidelines for Septage Management in Maharashtra, Government of Maharashtra

VIII. SMM, Urban Development Department (2016): Guidebook for Urban Local Bodies to implement Septage Management Plan, Government of Maharashtra

Selecting a context-appropriate combination of faecal sludge treatment technologies



Goal

To build the capacity of cities and other stakeholders working in urban sanitation to ensure improved delivery of sanitation services through decentralized approaches

What is SCBP

Sanitation Capacity Building Platform (SCBP) is an initiative of the National Institute of Urban Affairs(NIUA) for addressing urban sanitation challenges in India. The 3 year programme(starting 2016) is supported by a Gates Foundation grant. It is aimed at promoting decentralised urban sanitation solutions for septage and waste water management.

The Platform is an organic and growing collaboration of universities, training centres, resource centres, non-governmental organizations, consultants and experts. The Platform currently has on board CEPT University, CDD Society and BORDA, ASCI, AIILSG, UMC, ESF, CSE, WaterAid, CPR, iDECK, CSTEP and WASHi. The Platform works in close collaboration with the National Faecal Sludge and Septage Management Alliance(NFSSMA).

What we do

The Platform lends support to the Ministry of Housing and Urban Affairs (MoHUA), Government of India, by focussing on urban sanitation and supporting states and cities to move beyond the open defecation free (ODF) status by addressing safe disposal and treatment of faecal sludge and septage.

The Platform supports National Urban Sanitation Missions, States and Towns, by developing and sourcing the best Capacity Building, Policy Guidance, Technological, Institutional, Financial and Behaviour Change advise in favour of decentralised sanitation solutions.

How does the Platform work

NIUA initiates and facilitates engagement of the SCBP Platform Partners at the State government level, for advocating and awareness generation for Faecal Sludge and Septage Management(FSSM). Followed by on demand support for capacity building and implementation of decentralised sanitation solutions at state and city level. SCBP promotes a four-module based Capacity Building support.

Thematic Areas

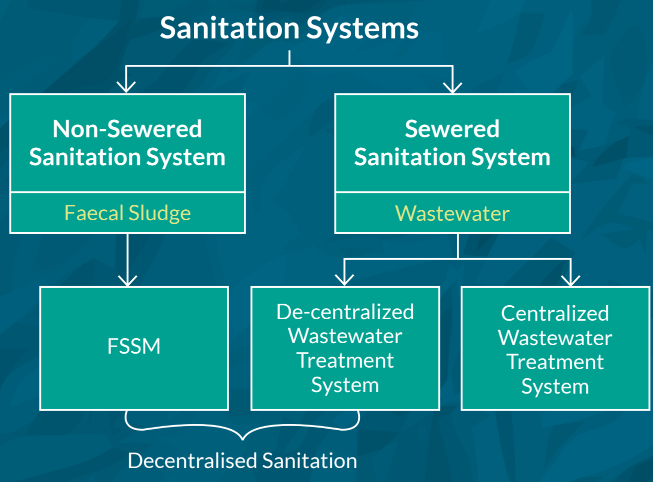
- Awareness and Advocacy
- Policy Advise
- Technical Support
- Developing Training Content and Modules
- Delivering Trainings
- Knowledge Building through Research and Learning events

Publications and Reports

Why Decentralised Sanitation Solutions

Given that 49% of the urban population in India relies on on-site sanitation, such as septic tanks and pits, decentralized sanitation options, such as Faecal Sludge and Septage Management (FSSM) and Decentralized Wastewater Treatment Systems (DEWATS) are critical for achieving the goals for urban sanitation under various national missions. Decentralized sanitation options are scientifically proven solutions to complement centralized systems, serving the underserved, particularly in peri-urban areas and informal settlements.

FSSM is the collection and transportation of faecal sludge from the containment system, treatment of the sludge at a designated site, followed by safe disposal or reuse of the treated sludge. DEWATS uses sewers to convey domestic wastewater from a neighbourhood or local catchment to a small, local treatment plant where it is treated through natural processes without any requirement for external energy to operate the system.



Target Audience

All stakeholders ranging from National Missions, State and Town Officials(Public Health, Engineering and Administration), Elected Representatives, Private Sector Consultants and Vendors, NGOs, Academia, Masons and the Citizens at large.

The Platform provides a sharing and cross learning opportunity for SCBP Partners. To pool in their knowledge resources on all aspects of urban sanitation capacity building. Facilitates joint development of training modules, learning and advocacy material including developing Key Messages and Content. And a platform for sharing and dissemination of FSSM Research, Advocacy and outreach to State governments and Urban Local Bodies.

FSSM Capacity Building Focus

1 **State Level Capacity Building for FSSM**

2 **Institutional Capacity Building for FSSM at National Level**

3 **Evidence Based Advocacy for FSSM**

Training Modules Development under SCBP

- FSSM Training of Trainer Module
- Integrated waste Water and Septage Management Module
- FSSM Orientation Module and Handbook
- Orientation Module for ULB Elected Representatives
- Specialized Module(3 day Advanced Technical Training Module for FSSM)
- Specialized Module(3 day Advanced Technical Training Module on Integrated Waste Water and Septage Management)
- ODF and FSSM Training Module
- Consultants Training Module on FSSM DPR preparation
- FSSM Training Module for Masons
- Learning Material on International FSSM experience

All Modules and learning materials translated in Hindi

Technical Support

Assessments
- Capacity need assessments
- Sanitation situation assessment – IWWSMP, CSP, Rapid assessment of FSSM situation

DPR for FSSM
- DPR for FSSM
- Transation advisory support
- Support for incremental changes

Policy Framework
- Review of legal and institutional framework
- Formulation of Policy / operational guideline / regulations for FSSM

1. State Level Capacity Building for FSSM

Supporting select State governments, their Para state Agencies, Towns and Urban Local Bodies

- Orientation and exposure visits for understanding septage and faecal sludge risks and challenges
- Institutional capacity strengthening through Training of Trainers programmes
- Four Modules Based FSSM Capacity Building Strategy

Capacity building activities are planned to cover all stakeholders involved in the FSSM value chain – government officials, elected representatives, masons, private sector and community

State and ULB officials

Training module and learning material – Orientation, specialized training on FSSM and IWWSM, Trainig of Trainers

Exposure visit – ODF sustainability, technology for FSSM, IWWSM, International visit to Malaysia

Institutional capacity building
Regional / state level training institutes, support for training programme under various national missions

Other stake holders
Academic Institute, Regional / state level training institutes, Consultants

Sensitization / orientation training → **First Specialized Training & National Exposure visit** → **Second Specialized Training on planning for FSSM** → **International Exposure visit**

Capacity Building for FSSM : Uttar Pradesh (UP)

- **Developing the State FSSM Operations Policy Guideline (Draft)**
- **Exposure visits and Orientation on FSSM for SBM Director and ULBs**
- **Planning support.** Submission of Faecal Sludge Treatment Budget for 61 AMRUT towns for the State Annual Action Plan(SAAP)
- **Technical Support.** Development of the first DPR for an FSTP in the state(Unnao town), and adopted for other towns
- **State Nodal Agency Capacity Building.** Supporting RCUES Lucknow in conducting FSSM Training for ULBs and conducting independent research in new towns

Capacity Building for ODF and FSSM : Rajasthan

- **Division level ODF and ODF++ City Trainings.** Followed by Exposure visits to Maharashtra and Madhya Pradesh(conducted for 90 officials)
- **Four Module based FSSM capacity building strategy**
    - Sensitization/ orientation training for 191 ULBs (till date 250 officials trained)
    - First Specialized Training
        - *Integrated waste water management and exposure visit to Pune (conducted for 30 officials)*
        - *Technology option for FSM and exposure visit to Devanhalli (cities where DPR is planned)*
    - Second Specialized Training
        - *Planning and Financing of FSSM projects (planned for officials from 10-15 towns – for incremental improvements in managing septage and sludge, Assessments)*
    - International Exposure visit for State officials and ULB officials (planned)

2. Institutional Capacity Building for FSSM at National Level

Nodal AMRUT Agencies Capacity Building Support for FSSM Trainings

- Training of Trainers on FSSM Planning : Eight AMRUT Institutes faculty
- Training of Trainers on Integrated Waste Water & Septage Management : Ten AMRUT Institutes
- Four AMRUT training agencies supported for integrating Training on FSSM into AMRUT training frame work – covering 200 officials from 12 states
- Exposure visits on Feacal Sludge Treatment Plant(FSTP) visit : 80 officials from 7 states to Devanahalli
- Exposure visit and integrated Waste Water and Septage Management (IWWSM) Training in Pune
- Advanced FSSM Technology Training

Private Sector Capacity Building

- National Consultation on private sector engagement in FSSM held in 2017
- Study initiated for developing a strategy for supporting manufacturers, vendors and project management consulting companies capacity building strategy
- Training Module developed for Consultants capacity building

Supporting Academia

- National consultation held in 2017 for 20 Faculty members from 15 academic institutes, to orient them on FSSM and explore demand for support by the academia
- Specific University level support plans being developed
- Workshops for Training of Trainers (ToT) support for universities and institutes. For integrating FSSM content in existing course work
- Developing dedicated Modules and related support for research and internships for students
- Promoting a platform for learning and exchange, research and advocacy

3. Evidence Based Advocacy for FSSM

Collation of existing knowledge, promoting new research, documentation and dissemination and learning

- Developing Training Modules, appropriate for different contexts (States, FSSM Thematic priorities and Stakeholders)
- Collating and creating Advocacy and Knowledge resources for all stakeholders on different aspects of FSSM service chain
- Urban Sanitation Research on urban sanitation status, pro poor implications of existing and proposed plans : for the states of Madhya Pradesh, Odisha, Karnataka, Telangana, Jharkhand, UP, Rajasthan and Uttarakhand
- FSSM Workshops, Advocacy and Learning events : Financing, Technology and Life Cycle costs of FSSM projects, Monitoring, Behaviour Change, etc
- Landscaping Study of Septage Treatment initiatives. Documentation and dissemination experiences and lessons of setting up and operations of Faecal Sludge Treatment Plants
- Research and advocacy on thematic FSSM challenges : Legal and Institutional, Operations, Financing, etc

SCBP Publications and Reports

- Capacity Need Assessment for FSSM Report
- Assessment of FSSM for 100 small towns of Rajasthan
- City sanitation Plans for four AMRUT cities in Odisha
- Detailed Project Reports(DPRs) for FSSM for UP, Rajasthan and Bihar
- Draft FSSM Operations Policy for UP and Rajasthan
- Assessment of legal and Institutional Frame work for FSSM in Uttar Pradesh
- FSSM Training Modules(7)
- Workshop Reports :
    - Practitioners Meet on Capacity Building for FSSM
    - Private Sector in FSSM
    - Academia engagement for FSSM
    - ToT Workshops for Institutes
    - Exposure Visits to Maharashtra
    - Rajasthan State Workshop
    - Achieving ODF : Recommendations for Rajasthan

Key Results SCBP FSSM Capacity Building

State Level Capacity Building	• State FSSM Perspective (Rajasthan) • City Sanitation Plans(4 towns of Odisha) with FSSM perspective • 191 ULBs of Rajasthan supported for ODF and FSSM • 61 AMRUT towns of Uttar Pradesh supported for FSSM • First Detailed Project Reports (DPRs) for setting up Faecal Sludge Treatment Plants in 3 towns (Uttar Pradesh, Bihar & Rajasthan)
Institutional Capacity Building at National Level	• Capacity Building of Nodal AMRUT Institutes(5) • State para state agencies supported for Planning and Technology • Private sector engagement in FSSM • Academia engagement and curriculum advise • 200 officials from 12 states provided with FSSM trainings • 80 ULB officials from 7 states taken for exposure visits to the Devanhalli FSTP plant.
Evidence Based Advocacy	• Capacity Needs Assessment for FSSM undertaken for 3 states (Uttar Pradesh, Bihar and Andhra Pradesh) • Thematic and Spatial Research on Urban Sanitation • State FSSM Policy Drafts (Uttar Pradesh and Rajasthan) • Training Modules Developed (8) • National and State level Advocacy with NFSSM Alliance • Advocacy Factsheets • Workshops & Learning Events

About NIUA

NIUA is a premier national institute for research, capacity building and dissemination of knowledge in the urban sector, including sanitation. Established in 1976, it is the apex research body for the Ministry of Housing and Urban Affairs (MoHUA), Government of India.

NIUA is also the strategic partner of the MoHUA in capacity building for providing single window services to the MoHUA/states/ULBs.

The Institute includes amongst its present and former clients Housing and Urban Development Corporation, Niti Ayog, City and Industrial Development Corporation of Maharashtra, USAID, World Bank, Asian Development Bank, GIZ, UNICEF, UNEP, UNOPS, Cities Alliance, Bill & Melinda Gates Foundation, Rockefeller Foundation, Global Green Growth Institute, and Bernard van Leer Foundation.

Some of the major areas of work include:

- Provide research support to MoHUA
- Conduct research studies on contemporary urban issues
- Coordinate capacity building and training activities
- Disseminate information through networks and knowledge hubs
- Analyze and promote policy change agenda
- Monitor and evaluate Government of India's urban programmes/schemes

Partners of the Platform

National Institute of Urban Affairs

1st and 2nd Floors, Core 4B, India Habitat Centre, Lodhi Road, New Delhi - 110003, INDIA

(+91 11) 24643284/24617517, (+91 11) 24617513 • niua@niua.org, www.niua.org, scbp.niua.org

For project information contact: Jyoti Dash (Programme Manager) - jdash@niua.org

National Institute of Urban Affairs

National Institute of Urban Affairs

1st and 2nd Floors, Core 4B, India Habitat Centre, Lodhi Road, New Delhi - 110003, INDIA

(+91 11) 24643284/24617517, (+91 11) 24617513 • niua@niua.org, www.niua.org, scbp.niua.org