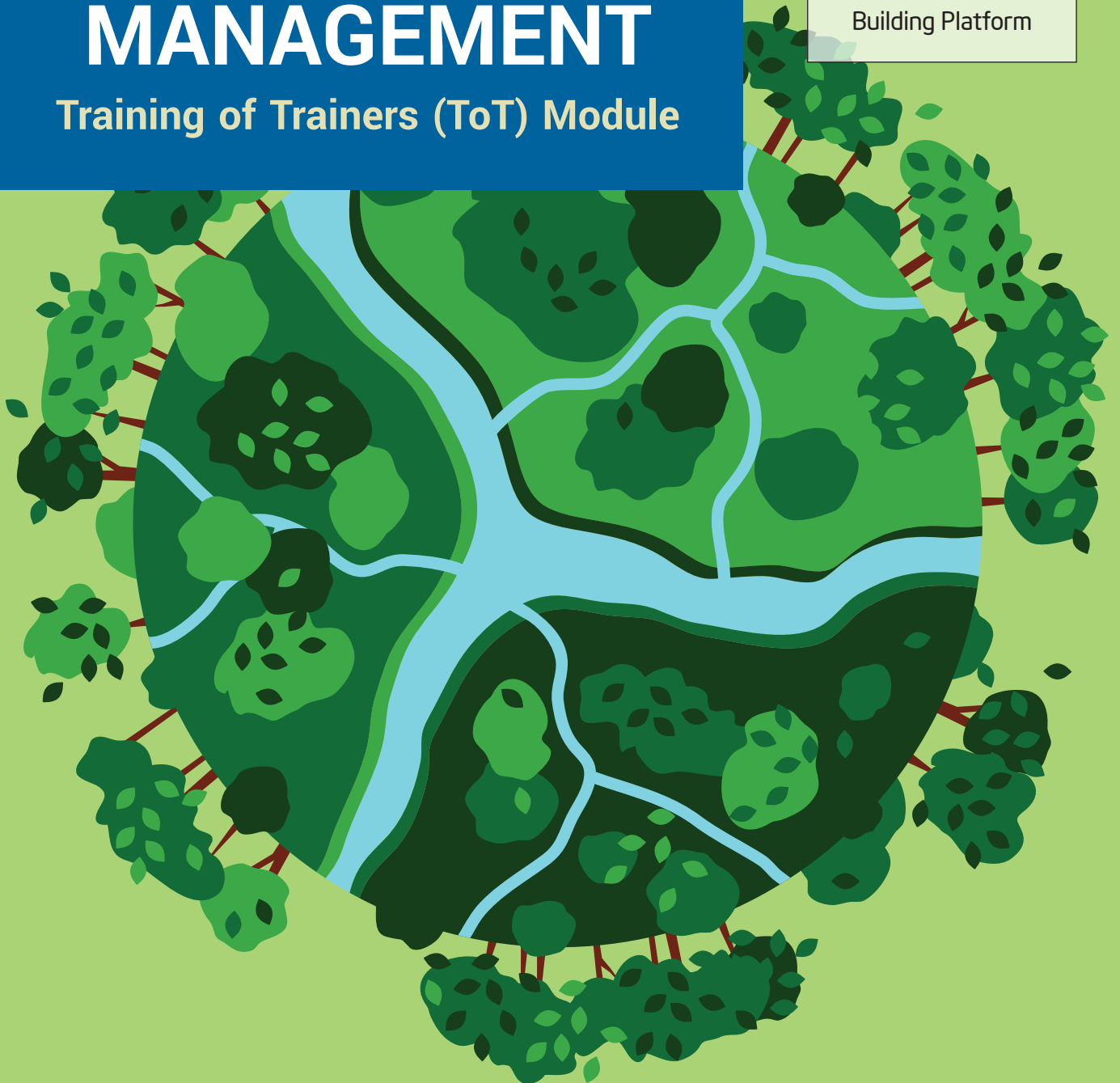


INTEGRATED WASTEWATER AND SEPTAGE MANAGEMENT

Training of Trainers (ToT) Module



Sanitation Capacity
Building Platform



Part C: Trainer's Manual

**INTEGRATED
WASTEWATER AND
SEPTAGE MANAGEMENT**

**Training of Trainers
Manual**

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LIST OF ABBREVIATIONS

| | | | |
|-------|--|-------|---------------------------------------|
| CBO | Community Based Organizations | MoHUA | Ministry of Housing and Urban Affairs |
| CLUES | Community-Led Urban Environmental Sanitation | MoUD | Ministry of Urban Development |
| CSP | City Sanitation Plan | NGO | Non-governmental Organization |
| ESF | Ecosan Services Foundation | NIUA | National Institute of Urban Affairs |
| HCES | Household Centred Environmental Sanitation | ODF | Open Defecation Free |
| IEC | Information, Education and Communication | SBM | Swachh Bharat Mission |
| IWM | Integrated Wastewater Management | SCBP | Sanitation Capacity Building Platform |
| | | WASH | Water, Sanitation and Hygiene |

1 Orientation to the Training course

1.1 Session objectives

| Activity | Time | Materials / Methods |
|---|--------|---|
| Opening of the training /Welcome address | 10 min | Flipcharts, color cards, |
| Introduction of the training to Provide a general understanding on concept and main contents of the training. | 10 min | PowerPoint Presentations, flipcharts, color cards |
| Self-introduction of participants | 30 min | Room mapping |

Session Time: 50 min

By the end of the session, participants will have

- Introduced themselves to the group
- Made their expectations for the workshop
- Received a review on the screenplay of the workshop
- Established training/workshop guidelines and etiquettes

Preparing for the Session

Before you go ahead with the session, please prepare the following:

- Prepare well in advance the flip charts needed (welcome, signs, introduction points, expectations from the workshop, Day 01 screenplay, Parking lot, Instructions, questions etc.). Make copies of workshop agenda or you can also present the agenda in a flip chart written large enough for everyone to see.
- Prepare name tags for participants and trainers
- List first day activities in a separate flip chart with times so that participants know how day will flow

1.2 Training methodologies for the Session

Introduction to the training

- Participants of an interactive training spend an intensive time together, full of encounters and interactions at different levels. An introductory round at the

beginning of the course will support this process, so that the trainees start getting to know each other. There are different techniques for introductory rounds depending on the available time and the envisaged intensity of getting to know.

- Before you start the session, introduce facilitator and trainers for the training. Give a brief profile of facilitator and trainer's. Introductory presentation should have;
- Present the overview of the training in PowerPoint presentations
- Slides should not be more than 15 - 20
- Before presenting the objectives of the training, try to gather objectives from participants
- Set the ground rules for the training

Self-Introduction:

| |
|--|
| Question |
| Where do you come from? |
| Where do you work? |
| Are you involved in your ODF activities in your city? |
| What is your approach for ODF? |
| What are your unique activities for IEC for ODF in your city? |

2 Water and Sanitation

| Activity | Time | Materials / Methods |
|--|--------|--|
| Introduction to environmental health | 10 min | Discussion, Flipcharts, colour cards, Power point |
| Introduction to Sanitation planning, excreta & septage management, waste and resource flows | 10 min | PowerPoint Presentations, flipcharts, colour cards |
| Group work: Linkage of water supply and environmental sanitation | 40 min | Flipcharts, colour cards, |

Session time: 60 min

2.1 Session objectives

By the end of the session, participants will have

- Understood what is environmental health.
- Gained knowledge on linkage between water supply and environmental sanitation.
- Participants will acquire information and knowledge about new options in sanitation in order to support urban dwellers in reducing environmental health risks, improving their nutritional status and protecting their water sources.

Preparing for the session

Read and review the lecture note (Appendix NN) and note prepare where pre-written flip charts are needed. Take print outs of contamination posters (1 for every 2 participants) for the group work. Write the heading “What is Environmental health?” on flipchart paper. And if needed (Optional) Write the session Learning Outcomes on flipchart paper.

2.2 Contents of the Session

Introduction to environmental health

The trainer will specify and define the aspects of Environmental health. The session will explain the components of environmental health. The trainer can explain how environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. Trainer will detail out the objectives of environmental sanitation and also

explain how the natural and built environment with its natural resources water, air and soil; all services and facilities required to keep the environment clean and protect health.

Water supply and environmental sanitation

The trainer explains in the session definitions of water supply, sanitation, and environmental sanitation. The trainer can explain in detail how Environmental sanitation aims at improving the quality of life of the individuals and at contributing to social development. The session will introduce how environmental sanitation addresses disposal or hygienic management of liquid and solid human waste, control of disease vectors and provision of washing facilities for personal and domestic hygiene and promotes both behaviour and facilities to form a hygienic environment. With the help of an F diagram, the trainer will explain how the pathogens move from the faeces of a sick person to where they are ingested by somebody else can take many pathways, some direct and some indirect. This diagram illustrates the main pathways. The F diagram shows how diseases from faecal matter can be spread—through fluids, fingers, flies, and fields. Water: One way is through the water. Germs from faeces on the ground can get into the water (fluids) and be drunk by someone in your family. Fingers: The second way is through fingers, or hands that haven't been washed after going to the toilet. These dirty hands can transmit the germs on to foods, which are then eaten. Flies: The third way is through flies. Flies can transfer germs from faeces to food, so it's important to keep flies and other bugs out of the kitchen area. The fourth way is through fields or floors. Germs can seep into crops and other sources of food if faeces are not disposed of properly. To prevent field contamination, it's crucial that faeces are disposed of on in toilets for latrines.

Resource and waste systems

This session will help participants to understand sanitation infrastructure, public health, and the environmental relation is a fundamental assumption for planning sanitation infrastructure in urban areas. The trainer will explain how proper infrastructure and reliable service provision keys to a sustained urban development are. The session will describe effective wastewater management refers to the process in which wastes and wastewater are managed from the point of generation to the point of use or ultimate disposal.

Urban challenges

The session intends to explain the factors leading to deficiencies in water and sanitation can be found on every level – from local to international. The trainer will like to throw light on inadequacies are thus proximate (household/local), contributory (city & town) or underlying (global/international). Trainer will try to explain the challenge in the developed world is mainly to prevent existing infrastructure from decay and to initiate a transition from disposal-oriented regimes and “end-of-pipe” solutions towards more sustainable approaches with a focus on reuse option.

2.3 Group work: Linking water supply and environmental sanitation



Water and sanitation are environmental issues to their very core, and together constitute one of the top drivers of development. Managing water supplies so they become neither depleted nor polluted, and providing good sanitation, are central to the health of communities and the environment on which they depend. Poor water and sanitation provision can affect entire communities: one person's bad sanitation is another's contaminated food or water. Even piped systems, if poorly managed, can concentrate any “downstream” problems— such as pollution in rivers, lakes and seas — and further degrade wildlife habitats and contribute to human health problems. Where water and sanitation deficiencies are severe, there are likely to be a range of serious public health hazards.

In this groupwork, Print Contamination posters (1 for every 2 participants) if not using PowerPoint for the exercise. Divide participants into pairs and hand out a

Contamination Poster to each pair. Ask the participants to look at the Contamination Poster and discuss the issues they see with sanitation, as well as any issues that are not illustrated in the poster. After 1-2 minutes, share responses as a large group. Write the responses on the flipchart titled "What is Environmental Sanitation?" Note that household wastewater management and stormwater drainage are not shown in the posters, so you may have to identify these as other aspects of environmental sanitation.

- a. Human and animal excreta (feces and urine) management
- b. Domestic wastewater management
- c. Solid waste management
- d. Vector control
- e. Stormwater drainage

Explain that drinking water is sometimes included in the definition, as sustainable environmental sanitation cannot be planned and implemented in isolation from water supply.

2.4 Further Readings

- <https://www.sswm.info/category/background/background/background/health-and-hygiene-issues/water-sanitation-and-health>
- ERLMANN, T.; BROGAN, J.; MUELLER, K.; SOROKOVSKIY, V.; AGUASAN (Editor); SWISS AGENCY FOR DEVELOPMENT AND COOPERATION SDC (Editor) (2017): SDG 6 along the water and nutrient cycles. Using the water and nutrient cycles as a tool for creating a common understanding of a water and sanitation system - including workshop material. Bern: AGUASAN.
- MINISTRY OF ENVIRONMENT (Editor) (2003): Sustainable Wastewater Management. A handbook for smaller communities. MNE: Wellington.
- SUSANA (Editor) (2011): Pathways for Sustainable Sanitation. (= SuSanA Factsheet). Sustainable Sanitation Alliance (SuSanA).
- BERTRAM, J.; CARINCROSS, S. (2010): Hygiene, Sanitation, and Water: Forgotten Foundations of Health. In: PLoS Med 7, 11.

3 Sustainable Sanitation and Water Management

Waste resources & Characteristics

| Activity | Time | Materials / Methods |
|---|--------|---|
| Waste products and main parameters used to describe wastewater | 20 min | PowerPoint Presentations, flipcharts, color cards |
| Group activity: Define boundaries, identify components of water and sanitation | 40 min | Flipcharts, colour cards, |

Session time: 60 min

3.1 Session objectives

By the end of the session, participants will have

- Understood terminology of wastewater management and understand the byproducts of sanitation value chain
- Recalled the different streams of wastewater and their quantities
- Understood the parameters of waste water characteristics
- Understood their local water, sanitation and nutrient cycle.

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. Group work sheets need to be printed. And if needed (Optional) Write the session Learning Outcomes on flipchart paper.

3.2 Content of the Session

Waste products

This session mainly serves to recall the different wastewater products. It defines Blackwater, gray water, excreta, fecal sludge, domestic wastewater, and storm water. The trainer will explain each product characteristic and its source.

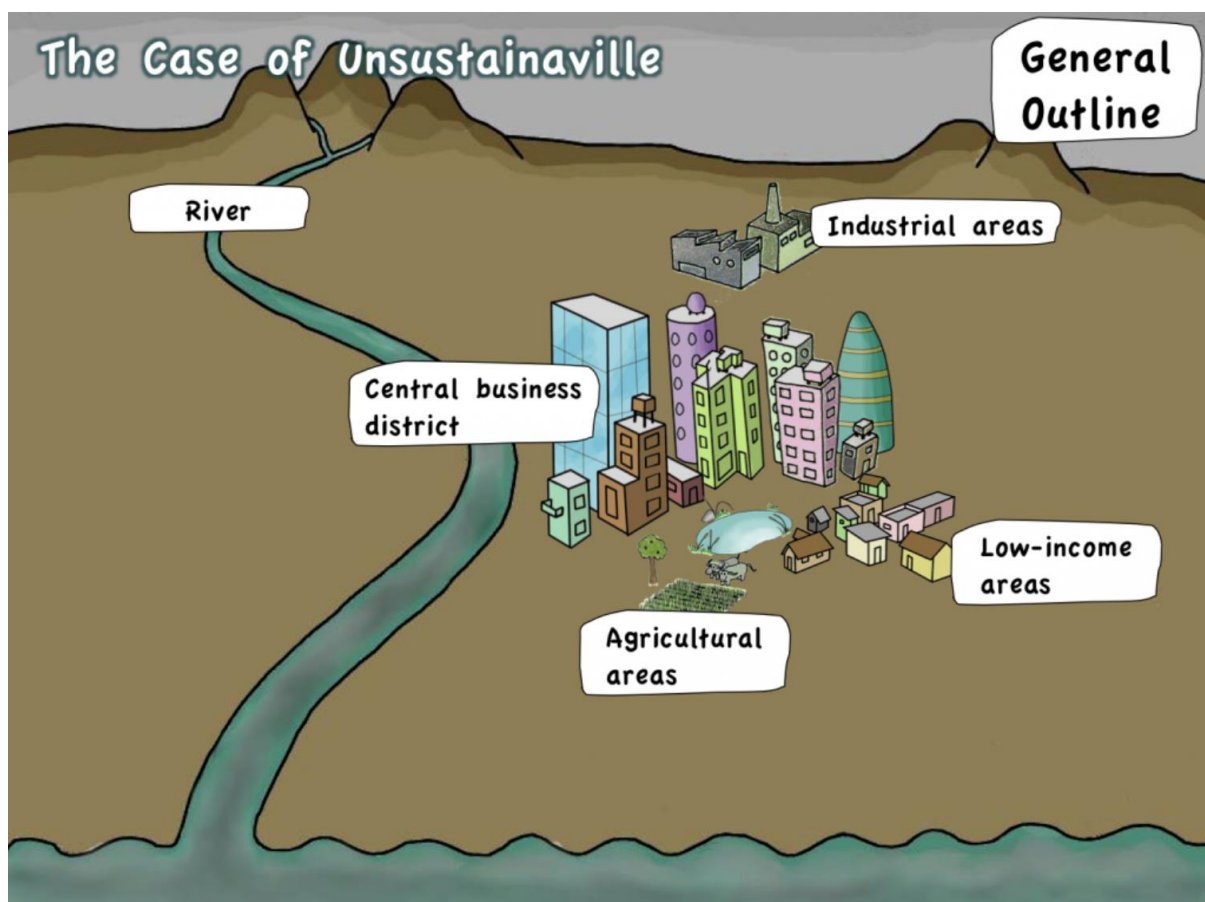
Parameters to characterize wastewater

The session will explain wastewater characteristics and typical wastewater parameters that suggest that the concentration of contaminants in wastewater and how it strongly depends on water consumption and prepares the ground for the

promoting discussion of treating wastewater flows separately in sustainable wastewater management among participants. This session will talk in detail about parameters like suspended solids, Biodegradable organics, bio stimulants (Nitrogen and phosphorous), pathogens and other physical parameters.

3.3 Group activity: Define boundaries, identify components of water and sanitation

The group activity will help the participants to define boundaries and identify water components of their locality. For this, Trainers will take an example of "The Case of Unsustainableville". Unsustainableville is in a plain, next to a river and some miles upstream from the sea. It has an industrial area to the North of the city, a central business district and some high-income areas. To the East, there are also some low-income areas that are not well developed. To the South, on the outskirts of the city, are some agricultural areas



Objective/purpose

This group work should give participants a comprehensive understanding of the local water and sanitation cycle by identifying the components (source, transport, use, etc.) and the existing links between them.

Methodology

Participants will receive a set of cards containing the following elements:

- Water sources
- Purification
- Distribution
- Agricultural use
- Industrial use
- Domestic use
- Collection
- Treatment
- Recharge/reuse

Using the cards and the arrows, sketch the water cycle in the City. In the process and discussions among themselves, participants will try to answer the following questions:

- Where does your water come from?
- Is the water in your area purified before being used for all purposes? What about the agricultural use?
- Who are the primary water users (e.g., domestic, agriculture, industry, etc.)?
- And then what happens? Is it collected altogether? Separately? And then, is it treated? Is the wastewater recycled or is it just discharged?

After the sketch is ready, one member of the group should give a 5 minutes' presentation.

Ecological Sanitation

| Activity | Time | Materials / Methods |
|--|--------|---|
| Introduction to ecological Sanitation and concepts of sanitation planning | 20 min | PowerPoint Presentations, flipcharts, color cards |
| Group activity: Identification of sanitation components of your system and nutrient cycle | 40 min | Flipcharts, color cards, |

Session time: 60 min

3.4 Sessions objectives

By the end of sessions, participants will have

- Understood the concept of ecological sanitation
- Understood how to close the loop of water and nutrient cycle
- Understood the concept of centralized and decentralized approaches of resource management
- Understood the key determinant for planning sanitation systems

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. Group work sheets need to be printed. And if needed (Optional) Write the session Learning Outcomes on flipchart paper.

3.5 Contents for the Session

Introduction to ecological Sanitation

This session introduces ecological sanitation and concept of closing the loop. The session will focus on the integrated perspective of ecological sanitation. The trainer will explain Ecological sanitation as a new paradigm in sanitation that recognises human excreta and water from households not as a waste but as resources that can be recovered, treated, where necessary, and safely used again. Participants will learn that Ecological sanitation systems offer a range of low cost to high tech sanitation options which are hygienically safe, comfortable to use, environmentally friendly and often more economical than conventional systems. The trainer can also explain how the ecosan ideally enable a complete recovery of nutrients in household wastewater and their reuse in agriculture. In this way, ecosan help preserves soil fertility and safeguard long-term food security, while minimising the consumption and pollution of water resources. The trainer can explain how Sanitation and wastewater treatment are closely interlinked with the given nexus.

Resource management

The session will introduce participants about know-hows of IWM centralised and decentralised approaches to resource management. The trainer will discuss with participants how can city provide sufficient water and appropriate sanitation to a growing urban population? Or Shall city continue to build long connecting sewers and

centralized treatment plants? Trainer can ask questions like Should cities rather go for smaller decentralized systems or start to source separate our wastewater as the city have been doing with solid waste? The participants will understand that answer lies not in one system or the other, but in the appropriate use of each system. The session will intend to explain the economic aspects of both the approaches.

Planning of Sanitation systems

The session intends to explain the planning of sanitation systems. The trainer will describe the key components for the planning and implementation of sanitation projects based on sanitation system function requirements rather than technologies. The session will introduce the process of integration of spatial data, Demand management, Collection and conveyance, WTP, STP and FSTP, Water resources and Energy requirements of the city. The trainer will explain the need for a logical approach which needs to be defined keeping in mind the local natural and built environment and how such logical framework is specific to the area and needs to be altered or adopted from place to place. The whole process will be explained with the help of case studies.

Closing the loop!

The session explains why it is very important to identify the water and nutrient pathway in the local system. Only after understanding the system dynamics in depth, it is possible to plan and implement sustainable solutions which will help to close the water and nutrient loop. Participants will understand that It is only through closing the loops (water and nutrient) that sustainability of water and sanitation system can be achieved. The trainer can conclude the session by stating that an approach to water management — linking water management, sanitation, and agriculture — is a crucial step to sustainability. Ecological sanitation approaches closes water cycle at a local level, recharges groundwater sources and provides valuable water for agriculture. It also closes the nutrient cycle, thus making expensive artificial fertilisers unnecessary and provides a much more balanced fertiliser. It also improves food security and even creates additional income. And solutions will be socially acceptable, economically viable and environmentally sustainable.

3.6 Group activity: Identification of sanitation components of your system/city and nutrient cycle

The group activity will help the participants to define boundaries and identify sanitation components of their locality. For this, Trainers will take again example of "The Case of Unsustainaville".

Objective/purpose

This group work should give participants a comprehensive understanding of the local sanitation components of the system with defining the nutrient cycle in the system and the existing links between them.

Methodology

Participants will receive a set of cards containing the following elements:

- Wastewater sources
- Collection
- Treatment
- Recharge/reuse

Using the cards and the arrows, sketch the nutrient cycle in the City. In the process and discussions among themselves, participants will try to answer the following questions:

- Where does the used water go?
- Is it collected (e.g. open drainage, piped sewer network, septic tanks, etc.)?
- Is there a centralized sewer network? Are all parts of your area connected to it? Or do decentralized, household-based solutions prevail?

After the sketch is ready, one member of the group should give a 5 minutes presentation.

3.7 Further Readings

- <https://www.sswm.info/category/concept/concept-introduction>
- ALSEN, K.W. (Editor); JENSSEN, P. (Editor) (2004): Ecological Sanitation: for Mankind and Nature. Aas: Norwegian University of Life Sciences.
- ESREY, S.; ANDERSSON, I. (2001): Ecological Sanitation. Closing the loop. In: Urban Agriculture UA Magazine 3 - Health aspects of urban agriculture.

- SUSANA (Editor) (2008): Towards more Sustainable Sanitation Solutions. (Version 1). Eschborn: Sustainable Sanitation Alliance (SuSanA).

4 Planning for environmental sanitation

| Activity | Time | Materials / Methods |
|---|--------|---|
| Planning of Environmental Sanitation | 60 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min

The session focuses on sustainable planning of environmental sanitation solutions, which include water supply, sanitation, stormwater drainage, and solid waste. By making use of representative case studies, different planning strategies are discussed, and the reader is introduced to new methodologies like the household centred environmental sanitation (HCES) approach. Finally, the enabling environment, a prerequisite for successful implementation of planning processes, is also discussed in detail.

4.1 Sessions objectives

By the end of sessions, participants will have

- Understood the different planning aspects of environmental planning
- Understood the integrated planning models like city sanitation plans, sanitation 21, CLUES etc.

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. Group work sheets need to be printed. And if needed (Optional) write the session Learning Outcomes on flipchart paper.

4.2 Contents of the session

Definition of Environmental planning

This session focuses on defining sustainable planning of environmental sanitation solutions, which include water supply, sanitation, storm water drainage, and solid waste. It describes what is good governance and explains how urban planning and urban management are the keystones of good urban governance. The session will also define the three tiers of integration of planning approaches - Macro, Micro and Intermediate level and the intensity public participation needed in each level.

Scale of Problem

The session will explain the urbanization in India. Urbanisation has become a standard feature of Indian society. At a time when the idea of a 'smart city' dominates policy discourse, India is faced with a genuine urbanisation challenge. The trainer will show statistics that despite a spotlight on the plight of the urban poor and provision of clean water for over a decade, both the number and the percentage of people without access to sanitation services continue to increase. Participants will learn about that with rapid urbanisation; environmental pollution is also increasing which in turn become an immense economic burden for the city.

Planning approaches

Different planning strategies like Planning approach, Market approach, and collective action models are discussed by making use of representative case studies. Planning approach model is explained with the help of Indore case study where it is explained that how an approach is a top-down approach and how it is planned. The trainer will describe the market approach which believes in the most straightforward version of market-oriented sanitary improvement, competing suppliers offer a range of services and technologies, and residents pay only for those best meeting their needs and budget with the example of Total Sanitation campaign movement.

Integrated planning model

This session will focus on integrated planning models were developed as traditional planning approaches have not been able to make a significant dent in the service backlog that still exists in many (developing) countries, planners have started to create integrated models based on the lessons learned in the past. City Sanitation plans will be introduced as one of the examples of integrated planning models. A City Sanitation Plan is a comprehensive, holistic and city-wide plan addressing universal access, safe collection, treatment and disposal of 100% liquid and solid waste. With the launching of the National Urban Sanitation Policy, the Government of India exhorted all Urban Local Bodies to prepare their CSP, providing them with a Framework to assist them in the process. A framework will be detailed out in this presentation.

Another approach explained in the session is The Community-Led Urban Environmental Sanitation (CLUES) approach. CLUES is a multi-sector and multi-actor approach for the planning and implementation of water supply, sanitation, solid waste management and storm drainage. It emphasises the participation of all

stakeholders from an early stage in the planning process. Participants will get a quick overview on Sanitation 21 and Citywide pathway to sanitation developed by USAID's SUWASA program (2015)

4.3 Further Readings

- LUETHI, C.; MOREL, A.; TILLEY, E.; ULRICH, L. (2011): Community-Led Urban Environmental Sanitation Planning (CLUES). Dubendorf: Swiss Federal Institute of Aquatic Science and Technology (Eawag).
- PARKINSON, J.; LUETHI, C.; WALTHER, D.; IWA (Editor); GIZ (Editor); Eawag-Sandec (Editor) (2014): Sanitation 21. A Planning Framework for Improving City-wide Sanitation Services. London: International Water Association (IWA).
- PEAL, A.; EVANS, B.; VAN DER WOORDEN, C. (2010): Hygiene and Sanitation Software. An Overview of Approaches. Geneva: Water Supply & Sanitation Collaborative Council (WSSCC).
- SUSANA (Editor) (2008): Planning for Sustainable Sanitation. (= SuSanA Fact Sheet). Eschborn: Sustainable Sanitation Alliance.
- WSP (Editor) (2007): Community-Led Total Sanitation in Rural Areas. An Approach that Works. Washington DC: Water and Sanitation Program.
- WATERAID (Editor) (2011): Revitalising Community-led Total Sanitation: A Process Guide. London: WaterAid.

5 Sanitation systems and technologies

| Activity | Time | Materials / Methods |
|--|--------|---|
| 5.1: Sanitation and its objective Functional groups | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 5.2: Sanitation systems and emergency sanitation infrastructure | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 5.3: Group activity: Sanitation Systems | 45 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min + 45 min

5.1 Sessions objectives

By the end of sessions, participants will have understood how to

- Explain different terminologies used in sanitation
- Explain the objectives of sanitation
- Categorize different sanitation systems and technologies
- Identify and select criteria for the selection of sanitation technology in a given context.

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. and if needed (Optional) Write the session Learning Outcomes on flipchart paper.

5.2 Contents of the session

Sanitation and its objectives

The trainer in this section has to set the tone for the complete presentation. The trainer can start the discussion by asking what sanitation means to few participants. The points should be noted on a flip chat. The discussion then should be guided to include following points;

Faecal oral disease transmission, safe management of excreta, hardware components involved, software components and basic and improved sanitation systems.

The objectives of the sanitation should be explained to the participants with examples for each point.

Functional groups

The trainer should focus on the five functional groups i.e. the sanitation value chain for all the streams of waste produced in the built environment. Trainer should talk in detail about each component giving examples of different technologies involved in each functional group. Trainer should from time to time remind the participants that we need to manage all the streams and hence we are looking into both liquid waste and septage management.

Sanitation systems

Here the trainer can ask each table to develop a complete sanitation system taking in to consideration all the five functional groups. Groups should be asked to incorporate the sanitation systems in to their group work.

Trainer can later give examples of pre-developed sanitation systems through the slides included in the ppt.

Emergency sanitation infrastructure

Sanitation itself is the last priority when it comes to managing a city. However, it is of utmost important that topics like emergency sanitation infrastructures should be introduced to the participants beforehand. During emergency situation like earthquake or tsunami etc the top priority is practicing safe sanitation in order to protect the water and food resources.

Trainer should give step by step approach towards managing sanitation services during emergency situation.

5.3 Group activity: Sanitation Systems

Objective/purpose

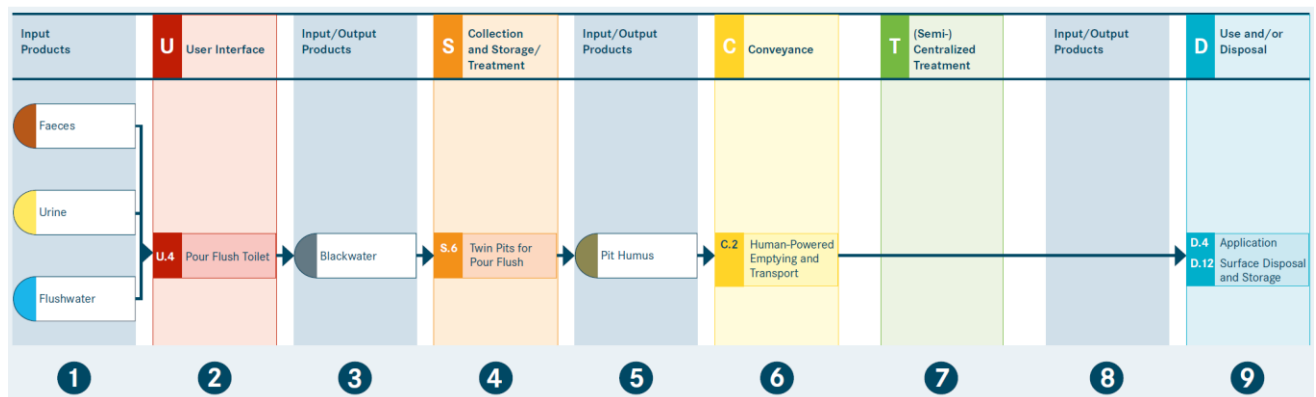
The group activity will help the participants to visualize a sanitation system with a matrix of functional groups (columns) and products (rows) that are linked together where potential combinations exist

Methodology

A sanitation system can be visualized as a matrix of functional groups (columns) and products (rows) that are linked together where potential combinations exist. Such a graphical presentation gives an overview of the technology components of a system and of all the products that it manages. Products are successively collected, stored,

transported and transformed along different compatible technologies from the five functional groups. The output of a technology in one functional group, thereby, becomes the input for the next. It is not always necessary for a product to pass through a technology from each of the five functional groups; however, the ordering of the functional groups should usually be maintained regardless of how many of them are included within the sanitation system.

Understand and visualise the system for the any two products and represent it in the given matrix on next page.



5.4 Further Readings

- TILLEY, E.; LUETHI, C.; MOREL, A.; ZURBRUEGG, C.; SCHERTENLEIB, R. (2008): Compendium of Sanitation Systems and Technologies. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (EAWAG) and Water Supply and Sanitation Collaborative Council (WSSCC).
- EAWAG/SANDEC (Editor) (2008): Sanitation Systems and Technologies. Lecture Notes. (= Sandec Training Tool 1.0, Module 4). Duebendorf: Swiss Federal Institute of Aquatic Science (EAWAG), Department of Water and Sanitation in Developing Countries (SANDEC).
- CPHEEO, GoI (2013): Manual on Sewerage and Sewage Treatment Systems, Part A: Engineering, 3rd Edition, Ministry of urban Development, Government of India. <http://cpheeo.nic.in/Sewerage.aspx>
- SPERLING, M. von (2007): Wastewater Characteristics, Treatment and Disposal. (= Biological Wastewater Treatment Series, 1). London: International Water Association (IWA) Publishing.

Sanitation System:

| Input Products | U User Interface | Input/Output Products | S Collection and Storage/ Treatment | Input/Output Products | C Conveyance | T (Semi-) Centralized Treatment | Input/Output Products | D Use and/or Disposal |
|----------------|-------------------------|-----------------------|---|-----------------------|---------------------|--|-----------------------|------------------------------|
| | | | | | | | | |

6 Designing of sanitation system

| Activity | Time | Materials / Methods |
|--|--------|---|
| 6.1: Process of designing sanitation systems and decentralised systems | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 6.2: Systematic planning of Sanitation systems and city sanitation plan | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 6.3: Group activity: Conceptualising Wastewater Treatment Systems | 60 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min + 60 min

6.1 Sessions objectives

By the end of sessions, participants will have

- Identified factors that affect the design and selection of sanitation technologies.
- Good exposure to benefits and drawbacks of decentralized systems.
- Understood need of systematic planning, framework of strategic planning of urban sanitation solutions.
- Understood the right approach towards drafting a city sanitation plan.

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. And if needed (Optional) Write the session Learning Outcomes on flipchart paper.

6.2 Contents of the session

Process of designing sanitation systems

The session will Identify factors that affect the design and selection of sanitation technologies. Trainer will explain the need of systematic planning and why systems thinking is important for urban environmental sanitation. Trainer can ask participants how will they choose technologies based on (a) People's Needs and Preferences (b) Environmental and Technical (c) Local Materials, Skills and Labour Economic Factors and (e) Health and Safety. Record responses on the appropriate flipchart.

Decentralized system

At this juncture it is important to re-introduce decentralized systems. The trainer should focus on the advantages of the decentralization and give appropriate examples. At the same time, it is good to familiarize the participants with the drawbacks of decentralization so as to build the capacity of the participants to take rational decision.

Systematic planning of Sanitation designing

The session will focus essential Factors for the provision of Sanitation Systems. Trainer will explain who should choose the technology options and based on what criteria it will be addressed. This session will review various models for environmental sanitation planning. Trainer should quickly recap the three models and lead the discussion to which is the most favourable model and why?

The discussion should converge towards the need of framework for strategic planning. After discussing the three steps of strategic planning, the trainer will discuss how these three steps should be incorporated while developing a city sanitation plan of the city. During discussing the City Sanitation Plan, trainer should give special emphasis on stages in planning process and the cyclic process of understanding the problems and finding appropriate solutions. It is important to stress on the fact how inclusion of various stakeholders should be done while developing the solution.

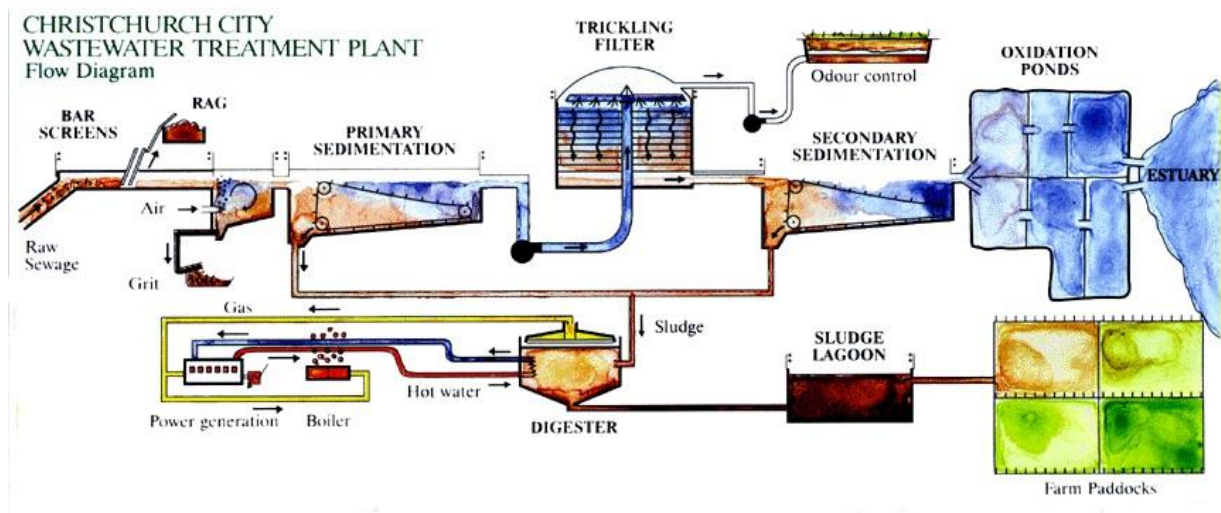
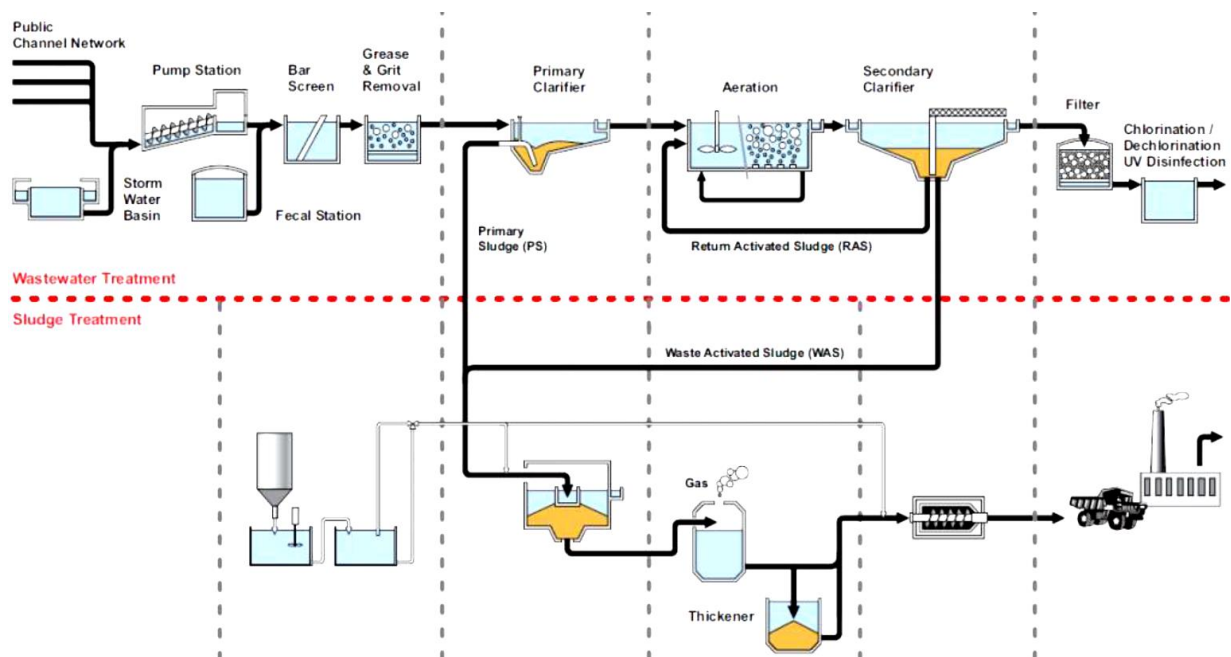
6.3 Group activity: Conceptualising Wastewater Treatment Systems

Objective/purpose

The group activity will help the participants to design the wastewater treatment system with different treatment units.

Methodology

Conventional wastewater treatment consists of a combination of physical, chemical, and biological processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater. General terms used to describe different degrees of treatment, in order of increasing treatment level, are preliminary, primary, secondary, and tertiary and/or advanced wastewater treatment. In some countries, disinfection to remove pathogens sometimes follows the last treatment step. A generalized wastewater treatment diagram is shown below,



Let's design the wastewater treatment system with visualising different treatment units. Distribute the participants in three groups (Group-1, Group-2, Group-3). Using colour cards, design the wastewater treatment chain on the given brown paper,

Group-1: Conventional Treatment System with Activated sludge process

Group-2: Wastewater Treatment System with Trickling Filters

Group-3: Natural Wastewater Treatment System (DTS and Constructed Wetlands)

Components:

| | | |
|-------------------------|--------------------------|-------------------------------------|
| Chlorination | Blowers | Vertical Flow Constructed Wetland |
| Nitrification Tank | Pumps | Horizontal Flow Constructed Wetland |
| Dual media filter | Sludge pumps | Activated Carbon Filter |
| Anoxic Tank | Screens | Ultraviolet Disinfection Unit |
| Pump station | Secondary Clarifier | Sludge Lagoons |
| Grease and grit removal | Denitrification Tank | Sludge Digesters |
| Primary Clarifier | Aeration Tank | Anaerobic Settler |
| Secondary Clarifier | Anaerobic Baffle Reactor | Trickling Filter |
| Oxidation Pond | Anaerobic Filter | |

6.4 Further Readings

- <https://www.sswm.info/category/step-university/module-2-centralised-and-decentralised-systems-water-and-sanitation>
- <https://www.sswm.info/category/step-university/module-3-ecological-sanitation-and-natural-systems-wastewater-treatment>
- <https://www.sswm.info/category/implementation-tools/wastewater-treatment>
- TILLEY, E.; ULRICH, L.; LUETHI, C.; REYMOND, P.; ZURBRUEGG, C. (2014): Compendium of Sanitation Systems and Technologies. 2nd Revised Edition. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).
- CPHEEO, GoI (2013): Manual on Sewerage and Sewage Treatment Systems, Part A: Engineering, 3rd Edition, Ministry of urban Development, Government of India. <http://cpheeo.nic.in/Sewerage.aspx>

7 Non-technical Aspects

| Activity | Time | Materials / Methods |
|---|--------|---|
| 7.1: Stakeholders and enabling environment | 15 min | PowerPoint Presentations, flipcharts, color cards |
| 7.2: Other non-technical aspects | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 7.3: Group activity: Stakeholders Analysis | 30 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 75 min

7.1 Sessions objectives

By the end of sessions, participants will have

- Identified the stakeholders involved in sanitation planning and their segmentation for utilizing their strengths
- Understood the importance of having a conducive enabling environment in the sanitation planning process
- Understood importance of institutional arrangements, political, economic and financial aspects in sanitation planning.

Preparing for the session

Read and review the lecture note (Appendix NN) and note to prepare where pre-written flip charts are needed. And if needed (Optional) write the session Learning outcomes on flipchart paper.

7.2 Contents of the session

Stakeholders and enabling environment

The session intends to understand the stake holders involved in sanitation systems planning and how a set of interrelated sector functions that impact the capacity of governments and public and private partners to engage in the sanitation service in a sustained and effective manner. Trainer will explain the key elements in building an enabling environment allowing a project or programme to be successful.

Factors for enabling environment

The session will detail out the enabling environment for sanitation, such as government support, legal frameworks, institutional arrangements, capacity building and financing. These are the five pillars of inter related conditions that impacts the potential to bring a sustainable and effective change.

Providing an enabling environment becomes very important in case of underserved or unorganized settlements such as slums. These informal settlements are highly complex and tend to be politicized. It is often seen that lack of awareness regarding WASH is the main reason why most of the projects fail in such environment. In this section the trainer is supposed to give a local example to the participant or initiate a discussion with regards to previous experience of the participants in execution of projects.

Institutional and political aspects

The following four points are to be covered under this; regulations and standards, organizational setup, political aspects and bureaucracy.

The regulations and standards differ from country to country and it is expected that the trainer should be well versed with the Indian regulations and standards with respect to the treated wastewater disposal. The trainer should also stress on why developing countries need stricter enforcement of regulations.

Sanitation systems needs a functional organizational setup of the key stakeholders (public utility, private sector and non-profit organizations) with clearly defined roles and responsibility. Here the trainer should give an example of how inclusion of private sector in the operating and maintaining the sanitation systems can off load burden over the public utilities.

Political aspects are the most complex but is managed well can be leveraged to execute the sanitation plan and develop a sustainable and economic system. The stakeholders involved in this aspect have a greater connect with the end beneficiaries and hence it is important to include them during the planning as well as the execution phase.

Bureaucracy is one of the main reasons why projects are delayed. If the roles and responsibilities are not defined, then the projects tend to delay in the sanction phase itself. Especially in a three-tier bureaucracy where the funds are provided by the central government, the planning is done by the state government and later handed

over to local government for operation and maintenance the projects tend to be more complex.

Economic aspects

This section speaks about how the local skills and public participation can not only lower the capital expenditure but also help in the monitoring and evaluation later. It is of utmost importance that the sanitation planning should include the local materials and tools. Trainer should give at least two examples how beneficial using local materials and tools can be. The section further speaks about the selection of appropriate and affordable technologies. While developing sanitation systems, it is important to understand the required service level and willingness to pay in order to ensure proper operation and maintenance of the system at later stage.

Financial aspects

The section deals with a concept called cost benefit analysis and subsidies and loans. Cost benefit analysis is a tool using which two or more scenarios should be compared however it is very complex to account for benefits improved health etc. However, this approach gives a decision maker a very holistic view of the scenario and assists the process of decision making.

The section later details about the two-different approach towards providing sanitation to the masses- subsidies and loans. The trainer should explain how integrating subsidies and loan component can improve rapid deployment of sanitation systems.

7.3 Group activity: Stakeholders Analysis

Stakeholder engagement or stakeholder involvement is vital for the successful implementation of sanitation and wastewater management projects. It is the art of including stakeholders in the planning process to take into account their needs, priorities, and interests, to achieve consensus and to remove opposition; in other words, to make them participate. Stakeholder engagement is mainly about defining the participation level of people in the process as the influence and interest of individual stakeholder change, leading to evolving stakeholder engagement strategies.

Objective/purpose

The group activity will help the participants to carry out the stakeholder's engagement or involvement in the successful implementation of sanitation and wastewater management projects.

Methodology

Write the heading "Stakeholder Characteristics" on flip chart paper.

Divide participants in groups. In groups ask participants to list all the stakeholders that are part of faecal sludge management on sticky notes in 5 minutes. After 5 minutes, ask participants to readout. There will be a lot of repetition. Participants should try and regroup the stakeholders. As the facilitator, you should also help regroup the stakeholders. Read out the stakeholders that the participants identified. Complete the list if any stakeholders are not mentioned.

- Municipal government authorities (for example, mayor, technical services, municipal police)
- Regional and national government authorities
- Utilities (for example, public, semi-private or private)
- Traditional authorities and influential leaders (for example, ethnic leaders, neighbourhood leaders, religious leaders)
- Private service providers
- Organizations active in sanitation (for example, community-based organizations [CBOs], nongovernmental organizations [NGOs], universities and research centres, donor agencies)
- Potential users of treatment products (for example, farmers, breeders, fuel consumers)
- Households

Ask participants, "What do you want to know about the stakeholders to determine who to engage in the different parts of the planning process, and to what degree?"

Record responses on the "Stakeholder Characteristics" flip chart.

- Interest
- Strengths
- Weaknesses
- Opportunities and threats
- Relationships between stakeholders
- Capacity building needs

- Experience in sanitation and wastewater management projects

Explain that once this information is collected, it is important to categorize stakeholders by interest and influence. Ask participants, “What is the difference between influence and interest?”

- Influence: Power that stakeholders have on the project (for example, decision making, implementation)
- Interest: Stakeholders whose needs, constraints and problems are a priority in the strategy

Note: The word “interest” can be confusing. Participants may think of how interesting (exciting) a topic is to the stakeholders. Make sure to clearly define these words. Add the definitions on a flip chart paper if necessary. Clarify that it is their interest in the outcome of the project. You can also use the word “impact” instead of interest. “Influence” can also be confusing. Explain that “influence” is a technical term used throughout the sector, which is why it's being used here.

Use flip chart to present the influence-interest matrix. Explain that it is a useful tool to categorize the stakeholders. This ensures that important stakeholders with little influence are given a voice.

| | Low Influence | High Influence |
|----------------------|----------------------|-----------------------|
| Low interest | | |
| High Interest | | |

Ask participants, “What factors may affect the influence that stakeholders have?”

Record responses on the “Influence” flip chart.

- Social, economic and social status
- Hierarchy (command and control, budget holders)

- Leadership (for example, charisma, political, familial)
- Control of strategic resources
- Possession of specialist knowledge (for example, engineering staff)
- Negotiating position
- Degree of organization (especially for informal groups)

Pick a few sticky notes and ask participants where they would place the stakeholders on the matrix.

- Certain minorities and low-income groups often have low influence and are not given a voice, like manual service providers, low-income households and farmers. Stakeholders with little influence and may see stakeholder meetings as a waste of money and time. Often, households lack influence, although they bear most of the costs, if not all, of the service.
- The influence and interest of the different governmental institutions are sometimes not easy to assess, especially if the institutional framework for faecal sludge management is not clear.
- Municipal authorities are usually key stakeholders, both in terms of influence and interest.

8 Need of Faecal Sludge and Septage Management

| Activity | Time | Materials / Methods |
|--|--------|---|
| 8.1: Sanitation facts – India, National Programs and Policies | 30 min | PowerPoint Presentations, flipcharts, color cards |
| 8.2: Introduction of FSSM and Need of FSSM | 30 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min

8.1 Sessions objectives

By the end of sessions, participants will have

- Understood the sanitation facts in India.
- Gained the knowledge on National programs and policies (like Swachh Bharat Mission, National policy on Faecal Sludge and Septage Management, FSSM in AMRUT).
- Understood the basics of Faecal Sludge and Septage Management. Needs and challenges in FSSM.

Preparing for the session

Read and review the lecture notes (Part A) and note to prepare where pre-written flip charts are needed. And if needed (Optional) write the session Learning outcomes on flipchart paper.

8.2 Contents of the session

Sanitation Facts in India

The session intends to understand the current sanitation stats in India and how a it is affecting at the social, economic, and environmental level. It is understood that the treatment capacity available is very less as 37% of the total of human waste that is generated in urban India and it reflecting the need of FSSM. Trainers will explain the key sanitation facts in India to overlook the situation and need of the management.

National Program and Policies

The session will detail out the national programs and policies released by the government to overcome the issues of Sanitation. It includes the key objectives about the programs and policies and its components involved in the guidelines. In this session, trainer has to explain the Swachh Bharat Mission (SBM) Program, National Faecal Sludge and Septage Management (FSSM) Policy, FSSM in AMRUT Program. In this section the trainer is supposed to provide information about the components of the program and policy and has to explain role of each stakeholders as per the respective guidelines.

Introduction of FSSM

This session will detail out the introduction faecal sludge and septage management (FSSM) and difference in between faecal sludge and septage. It will also include the faecal sludge sanitation value chain which involves the five steps as capture, emptying, transport, treatment and resource recovery/reuse.

Need and Challenges in FSSM

This section speaks about the need of faecal sludge and septage management. As if there is insufficient infrastructure, health and environmental implications, lack of regulations and no approach of resource recovery, then FSSM is the need of the hour. The challenges involved in the management of faecal sludge is explained step by step with the approach of sanitation value chain. Trainer has to explain the challenges component wise in the Sanitation value chain with few examples for each component.

8.3 Further Readings

- I. 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](#)
- II. STRANDE, L.; RONTELTAP, M.; BRDJANOVIC, D. (2014): Systems Approach for Implementation and Operation. London: IWA Publishing [URL](#)
- III. Ministry of Housing and Urban Affairs, Government of India: National Policy on Faecal Sludge and Septage Management (FSSM) (2017) [URL](#)

9 Faecal Sludge and Septage Management (FSSM) Planning Process

| Activity | Time | Materials / Methods |
|---|--------|---|
| 9.1: Assessment of Initial Situation, Stakeholders Analysis, Stakeholders Engagement | 40 min | PowerPoint Presentations, flipcharts, color cards |
| 9.2: Planning of Faecal Sludge and Septage Management | 20 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min

9.1 Sessions objectives

By the end of sessions, participants will have

- Understood the process of assessment of initial situation
- Understood the role of stakeholders and their engagement in the FSSM activities
- Understood the planning process of Integrated Faecal Sludge Management systems

Preparing for the session

Read and review the lecture notes (Part A) and note to prepare where pre-written flip charts are needed. And if needed (Optional) write the session Learning outcomes on flipchart paper.

9.2 Contents of the session

Assessment of Initial Situation

The session intends to understand the process of assessment of the initial situation, which is the first crucial step in the planning process, as it provides the baseline information for decision making. The main goals of the assessment of the initial situation are to set the scene, understand the context, get to know stakeholders and provide enough information to start elaborating the Faecal sludge management scenarios, including context specific design parameters and therefore this characterized mainly by data collection via different options. Data collection needs to be carried out step by step during the exploratory investigation, preliminary studies

and feasibility study. Trainer has to explain the different tools and methods of data collection and what kind of data has to be collected which is necessary for the planning process.

Stakeholders Analysis

The session will detail out the process of stakeholder's analysis. It includes the process of identifying and characterizing the stakeholders, investigating the relationships between them, and planning for their participation. It is vital tool for understanding the social and institutional context of a project or a policy. Its findings can provide early and essential information about who will be affected by the project and who could influence the project, which individuals, groups or agencies need to be involved in the project and whose capacity needs to be built to enable them to participate. In this section the trainer is supposed to explain the step by step process of stakeholder's analysis with the context of Faecal Sludge and Septage Management point of you as similarly explained in previous non-technical aspects session for wastewater management planning process.

Stakeholders Engagement

This session will detail out the need of stakeholder's engagement in the FSSM planning process. Stakeholder engagement or stakeholder involvement is a key for the successful implementation of faecal sludge management (FSM) projects. It is the art of including stakeholders in the planning process in order to take into account their needs, priorities and interests, to achieve consensus and to remove opposition. Stakeholder engagement is largely about defining the participation level of people in the process and how to best answer their needs (e.g. through awareness raising or training and capacity building). In this session, the trainer has to explain the stakeholder's participation levels, milestones, crosscutting tasks and roles and responsibilities of stakeholders

Planning of Integrated Faecal Sludge Management System

This section speaks about the need of integrated approach in faecal sludge and septage management. It also includes the enabling environment which is critical for the success of any type of investment, whether this is for the improvement of a single public latrine or a city-wide FSM system. Understanding the conditions necessary in a particular context for the environment to be enabling is part of an integrated approach. In this session, trainer has to explain the criterias for the section of treatment option with the use of flow chart given in the annexure.

9.3 Further Readings

- I. STRANDE, L.; RONTELTAP, M.; BRDJANOVIC, D. (2014): 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](#)

10 Financing of Faecal Sludge and Septage Management (FSSM)

| Activity | Time | Materials / Methods |
|---|--------|---|
| 10.1: Assessment of financial requirements, Potential sources of financing, Stakeholders involved in financial transfers | 40 min | PowerPoint Presentations, flipcharts, color cards |
| 10.2: Financial transfers and Financial Flow Models | 20 min | PowerPoint Presentations, flipcharts, color cards |
| 10.3: Group Activity: FSSM Planning Process | 60 min | PowerPoint Presentations, flipcharts, color cards |

Session time: 60 min + 60 min

10.1 Sessions objectives

By the end of sessions, participants will have,

- Understood the assessment of financial requirements and potential sources of financing.
- Understood the stakeholder's involvement in financial transfers.
- Understood the types of financial transfers and financial flow models.

Preparing for the session

Read and review the lecture notes (Part A) and note to prepare where pre-written flip charts are needed. And if needed (Optional) write the session Learning outcomes on flipchart paper.

10.2 Contents of the session

Assessment of financial requirements

The session intends to overview on the assessment of the financial requirements in the integrated FSSM planning phase. The financial requirements as capital Investment and O&M costs of FS collection and treatment must be determined on a case-to-case basis as local conditions are decisive. It also includes the FSM component wise financial requirements with respect of capital and O&M costs.

Trainer has to explain the different tools and methods of data collection and what kind of data has to be collected which is necessary for the planning process.

Potential sources of financing

This section describes the potential sources of financing in each component of the Faecal sludge management system. There are some major sources which are crucial in the proper financial fulfillment of the system e.g. central or state government grants, government subsidy, local level service taxation, CSR fundings etc.

Stakeholders involved in the financial transfers

This session will list out the stakeholders in a FS system which will be involved in some kind of financial interaction. Stakeholders are those people, institutions or enterprises that send or receive payment in exchange for taking responsibility for one or more processes in the FS treatment chain. In this session, trainer has to explain the stakeholders and their financial responsibilities with some examples.

Financial Transfers

This section speaks about the different financial transfers involved in different activities in FSSM system. In FSM system, money is exchanged for different activities (e.g. emptying, transport, processing), at different orders of magnitude (e.g. small service payments, massive construction costs), and with different frequency (e.g. daily transfer fees, annual taxes). To achieve a financially sustainable business model, a prudent selection of the transfer types must be implemented. In this session, trainer has to explain the different transfer types with different examples.

Financial Flow Models

This section speaks about the different financial flow models in FSSM system. There is no single FSM model that has proven to be effective in all situations; indeed, service delivery models are constantly modified and restructured depending on the economic, legal, and environmental conditions. Furthermore, the responsibilities within the system are constantly changing and as such, the financial transfers between stakeholders can take several forms. In this session, trainer has to explain five different financial models with different examples and comparison in-between all models.

10.3 Group activity: FSSM Planning Process

The stakeholders who are designated with the responsibility for planning and implementing a city wide faecal sludge management system often face complicated situation characterised by diverse levels of service. In FSSM planning process, it aims to transform complex situation into a well organised and coordinated

management framework as in form of city sanitation plans, faecal sludge and septage management plan etc. In this process, stakeholders required to estimate or calculate the requirement of management infrastructure.

Objective/purpose

The group activity will help the participants to carry out the estimation of different infrastructure, administrative requirements of the faecal sludge and septage management.

Methodology

In this activity, trainer has to instruct participants to use the equations given below with different activity requirements. In this activity, some assumptions as given for the estimations. With reference of this activity, the stakeholders as ULBs or Consultants has to calculate the requirements as per the scenario of the city.

Estimating Techniques

A) Capacity of FSTP and Number of vacuum trucks required to service the city

| No. | Description | No. |
|-----|---|-----------------------|
| 1. | Population | 75,000 |
| 2. | Total households (HHs) | 15,000 |
| 3. | HHs having septic tanks (STs) | 12,000 |
| 4. | No. of community septic tanks | 15 |
| 5. | Average volume of HH septic tank | 3 cum |
| 6. | Average volume of community septic tank | 8 cum |
| 7. | Septic tank desludging frequency | 3 years |
| 8. | No. of working days in a year | 300 days |
| 9. | Capacity of vacuum truck (VT) per trip | 4 cum |
| 10. | No. of trips per VT per day | 5 trips / truck * day |

Step 1:

$$\text{HHs to be services annually} = \frac{\text{HHs having STs}}{\text{Desludging frequency}}$$

$$\text{HHs to be services daily} = \frac{\text{HHs to be services annually}}{\text{Total number of working days}}$$

Similarly calculate the Communities to be serviced daily!

Step 2:

$$\begin{aligned} \text{Total volume of FS to be treated daily} = \\ (\text{HHs STs serviced daily} \times \text{Volume of HH septic tank}) + \\ (\text{Community STs serviced daily} \times \text{Volume of community ST}) \end{aligned}$$

Step 3:

$$\text{Total trips of vacuum trucks} = \frac{\text{Total Volume of FS to be treated}}{\text{Capacity of the vacuum truck per trip}}$$

$$\text{No. of vacuum trucks required} = \frac{\text{Total no. of trips per day}}{\text{No. of trips per vacuum truck per day}}$$

B) Operation and maintenance cost of conveyance

| No. | Description | No. |
|-----|---|--------------------|
| 1. | Average distance per trip (to and fro) | 20 km |
| 2. | Fuel price | INR 70 / Lit |
| 3. | Average of the vacuum truck (VT) | 5 km / Lit |
| 4. | Average cost of O&M per VT | INR 3000 per month |
| 5. | Manpower per VT | 3 per truck |
| 6. | Man-month cost | INR 10,000 |
| 7. | Overhead + Insurance + Miscellaneous cost | 10% |

O&M cost of conveyance:

$$\begin{aligned} \text{(A) Fuel cost for scheduled desludging} = \\ (\text{No. of trips of VTs daily} \\ \times 300 \text{ days} \times \text{Average distance per trip}) \frac{\text{Fuel Price}}{\text{Average of the vacuum truck}} \end{aligned}$$

$$\begin{aligned} \text{(B) Repair and maintenance cost of VT} = \\ (\text{No. of VTs required} \times 12 \text{ months} \times \text{Average O\&M cost of VT per month}) \end{aligned}$$

$$\begin{aligned} \text{(C) Manpower cost} = \\ (\text{No. of VTs required} \\ \times 12 \text{ months} \times \text{No. of manpower per VT} \times \text{Manmonth cost}) \end{aligned}$$

$$\text{(D) Sub total} = (A) + (B) + (C)$$

(E) *Overheads + Insurance + Miscellaneous Costs = (D) × 10%*

(F) *Total O&M cost of conveyance = (D) + (E)*

C) Operation and Maintenance cost of FS Treatment

| Nº. | Description | No. |
|------------|---|--|
| 1. | Energy cost | < 25 cum/d = INR 5,000 25-50 cum/d = INR 10,000 50-75 cum/d = INR 15,000 >75 cum/d = INR 20,000 |
| 2. | O&M or electro-mechanical components | INR 5000 per month |
| 3. | Manpower requirement | 1 Operator 2 skilled persons 4 watchmen (2 per shift) |
| 4. | Man month cost | Operator = INR 25,000 Skilled person = INR 15,000 Watchmen = INR 8,000 |
| 7. | Overhead + Insurance + Miscellaneous cost | 10% |

O&M Cost of FS Treatment

(A) *Energy cost = (Energy cost per month × 12 months)*

(B) *O&M cost of electro – mechanical components = (O&M cost per month × 12 months)*

(C) *Manpower cost =*

(No. of Operator × manmonth cost × 12 months) + (No. of skilled person × manmonth cost × 12 months) + (No. of watchmen × manmonth cost × 12 months)

(D) *Sub total = (A) + (B) + (C)*

(E) *Overheads + Insurance + Miscellaneous Costs = (D) × 10%*

(F) *Total O&M cost of treatment = (D) + (E)*

D) Property Tariff Calculation

Assuming that the conveyance and the treatment is handled by the same public utility and the property tax collection efficiency of ULB is 70%.

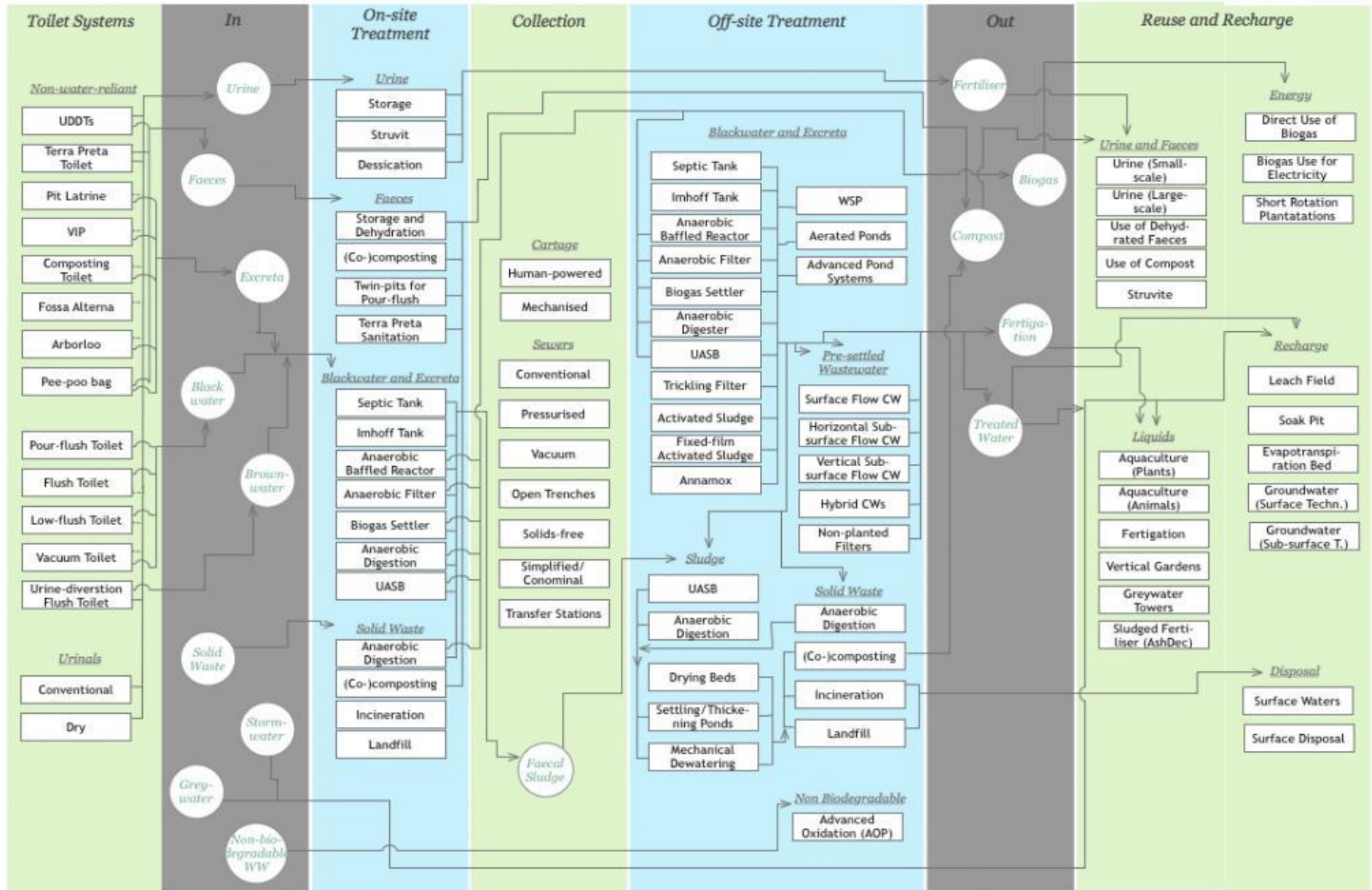
Annual O&M cost = Annual O&M cost of conveyance + Annual O&M cost of treatment

Property tariff = Annual O&M cost / (Total no. of properties × Property tax collection efficiency)

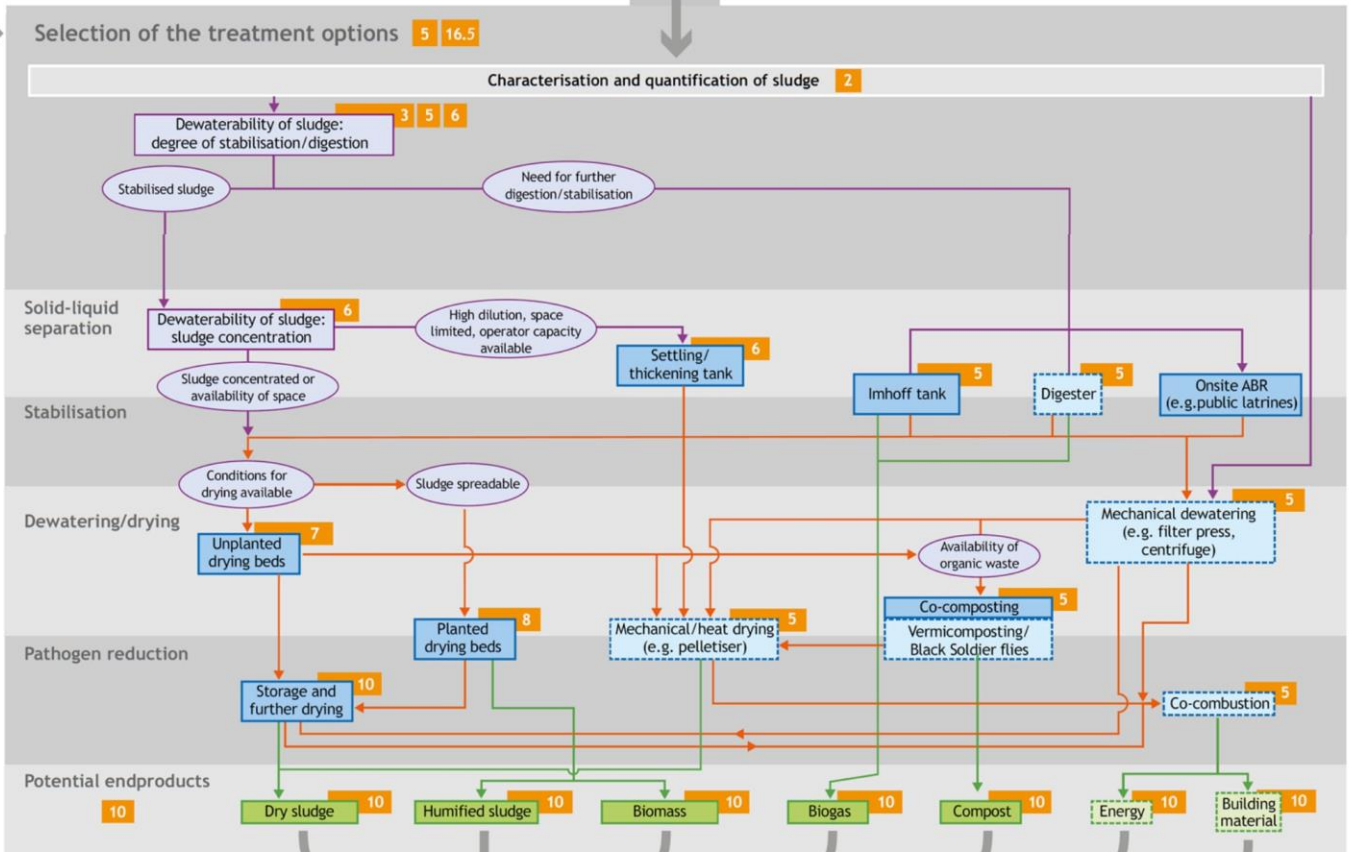
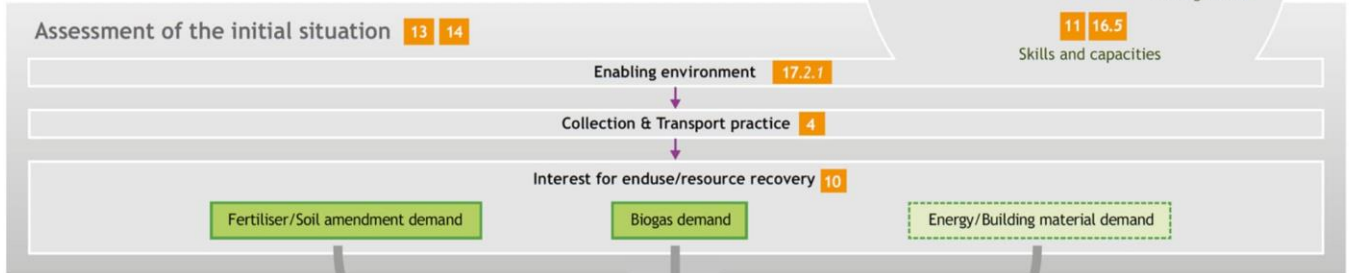
10.4 Further Readings

- I. STRANDE, L.; RONTELTAP, M.; BRDJANOVIC, D. (2014): 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](#)

Annexure



Selecting a context-appropriate combination of faecal sludge treatment technologies



Iterative process until optimal solution is obtained



Final choice of combination of technologies

