ADVANCED TRAINING
ON
DESIGN OF FAECAL SLUDGE TREATMENT SYSTEMS

ONLINE TRAINING PROGRAMME REPORT
ADVANCED TRAINING ON DESIGN OF FAECAL SLUDGE TREATMENT SYSTEMS

ONLINE TRAINING PROGRAMME REPORT
Advanced Training on Design of Faecal Sludge Treatment Systems
(Online Training Programme Report)

National Institute of Urban Affairs, Delhi

SANITATION CAPACITY BUILDING PLATFORM

Deep Pahwa, Devender Singh Rawat, Bhavnesh Bhanot, Preeti Shukla

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Year of Publishing 2020

We are thankful to the partners for supporting us in delivery of case studies and sharing their experiences during the online training:
IIHS, Chennai: Cotreatment of faecal sludge and septage at STP, Trichy
OWSSB and EY, Odisha: FSSM approach in Odisha and technical approach towards Bhubaneswar FSTP.
CWAS-CEPT, Ahmedabad: Wai and Sinnar, Maharashtra.

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
E-Mail: scbp@niua.org
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<th>Description</th>
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<tbody>
<tr>
<td>AMRUT</td>
<td>Atal Mission for Rejuvenation and Urban Transformation</td>
</tr>
<tr>
<td>BIS</td>
<td>Bureau of Indian Standards</td>
</tr>
<tr>
<td>CEPT</td>
<td>Centre for Environmental Planning &amp; Technology</td>
</tr>
<tr>
<td>CSP</td>
<td>City Sanitation Plan</td>
</tr>
<tr>
<td>CW</td>
<td>Constructed Wetlands</td>
</tr>
<tr>
<td>DPR</td>
<td>Detailed Project Report</td>
</tr>
<tr>
<td>DTS</td>
<td>Decentralised Treatment System</td>
</tr>
<tr>
<td>ESF</td>
<td>Ecosan Services Foundation</td>
</tr>
<tr>
<td>FS</td>
<td>Faecal Sludge</td>
</tr>
<tr>
<td>FSSM</td>
<td>Faecal Sludge and Septage Management</td>
</tr>
<tr>
<td>FSTP</td>
<td>Faecal Sludge Treatment Plant</td>
</tr>
<tr>
<td>GoI</td>
<td>Government of India</td>
</tr>
<tr>
<td>GoM</td>
<td>Government of Maharashtra</td>
</tr>
<tr>
<td>IHHL</td>
<td>Individual Household Latrine</td>
</tr>
<tr>
<td>IIHS</td>
<td>Indian Institute of Human Settlements</td>
</tr>
<tr>
<td>NIUA</td>
<td>National Institute of Urban Affairs</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation &amp; Maintenance</td>
</tr>
<tr>
<td>OWSSB</td>
<td>Odisha Water Supply &amp; Sewerage Board</td>
</tr>
<tr>
<td>PBMC</td>
<td>Port Blair Municipal Corporation</td>
</tr>
<tr>
<td>PCB</td>
<td>Pollution Control Board</td>
</tr>
<tr>
<td>PMC</td>
<td>Pune Municipal Corporation</td>
</tr>
<tr>
<td>RAS</td>
<td>Rapid Assessment Survey</td>
</tr>
<tr>
<td>SCBP</td>
<td>Sanitation Capacity Building Program</td>
</tr>
<tr>
<td>SeTP</td>
<td>Septage Treatment Plant</td>
</tr>
<tr>
<td>SHG</td>
<td>Self-help Group</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>STP</td>
<td>Sewage Treatment Plant</td>
</tr>
<tr>
<td>SWM</td>
<td>Solid Waste Management</td>
</tr>
<tr>
<td>ULB</td>
<td>Urban Local Body</td>
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INTRODUCTION
Introduction

The water and sanitation sector in India needs reforms if national and global benchmarks for service delivery are to be successfully met. The current state of the sanitation sector is such that huge gaps in the sanitation service chain are faced by a majority of the population of India. This highlights the need for not just institutional remodelling of the sector, but also for adopting a novel approach, innovative ideas and urgent decentralization if the sanitation services are to reach the last common denominator. For decentralization we need to focus on onsite sanitation systems consisting of containment and treatment units such as septic tanks and anaerobic settler, baffled reactor respectively. These units need to be desludged at a regular interval in order to maintain the treatment efficiency of the unit.

Faecal sludge & septage management (FSSM) refers to the removal, treatment, and disposal of sludge from containment and treatment units. Faecal sludge and septage is different from domestic sewage and contain mostly human excreta/waste rather than the waste that drains from kitchens, etc. The Government of India's (GoI) goal is for all cities to have networked sewerage connections, which would send liquid waste to a central location for treatment and disposal. However, such a centralized wastewater management system is not feasible for towns where the population density is low and financial management is not up to the mark.

Presently, majority of the urban local bodies (ULBs) do not have the required infrastructure for end to end management of liquid waste for their complete population. This means the sludge from the containment units has to be emptied and moved to a location that will process it further making it safe for reuse or disposal. This ensures that part of the pollution load is reduced and the health of the onsite containment units is maintained.

Most cities in India lack the capacity to regulate emptying, conveyance, treatment and dumping of faecal sludge and septage. Given these issues of collection, treatment, and disposal, it is exciting that innovators are starting to look to this waste as a resource rather than a burden. While there is value of innovation at each level of the sanitation chain, mostly due to the human resource and health potential in infrastructure building and collecting waste, there is additional value in turning the faecal sludge matter into an environmentally beneficial and profitable resource.

This online certificate course was developed to understand all aspects of FSSM across the service value chain.

Course Objective

To build the capacities of participants so that they can understand, analyze and apply learnings in real-life scenarios for technical and financial planning of Faecal Sludge and Septage Management at a city level, including designing of Faecal Sludge and Septage Treatment Plant.

The programme is based on the module developed by NIUA, New Delhi in partnership with ESF, Pune and endorsed by MoHUA. This report summarizes the learnings from the first training programme based on this advanced module. Given the situation due to COVID-19 Pandemic, SCBP has been trying to organize capacity building activities through online mode. This is the pilot attempt under SCBP for delivery of such advanced training programme through online mode. The report elaborates on the online training given to technical experts, practitioners from local or state government organizations, and PMUs or private consulting firms in India, on design of treatment systems for Faecal Sludge and Septage Management (FSSM). Being the first attempt to conduct an intensive training program on FSSM, it was important for organizing agencies to understand the learning impact of online training and the viability of continuing such online training till the time restrictions continue on conducting face to face training. The feedback from the training has also helped us in reviewing and updating the content of the module. The updated module can be accessed at the following link:
The content of the module designed for Face to Face training (4 days training) was restructured for delivery through online mode. A 10-day course with a total duration of 20 hours was designed for online delivery. In order to engage participants and ensure that capacity is built to the level of practicing FSSM or conducting similar training, the course was developed using a case methodology and had a mix of presentations, case studies, exercises, information videos and quizzes. The Part A- Presentation Slides and Part B -Learning Note were shared with participants as reference materials. The online sessions were for 15 hours whereas the remaining 5 hours were dedicated to quizzes and exercises which participants had to attempt in order to complete the course. The exercises are based on the Part C of the module, the Workbook, various sections of this workbook were converted to assignments which the participants had to complete and submit in two phases. A separate session was arranged to conduct further discussions with participants to clarify their doubts and queries. A final online quiz was conducted during this session, where in the learning impact assessment was done. In order to successfully complete the course with certification, the participants had to attend all the sessions, attempt at least seven out of the ten session quizzes, complete the exercise and attempt the final online quiz.

Agenda

Following is the day wise agenda of the training. A detailed session wise agenda is available in the annexure.

Table 1: Agenda of the Training of trainers

<table>
<thead>
<tr>
<th>Day</th>
<th>Session</th>
<th>Topic</th>
<th>Contents</th>
<th>Duration [min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 June 2020</td>
<td>1a</td>
<td>Introduction to Faecal Sludge and Septage</td>
<td>• Sanitation System Approach&lt;br&gt;• Wet Sanitation Systems&lt;br&gt;• Sanitation Service Chain&lt;br&gt;• Challenges in Sanitation Services</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>Characterisation of Faecal Sludge and Septage</td>
<td>• Parameters for characterizing&lt;br&gt;• Categories of sludges&lt;br&gt;• Operational factors affecting the characteristics</td>
<td></td>
</tr>
<tr>
<td>18 June 2020</td>
<td>2</td>
<td>Quantification of Faecal Sludge and Septage</td>
<td>• Need of quantification of sludge&lt;br&gt;• Methods of quantification of sludge&lt;br&gt;• Operational factors to be considered while quantification&lt;br&gt;&lt;strong&gt;Case Study:&lt;/strong&gt; Port Blair, Andaman and Nicobar Islands&lt;br&gt;&lt;strong&gt;Exercise:&lt;/strong&gt; Quantification, Collection and Transport</td>
<td>90</td>
</tr>
<tr>
<td>19 June 2020</td>
<td>3</td>
<td>Emptying and Conveyance of Faecal Sludge and Septage</td>
<td>• Types of desludging methodologies&lt;br&gt;• Technical options for emptying and conveyance&lt;br&gt;• Optimizing emptying and conveyance&lt;br&gt;&lt;strong&gt;Case Study:&lt;/strong&gt; Wai &amp; Sinnar, Maharashtra&lt;br&gt;&lt;strong&gt;Reading Material:&lt;/strong&gt; Guidelines, Advisories and Manual Scavenging Act and Rules 2013</td>
<td>90</td>
</tr>
<tr>
<td>Date</td>
<td>No.</td>
<td>Topic</td>
<td>Details</td>
<td>Duration</td>
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| 20 June    | 4   | Treatment of Faecal Sludge and Septage                                 | - Treatment targets and specific objectives  
- Approaches for faecal sludge and septage management  
- Treatment mechanisms  
- Driving factors for selection of treatment mechanisms  
**Case Study:** Co treatment at Puri STP, Odisha
**Exercise:** Decision Making Criteria for components of treatment | 90       |
| 21 June    | 5   | Septage Receiving Station                                             | - Objectives and Design of septage receiving station  
- Components of septage receiving station  
- Type of septage receiving station | 90       |
| 22 June    | 6   | Non-mechanized Treatment Units of Faecal Sludge and Septage & its Design | - Stages of treatment of faecal sludge and septage  
- Non mechanized treatment units  
  - Designing of -  
  - Settling Thickening Tank (STT)  
  - Anaerobic Digester (AD)  
  - Unplanted Drying Beds  
**Case Study:** Bhubaneshwar FSTP, Odisha
**Exercise:** Designing of STT, AD, and Unplanted Drying Beds | 90       |
| 23 June    | 7   | Mechanized Treatment of Faecal Sludge and Septage                     | - Stages of treatment of faecal sludge and septage  
- Mechanized treatment units  
- Selection of -  
  - Dewatering technology,  
  - Drying technology,  
  - Thermal treatment  
**Exercise:** Mechanical treatment of Solids | 90       |
| 24 June    | 8   | Financial aspects of FSSM                                             | - Financial components of FSSM  
- Financial and contracting models  
**Case Study:** Financial Aspects of Port Blair FSTP, Andaman and Nicobar Islands
**Exercise:** Revenue Streams and Project Life Cycle Cost Analysis | 90       |
| 25 June    | 9   | Siting and Layout Planning of Treatment Plant                         | - Site characterisation and evaluation  
- Site selection criteria  
- Safety planning at treatment plant  
- Importance of layout planning and examples | 90       |
| 26 June    | 10a | Construction and commissioning of Treatment Plant                    | - Pre construction activities  
- During construction activities  
- Stages in commissioning of plant  
- Handover process of the plant | 90       |
|            | 10b | Operation and Maintenance of Treatment Plant                          | - Integration of O&M with design of treatment plant  
- Introduction to asset management  
- Content of O&M plan for treatment plant  
- Monitoring and record keeping at treatment plant | 90       |
|            |     | **Total duration [hours]**                                            | 15       |
SESSIONS
Sessions

Day 1, June 17th, 2020
The online training program was kicked off with a formal introduction of the Sanitation Capacity Building Platform by Mr. Depinder Kapur, Team Lead, NIUA. The training and online platform for all the practitioners hosted by NIUA was introduced by Ms. Jyoti Dash, Sr. Program Manager, NIUA. Ms. Sreevidya Satish, the moderator for the training, introduced Ecosan Services Foundation (ESF).

The session began with the introduction to the course, course outline, structure and objectives of the course. The Microsoft Teams platform, being used to deliver the course, was introduced to the participants, along with a brief guide on how to utilise its features. Introduction of the lead trainers and facilitators was carried out, followed by setting the ground rules for all the participants and explaining the mandatory criteria for the successful completion of the course.

Session 1a: Introduction to Faecal Sludge and Septage Management
Mr. Dhawal Patil, Sr. Resource Person presented the first session on Introduction to Faecal Sludge and Septage Management. Session started with types of sanitation systems and its approaches and difference between sewered and non-sewered sanitation system. Following were the points of discussion from the slide-deck:

- Sanitation system components
- Sanitation services chain
- Challenges for FSSM
- Different sanitation systems
- Summary: Sanitation system approach helps to break down the system and understand its nuances

Session 1b: Characterisation of Faecal Sludge and Septage
The second session began with the presentation on basics of FSSM. Following were the points of discussion:

- Type of sludge: Faecal Sludge, Septage and Sewage Sludge
- Characterisation of sludge and ratios of sewage, septage and public toilet sludge
- Operational Factors: Toilet usage, storage, climate, infiltration and exfiltration, equipment used
- Sampling procedures
- Summary: Characteristics of sludge can change from city to city & varies with multiple factors

Following were the queries raised during the session:

- What is dewaterability?
- What are the parameters at the sampling level at the source?
- How is COD:BOD ratio helpful in determining whether DEWATS technology is suitable for faecal sludge/ septage treatment?

Exercise: Part A & B - Section 1
The lead trainer took all the participants through Part C: Design Workbook which was shared with all the participants. The workbook contained two parts dedicated to two different cases. The trainer briefed participants about the two cases and instructed them to go through Section 1 of both parts carefully.
The session ended with Mr. Akshay Agarwal, Program Officer, NIUA briefing the participants on the session quiz. He introduced Classmarker, the platform used for conducting the quiz, and guided participants on how to utilise it for the purposes of the course.

**Day 2, June 18th, 2020**

The second day started with the recap of Day 1 by Mr. Dhawal Patil. He briefly summarised & discussed the presentation points covered the previous day on development of sanitation infrastructure in a rapidly urbanising country such as India. Following were some of the answers pertaining to the quiz raised by participants:

- How does COD:BOD ratio affect dewaterability?
- Explain the sludge accumulation difference for Leh & Devanhalli FSTP.

**Session 2: Quantification of Faecal Sludge and Septage**

Mr. Saurabh Kale, Sr. Resource Person was the lead trainer for this session on quantification of faecal sludge & septage. The following points were covered in this part of the session:

- Need for quantification of sludge
- Methods of quantification: Sludge production and collection method – To understand type of desludging and type of data collection methods. Data gaps and challenges were also presented to the participants. Each method was discussed in detail and parameters during estimation of sludge discussed
- Data points for quantification and factors affecting the collection
- Types of Stakeholders and data collection
- Challenges in appropriate data collection
- Operational factors to be considered
- Seasonal variations and causes of variation
- Peaking factor

Following were the questions that were asked by participants which were answered by the trainers:

- What is the septage accumulation rate?
- What is the significance of peaking factors of <1?

**Case Study: Port Blair, Andaman and Nicobar Islands**

Mr. Dhawal Patil was the speaker for this case study session. It was presented on the basis for Quantification Approach based on Sludge Collection Method. The data for the sanitation system profile was collected from the
Port Blair Municipal Corporation (PBMC). The steps which were taken during the process of planning of FSTP at Port Blair was explained. It also showcased the sanitation service chain of the city to explain sanitation scenario in the city. Quantification of sludge was done for the city in the form of daily collection frequency of trips to the disposal site. It explained about the seasonal variation, collection frequency in critical months & how winter season was the peak season for desludging due to the floating population/tourists. Optimising collection and conveyance were done as follows:

- Scheduled service for commercial and public properties
- PBMC recommended to add 4 KL vacuum truck
- Monitoring process: Stricter regulations & GPS on trucks
- Regulating the collection and conveyance
- Proposed fixed charges (INR/lit. considering the distance)

Design capacity was reached by following factors:
- Population growth
- Design capacity and period
- Faecal sludge & sewage sludge - 12 KLD
- Septage – 30 KLD

Following were the questions that were raised during this session:
- Why are trucks of capacity (>4KLD) being used at Port Blair?
- Can faecal and septage be treated in one treatment plant?
- Please clarify the calculation details of FS and septage in the ratio of 30 and 12 out of a total quantity of 42?

Exercise: Part A & B – Section 2
The exercise on Collection and Transport stage of FSSM was explained. The exercise comprised of comprehending the data from previous day's exercise and analysing it further to quantify the sludge and the vehicles required to provide service to the households.

Day 3, June 19th, 2020
The moderator started Day 3 with the feedback on previous 2 days' training sessions. A brief of the 3rd session along with the case study was then provided to the participants.

Recap of Day 2 was taken by Mr. Saurabh Kale, post which the emptying and collection exercise (Section 2) was explained by Mr. Dhawal Patil in detail to all participants before beginning the sessions for Day 3.
Session 3: Emptying and Conveyance of Faecal Sludge and Septage

The objective of the session was to introduce technology options for emptying and conveyance of FS and Septage. Mr. Saurabh Kale was the lead trainer for this session and the following topics were covered:

Types of collection and transportation:
- Manually operated mechanical emptying
  - Sludge Gulper, manually operated diaphragm pumps, MAPET
- Motorised emptying
  - Pit Screw Auger, Vacuum Trucks (suction truck or honey suckers), Vacutug

Transfer Station
- Types of transfer stations: networked connected, modular (detachable tanker), mobile transfer station

Dewatering Truck

Case Study: Wai & Sinnar, Maharashtra

Ms. Arwa Bharmal, Program Lead, CWAS, CEPT University, was the guest speaker for this case study on Wai & Sinnar, Maharashtra. She explained the setting up of scheduled emptying services at Wai, Maharashtra. She also discussed the current practices of desludging in Indian cities being mostly of complaint redressal and not a public service, as well as the way sewerage and SWM are handled. She also explained the adverse environmental impact due to poor quality of dumping of FS in the water bodies & the recent initiatives in Maharashtra under the Swachh Maharashtra Mission where subsidies are given for construction of IHHL.

The sanitation situation of Wai in 2013 of access to toilets, collection of sewage, conveyance, transport and treatment was explained & how private operators were assigned to collect FS from households. Doing so has enabled Wai to become the 1st city in India to follow scheduled desludging. Zoning of areas was done in Wai for better implementation of schedule desludging, and emergency desludging was also carried out by private operators.

Figure 3: Snapshots from case-study on Wai & Sinnar

Advanced Online Training on Faecal Sludge and Septage Management (FSSM)
Reference Material
The participants were provided with reading and reference material after the session. The material consisted of GoI's Manual Scavenging Act, 2013, a primer on FSSM, ODF protocols and byelaws by government, SOPs for cleaning of septic tank and sewers, emergency response for sanitation units and IS codes by BIS, among others. The lead trainers suggested the participants to go through all such reference material to gain a better understanding about FSSM.

Figure 4: List of reference material shared with the participants for further reading

Day 4, June 22nd, 2020
Day 4 began with general information regarding the technical part of the training & asked the participants to utilise the WhatsApp group created for the course for further doubts at any point during the course. The moderator introduced the guest speakers for the day with co-treatment case study, Trichy from IIHS. Mr. Saurabh Kale took a quick recap of Day 3 which covered emptying and conveyance of FS and septage so that participants had some revision for the upcoming session.

Session 4: Treatment of Faecal Sludge and Septage
The objective of the session was to introduce treatment targets and objective approach for FSSM, treatment mechanisms, stages, and chain and selection of treatment technology. Mr. Dhawal Patil was the lead trainer for this session & the following points covered in this session:
1. Treatment targets
2. Treatment Objective
   - Dewatering
   - Pathogen removal – reduce the pathogens completely
   - Nutrient Recovery
   - Stabilization
3. Approaches for FSSM
   - Deep Row Entrenchment
   - Co treatment in STP and MSW plant
4. Treatment Mechanism and its objective
5. Treatment Stages
6. Treatment Chain
7. Treatment Option depends on

Figure 5: Treatment chain of Faecal sludge & Septage
Case Study: Co treatment of FS & Septage at STP, Trichy

Mr. Santosh Raghavan from IIHS was the guest speaker for this case study & presented the case study on co-treatment of FS & septage in STP, Trichy. The session started with some questions to all the participants about co-treatment. An overview of Trichy City was presented. Trichy has been practicing co treatment for more than a decade. Following were some of the major points discussed pertaining to the case study:

- Decanting stations & their guidelines
- Screening and grit facility and receiving facility
- Layout, infrastructure and O&M
- Demonstration
- Co-treatment of FS with sewage
- Checklist for assessment of pumping station
- ULB details
- Location and access details
- Availability of space and existing infrastructure

![Figure 6: Snapshots from case-study of co-treatment in Trichy](image)

Exercise: Part A & B – Section 3

Day 4 exercise was explained by the lead trainer regarding Section 3. This was based on the findings of the previous section and its interpretation to decide the requirement of treatment units.

![Figure 7: Section-3 exercise from workbook](image)

### Table 5: Number of vacuum trucks required of different capacities

<table>
<thead>
<tr>
<th>Capacity of vacuum truck (cum)</th>
<th>Number of trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 6: Need of stabilization for septage from different sources

<table>
<thead>
<tr>
<th>Source of septage</th>
<th>Stabilization required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas anaerobic OST</td>
<td>(YES / NO)</td>
</tr>
<tr>
<td>Community toilet anaerobic OST</td>
<td>(YES / NO)</td>
</tr>
<tr>
<td>Public toilet anaerobic OST</td>
<td>(YES / NO)</td>
</tr>
<tr>
<td>Aerobic OST</td>
<td>(YES / NO)</td>
</tr>
</tbody>
</table>

### Table 7: Volume of septage

<table>
<thead>
<tr>
<th>Volume of septage</th>
<th>Unit</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization (m3)</td>
<td>m3</td>
<td></td>
</tr>
<tr>
<td>Solid liquid separation (m3)</td>
<td>m3</td>
<td></td>
</tr>
</tbody>
</table>
Day 5, June 23rd 2020
A brief recap of the previous session was given to the participants. The guidelines on how to attempt the quizzes & exercises & their importance was reiterated.

Session 5: Septage Receiving Station
Mr. Saurabh Kale was the lead trainer for the session. Septage receiving station & its different components were explained in the session. The main aim of the septage receiving station is to reduce the impact on the treatment plant. The layouts of dumping stations were explained through schematic diagrams.

The different options of receiving stations were covered along with the working diagram of each type.

Figure 8: Snapshot of the session on Septage receiving station

The lead trainer also discussed about the reference material that had been shared with all the participants.

Informational videos: Septage receiving station & integrated mechanized septage receiving station
Mr. Dhawal Patil conducted this session with the ongoing presentations. A video regarding working of the mini screens was shown. The trainer explained the working of the various equipment shown in the video.

Figure 9: Informational video on septage receiving station
Videos of the grit removal chamber and mechanized receiving station were shown. The final video contained the design & implementation and other factors which are considered for the receiving station.

Some of the questions by participants included:
- What if the septage of the truck needs to be stored temporarily, is it advisable to consider a holding tank at the inlet?
- Is there any specific material used for the pre-fabricated bar screen for handling septage?

**Day 6, June 24th 2020**
Mr. Saurabh Kale gave a recap of the previous session on the design aspects of septage receiving station.

**Session 6: Non-mechanized Treatment Units of Faecal Sludge & Septage & its Design**
Mr. Dhawal Patil was the lead trainer for this session. Following were the points that were explained in the session:
- Solid liquid separation
  - Geo-bags
  - Settling thickening tanks
- Stabilization
  - Anaerobic digester
- Dewatering & Drying
  - Planted & Unplanted drying beds
- Pathogen reduction
  - Co-composting & Extended storage

The following were some of the questions that were raised by the participants:
- What is supernatant?
- Is there any specification for sand used in drying beds?
- Is 7 days drying period enough for sludge drying bed?

![Figure 10: Snapshot of the session on non-mechanized treatment of FSS](image)

**Case Study: Septage Treatment Plant, Bhubaneshwar, Odisha**
Mr. Binod Kumar Sahoo, Project Director, OWSSB was the guest speaker for this session & presented the case study on FSSM approach in Odisha and technical approach towards Bhubaneshwar FSTP. Non-mechanized septage treatment plant (SeTP) has been set up at Bhubaneshwar by OWSSB. The SeTP is very efficient under extreme climatic conditions as well. The FSTP at Bhubaneshwar is gravity-based. He explained the working & operational aspects of the plant at Bhubaneshwar. The scaling up of FSSM in the state of Odisha is currently being implemented on a large scale. The government of Odisha along with OWSSB has spearheaded this project.
of bringing the state of Odisha under FSSM. Self-help groups have been engaged and trained specifically to run the treatment plants thus increasing awareness among people.

Following are the learnings from the case study that was shared:

- FSSM can be adopted effectively in towns & cities for liquid waste management in the absence of sewerage system
- Non-mechanised treatment/natural treatment systems should be adopted as far as possible since O&M is very simple and less costly
- Pollution of water bodies can be prevented to a great extent with proper treatment of septage

Figure 11: Snapshot from the Bhubaneswar case-study presentation

The moderator appreciated sharing the experiences pertaining to FSSM in the state of Odisha. The participants expressed their appreciation for Mr. Sahoo sharing OWSSB’s experiences and congratulated him for the work done in Odisha.

Exercise: Part B – Section 4,5 and 6

The lead trainer explained the participants how the sections 4, 5 and 6 of Part B of the exercise were to be done & what all assumptions for the calculations should be considered. The exercise was based design of the non-mechanised treatment units such as settling thickening tank, anaerobic digester, unplanted sludge drying bed.

Figure 12: Exercise section-4,5 from workbook

\[
\text{5.2 Sizing of the settling thickening tank}
\]

\[
\text{Where:}
\]

\[
\begin{align*}
\text{q} & = \text{hourly peak flow} \\
\text{S} & = \text{required surface area of the settling thickening tank} \\
\text{Assume the width of the settling thickening tank to be } w, \text{ hence the length will be } l \\
\text{Surface area of the tank will be } 2wl \\
\text{Then, } 2wl = \frac{q}{S} \\
\text{Hence, width of the settling thickening tank} = \frac{q}{2S} \\
\text{Length of the settling thickening tank} = \frac{q}{2S}
\end{align*}
\]

\[
\text{5.3 Diagram}
\]

- FSTP (after screening)
- Sedimentation tank
- Thickened sludge
- Thickened sludge extraction (pump)
Day 7, June 25th 2020
Mr. Dhawal Patil gave a recap about previous session on non-mechanized treatment units and explained the solution of the exercise workbook for the previous sections.

Session 7: Mechanized treatment of faecal sludge & septage
Mr. Dhawal Patil was the lead trainer for this session. The stages of treatment for faecal sludge & septage, the mechanized treatment units & the system description, performance parameters, design considerations for all of the treatment units were explained in this session. Following were the topics that were focused in the presentation:

- Solid liquid separation
  - Screw press
  - Belt press
- Drying
  - Solar drying
  - Belt dryer & Paddle dryer
  - Thermal drying

![Figure 13: Snapshot of the session on mechanized treatment of FSS](image)

At the end of the session, Q&A session was undertaken by the moderator & lead trainers.

Exercise: Part A – Section 4, 5 and 6

![Figure 14: Exercise Section 6,7 From Workbook](image)
This section was dedicated to designing of treatment components for the FSTP in Part A. The treatment components to be designed were settling thickening tank, anaerobic digester, screw press, belt press and calculation to understand the energy balance in drying and incinerating the biosolids. Energy balance calculation helps to understand the feasibility of employing thermal treatment of biosolids.

**Day 8, June 26th 2020**
The lead trainer began day 8 with a recap of the previous session & discussed the solutions for the exercise from the workbook.

**Session 8: Financial aspects of FSSM**
Mr. Saurabh Kale was lead trainer for this session. Participants were posting their questions & doubts in the chat box of Microsoft teams while the session was ongoing and these queries were being answered by other trainers during the session. All the participants were encouraged by the trainers & the moderator to ask any questions they had pertaining to the ongoing sessions.

The main learning from this session was to understand the importance of different financial transactions. As a consultant, it was important to know these aspects with the relevant stakeholders in order to reduce the risk to the sustainability of the project. Following were the topics explained in this session:

- Financial aspects
  - Capital expenditure
  - Operational expenditure
  - Income & revenue
  - Annualized cost

- Financial flow models
  - Private service model
  - Licensing model
  - Sanitation tax model
  - Incentivized disposal model

Following were some of the questions raised by the participants during the session:

Aren’t the discharge fees, purchase price & budget support considered as revenue?
Exercise: Part A & B – Section 7 & 8

The trainer explained Sections 7 and 8 of the exercise. Section 7 consists of quantifying the treated end products produced at the FSTP and Section 8 consists of performing a life cycle cost analysis based on annualized cost method to calculate cost of project per household or per KL of sludge. This helps to determine the affordability of the FSSM systems.

Case Study: Port Blair, Andaman & Nicobar Islands

Mr. Dhawal Patil presented the case study session on Port Blair where Ecosan Services Foundation has worked along with NIUA on preparation of DPR on FSSM. Following were the topics that were explained in detail in this case study:

- Selection criteria
- Treatment units considered & selected
- Treatment chain
- Decanting station
- Capital expenditure
- Key points to be considered
- Financial estimates
- Financial modelling
- Sanitation tax

Figure 17: Snapshot from the case study based on FSSM DPR for Port Blair

---

### Table: annual capital cost of different capital expenditure in an exercise of FSSM project

<table>
<thead>
<tr>
<th>Component</th>
<th>Annual capital cost (INR/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land acquisition</td>
<td></td>
</tr>
<tr>
<td>Civil structure</td>
<td></td>
</tr>
<tr>
<td>Electro mechanical component</td>
<td></td>
</tr>
<tr>
<td>Electrical and plumbing</td>
<td></td>
</tr>
<tr>
<td>Total capital cost</td>
<td></td>
</tr>
</tbody>
</table>

8.4 Total annual cost

\[
\text{Total annual cost} = \text{Total annual capital cost} + \text{Salaries and benefits} + \text{Total revenue generation}
\]

Thus, the total annual cost for the scenario is ___________ (INR)/year.

8.5 Cost of treatment

Calculate the cost of treatment of unit volume of the sewage from the total annual cost.

Cost of treatment is ___________ (INR)/KL.
Following were the questions that were raised during the session:

- What will be the cost analysis with respect to a mechanised treatment plant & a natural treatment plant?
- Explain more about equalisation tank?

![Figure 18: Q&A session undergoing after the session](image)

Instructions pertaining to the final submissions of the exercises & how it should be compiled & submitted was explained by the moderator.

**Day 9, June 29th 2020**

Mr. Saurabh Kale gave a recap on session for financial aspects. While the recap session was going on, Mr. Dhawal Patil had requested all the participants in the chat box to fill the feedback forms related to case studies taken. Later the solutions for the exercise Sections 7 & 8 were also discussed.

**Session 9: Siting & Layout Planning of Treatment Plant**

Mr. Dhawal Patil was the lead trainer for this session. He discussed & showcased good design examples & practices being followed currently. Following were the topics covered in this session:

- Siting at FSTP
- Layout planning

![Figure 19: Good design examples of treatment units are treatment plants](image)
Most of the session was covered using pictures to better illustrate the good as well as not so good design of various units in a treatment plant. The design of units becomes utmost important for proper operation and maintenance and safety of the workers.

Following were some of the questions that were asked during the session:
- Do we require any license or environmental clearances to run the plant?
- Can we have provisions for a rainwater harvesting system at the FSTP?
- Is there any FSTP where methane gas is extracted commercially?

**Day 10, June 30th 2020**
Mr. Dhawal Patil began the session with a recap of the previous session. The solutions to the exercise were shared with the participants. The participants were requested to check the solutions and post the queries for discussion during the 11th session.

**Session 10a: Construction, Quality Control & Commissioning of Treatment Plant**
Mr. Dhawal Patil was a lead trainer for this session. He explained the purpose of a contract & how important it is to state the responsibilities and duties among all the parties who are getting together for the said project/contract. The session described the various stages for the pre-construction, construction, post-construction & handover stages. Following were the topics of the session that were explained:
- Pre-construction
  - Contract documentation
- Construction
  - Site supervision
  - Sound construction
  - Accurate construction
- Post-construction
  - Pre-commissioning tests
  - Process commissioning
  - Process performance test
- Handover documentation

Following points can be summarized from the session:
- Contract documentation is important before starting the construction of the treatment facility
- Site supervision is required for monitoring of the construction process & quality of it
- Commissioning of treatment facility has multiple steps & might be time consuming process, however it needs to be completed before introducing any waste & handing over
- Handing over documents is an important link between the designer, contractor & the organization performing the O&M

Following were some of the questions raised during the session:
- Was there any SeTP/STP in India where dried sludge is made 100% pathogen-free & sold directly to the customers?

**Session 10b: Operation & Maintenance of Treatment Plant**
Mr. Saurabh Kale was a lead trainer for this session. Following points were discussed in detail for this session:
- Integrating O&M with planning & design
  - Considerations for O&M planning
  - Need of O&M plan
- O&M Planning
  - Content of O&M plan
  - Asset management
- Monitoring & record-keeping
  - Chain of custody

Following were some of the questions that were raised during the session:
- What all provisions of O&M should be included in the contract?
- What is defect liability period?
- Does the FSTP go for quality system certifications?

After the session, the moderator addressed the participants about the next day's Q&A session.
Day 11, July 1st 2020  
The moderator began the last session by welcoming the participants for the closing session & instructed the participants about the quiz & feedback session. The agenda was shared with the participants on screen. 

Figure 20: Agenda For The Closing Session

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Resource Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00 to 3.05</td>
<td>Welcome Remarks &amp; agenda for the day</td>
<td>Sreevidya Satish</td>
</tr>
<tr>
<td>3.05 to 3.35</td>
<td>Q &amp; A session</td>
<td>Dhawal Patil &amp; Saurabh Kale</td>
</tr>
<tr>
<td>3.35 to 3.50</td>
<td>Live Quiz through Class Marker</td>
<td>Akshay Agarwal</td>
</tr>
<tr>
<td>3.50 to 4.00</td>
<td>Feedback through <a href="http://www.menti.com">www.menti.com</a></td>
<td>Akshay Agarwal</td>
</tr>
<tr>
<td>4.00 to 4.10</td>
<td>Feedback by individual participants</td>
<td>Sreevidya Satish</td>
</tr>
<tr>
<td>4.10 to 4.20</td>
<td>Announcement on Certificate Issue Process</td>
<td>Sreevidya Satish</td>
</tr>
<tr>
<td>4.20 to 4.30</td>
<td>Closing Remarks and Vote of Thanks</td>
<td>Dayanand Panse &amp; Depinder Kapur</td>
</tr>
</tbody>
</table>

Closing Session  
Both the lead trainers started this session with answering the questions raised by the participants over the whole training period through emails & on the WhatsApp group. They clarified all doubts raised by the participants through the session.  

Following were some of the topics covered:  
- Characterization of sludge, based on COD  
- Treatment of sludge  
- Thermal drying of bio-solids  
- Thermal treatment of bio-solids  
- Defect liability period  
- Sludge loading rate comparison

Figure 21: Doubt clearing session by Saurabh Kale & Dhawal Patil

Thermal Treatment of Bio Solids

\[ \frac{4186 \times (100 - 30) + 2260 \times (C_i - 0.05)}{0.60} = (1 - C_i) \times 12000 \times 0.85 \]
\[ 293 + 2260C_i - 113 = 6120 - 6120C_i \]
\[ 2260C_i + 6120C_i = 6120 + 113 - 293 \]
\[ 8380C_i = 5940 \]
\[ C_i = 0.70 = 70\% \]

Thus, the solid content of dewatered solids should be at least 30%.

After the Q&A session, live quiz covering the topics for the whole training was conducted for all participants present.
After the online quiz, a live feedback was taken from all the participants through Mentimeter platform.

After the feedback, the certificate issuance criteria & its process was explained by the moderator to all participants. Some of the participants were requested to share their live feedback, their whole experience & learnings from this training.
After the feedback session, the moderator invited Dr. Dayanand Panse, Director, ESF & Mr. Depinder Kapur, Team Lead, SCBP, NIUA for a vote of thanks to end this training program.

Figure 25: Dr. Dayanand Panse & Mr. Depinder Kapur Sharing Their Vote Of Thanks To Everyone
Feedback

Providing feedback towards the training as well as case studies shared during the training program was voluntary. Up to 60% of the participants have shared their feedback.

Considering the feedback carried out for case study and the overall training, following inferences were drawn.

**Case study feedback**

The chart below depicts the overall ratings received from the participants for the case studies that were showcased during this training. The ratings are out of 5. Overall, the participants liked the different case studies presented by the respective experts.

![Figure 26: Case Study Feedback](image)

Following is the feedback with respect to each case study which was provided by the participants:

- **Co treatment, Trichy**: The case study included basic information regarding the receiving station and the co-treatment of septage with sewage at the STP. However, most of the time was spent on the theory part of co-treatment rather than focusing on the interventions done to set up a decanting station at the pumping station and the impact and mitigation of co-treatment at the STP.

- **Scheduled desludging, Wai**: The case study included ODF and ODF+ journey of Wai, operation of the scheduled desludging, treatment plant and learnings. Participants expressed their willingness to know more about the planning and monitoring of the scheduled desludging at city scale.

- **Septage Treatment Plant, Bhubaneshwar**: The case study focused on selection of the technology, photos from the actual plant, data from monitoring of the plant and operational and maintenance challenges and their mitigation. Participants found the case study to be very helpful and requested to get in touch with the resource person for getting further details on design of the treatment units.

- **FSSM, Port Blair**: The case study was based on DPR preparation of FSSM for city of Port Blair. In this study, focus was given on each stage of DPR preparation – data collection, analysis of data, selection of technology, financial calculation of life cycle cost, cost recovery options for the ULB. Participants took interest in the case study and had requested for the copy of the DPR to get in-depth knowledge about each component of the DPR.
**Training Feedback**

The table below represents the feedback of the participants where they have indicated their satisfaction from this training program. The ratings are out of 5. It has been observed that all participants have approved of the course content which is related to their current work profiles and the course has improved their understanding about FSSM.

![Figure 27: satisfaction with Overall Training](image)

The table below shows the ratings for various aspects while conducting this training. The total ratings are out of 5. It has observed that all the ratings are in the range of 4 - 5, which infers that all the participants were satisfied with the training content and methodology for delivery.

![Figure 28: Feedback on Training content & training methods](image)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>The course content was very relevant for your present job/department</td>
<td>4.7</td>
</tr>
<tr>
<td>The course has resulted in improved understanding of the subject</td>
<td>4.8</td>
</tr>
<tr>
<td>The course has improved skills/understanding in FSSM</td>
<td>4.8</td>
</tr>
<tr>
<td>The training methods used allowed proper understanding of the topic</td>
<td>4.6</td>
</tr>
<tr>
<td>The level of exercises was appropriate for the course and not too difficult or too easy</td>
<td>4.6</td>
</tr>
<tr>
<td>The modular format of the course made it easy to follow, and the extra reading material helped</td>
<td>4.5</td>
</tr>
<tr>
<td>The training sessions delivery by the trainers were of high standard</td>
<td>4.7</td>
</tr>
<tr>
<td>The sessions were interactive enough to reinforce learning outcomes, and the Q&amp;A sessions at the end of each day helped</td>
<td>4.4</td>
</tr>
<tr>
<td>The handouts, workbook and reference material provided were adequate</td>
<td>4.4</td>
</tr>
<tr>
<td>The quality of presentations/lectures aided in understanding FSSM</td>
<td>4.6</td>
</tr>
<tr>
<td>The training methods used allowed proper understanding of the topic</td>
<td>4.6</td>
</tr>
</tbody>
</table>
The chart below displays the overall ratings pertaining to the online training program management. The total ratings are out of 5. All the participants were very satisfied with this whole training scheduling & it’s management.

**Figure 29: Feedback on Online training program management**

- **Duration of the course was appropriate for online format, in terms of daily sessions, quizzes and exercises:** 4.5
- **Handling of online quiz platform was good, and issues were resolved quickly:** 4.8
- **Communication and overall support provided during the program was of high standard:** 4.7

The table below showcases the challenges participants faced or experienced during this online training course & their count for each of those challenges. Being an intensive course with consecutive 10 days of sessions, the participants found the duration provided for completing the exercises inadequate. Participants were working professionals and hence, time management was quite critical. A similar feedback was received pertaining to the time slot (schedule) of the sessions.

**Figure 30: Different Challenges Faced by the participants in the Exercises**

- **Too complex:** 1
- **Solutions not clear:** 5
- **Inadequate duration to complete and submit:** 10
- **Other:** 3

**Figure 31: Challenges faced by Participants in Online Training Delivery Part**

The chart below shows the results for all the participants who require support further in various capacities for implementation activities in their respective states. The total number of participants who require such support for such capacities has been given below:
Testimonials by the participants

The table below presents some of the valuable comments that have been shared from the participants in their feedback forms.

<table>
<thead>
<tr>
<th>SR. NO</th>
<th>NAME OF THE PARTICIPANT</th>
<th>ORGANIZATION</th>
<th>Testimonial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ms Pushpa Martin</td>
<td>Jharkhand state sewerage department</td>
<td>The FSSM online Certificate Training Program was very effective and helpful for professional working on FSSM.</td>
</tr>
<tr>
<td>2</td>
<td>Ms Anisha Dey</td>
<td>WASH Institute</td>
<td>Wonderful programme, the interactive session and it was very helpful in clearing the doubts. Congratulation to the organizing team.</td>
</tr>
<tr>
<td>3</td>
<td>Mr Vivek Raj Pandey</td>
<td>IPE Global</td>
<td>This online training exceeded my expectations and changed my thoughts for such online platforms! It was extremely well-planned with engaging materials. What impressed me the most about this course is the quality of the presentation, the interesting case studies of Andaman and the way team NIUA planned and arranged all the training materials within timeframe. The timely support on queries offered by presenter on the online forums e.g. WhatsApp has been great. Inclusion of specifically tailored suggested readings have made this training, quizzes and exercise truly innovative. I would recommend others taking similar training. It's super intensive with lots of reading involved. The time slot for working professionals like us was challenging yet very rewarding! Thank you NIUA &amp; ESF for all your support. Hope to see more of you in future.</td>
</tr>
<tr>
<td>4</td>
<td>Mr. Manoj Pandey</td>
<td>ATI, Nainital, Uttarakhand</td>
<td>The training was wonderful and very engaging. There was lot of in-depth learnings about FSSM from the practioners perspective. The resource persons had good understanding of the subject matter and never left the questions unanswered or unattended. The buddy system between Mr Dhawal and Mr Saurabh for clarifying the doubts in the chat box helped the participants while conducting the sessions. Overall, the training will definitely help us to conduct similar training in the state to build capacities of officials at state level.</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Organization</td>
<td>Feedback</td>
</tr>
<tr>
<td>---</td>
<td>----------------------</td>
<td>------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Mr. Kaushik Ghosh</td>
<td>ATI, Kolkata, West Bengal</td>
<td>The training was interesting and provided lot of useful information. Due to the mix of case studies and videos, the session was made engaging. The exercise made sure that the concepts explained in the session could be put to use and applied to solve the problems. Thus, ensuring holistic learning.</td>
</tr>
<tr>
<td>6</td>
<td>Ms. Jega Loyal</td>
<td>Indian Institute of Human Settlement (IIHS)</td>
<td>The exercise was very engaging and helped practitioners like us to apply the knowledge gained and test it out. The doubts and queries raised while solving the exercise offline were clarified by the resource person through chat without any delay even on weekend. This allowed us to solve the exercise smoothly.</td>
</tr>
</tbody>
</table>
Learning Impact Assessment

The training program saw active participation by 58 participants from different organisations. The overview of this is presented below:

As per the overall course statistics, it can be interpreted that the course was successfully completed by 72% (42 out of 58) of the participants over the period of 11 days. The basis of completion of the training course was determined by (a) attendance for the sessions, (b) evaluating the participants attempt to 10 session quizzes, (c) submission of the solutions to the exercise and (d) scores of the final quiz (which was conducted live during the closing session).

The participation of women in the online training was significantly higher as compared to a face to face training. In this online course 33% (19 out of 58) of the participants were women. It is also interesting to note that 79% (15 out of the 19) women participants completed the course successfully whereas only 69% (27 out of 39) men completed the course. It was also noted that most of the women participants had given a sincere attempt to the exercise and had actively engaged with the resource persons by asking relevant questions.

The learning impact of the training program was assessed depending upon same criteria listed above. 96% of the participants scored more than 1/3rd of the total marks i.e. more than five in the final quiz. Approximately 40% of the participants who attempted the final quiz, scored more than 2/3rd. The highest score of 14 out of 15 was received by 3 participants.

It was observed that all the participants who had attempted all the quizzes and the completed the exercises scored well, thus reinforcing the fact that participants who showed interest and dedication towards the training program benefited significantly in terms of improving their knowledge about FSSM.
Learnings and Way Forward

In a face to face training programs, the participants are motivated to attend the training and learn. In this case, the participants are away from day to day work and hence, it is relatively easy to capture their attention and maintain their interest for the trainers. The trainer as well as trainees are connected in person and hence, the learning is accelerated and ensured. Following are the learnings from the online training conducted:

Agenda and schedule
The agenda should be tailored for the target audience. A training program having focussed topic for appropriately targeted audience has more impact.

The schedule of the session needs to be carefully planned. If the sessions are to be conducted during weekdays, the time slot should be either start of the working hours or the end of the working hours. This allows the participants to manage their time well with the daily work.

The orientation training having 5-6 session in case of face to face training should be condensed into 3-4 sessions (60-90 minutes in each) and conducted over a duration of 2-3 days.

The advanced trainings which are usually conducted for up to 3 days in face to face format should be ideally split into 10 -12 session (60-90 minutes each). The duration of such courses can be based on the type of the target audience. In case of working professionals in private organizations, the course can be conducted in 10-12 days. However, in case of government officials belonging to parastatal agencies and ULBs, the same course should be conducted over a longer period.

Content
The content of the sessions needs to adapted for the online delivery of the sessions. It is recommended to use images and illustrations to state the point. The flow of the topics plays an important role to retain the attention of participants. The session should begin with easy to grasp concepts leading into more detailed and important points. Each session should focus on not more than 5 points.

The duration of the session can be up to 90 min, provided the session is a good mix of PowerPoint presentation, audio visual aids such as information videos, case studies, quiz etc.

Exercises
All the activities and exercises conducted in face to face training cannot be conducted in online training program. The exercises should be split in such a way that they go along with the session.

Simple and basic exercises can be conducted online during the session, however, for more elaborate exercises, it is recommended that they be attempted offline by the participants. For this, the trainers need to ensure that participants understand the concepts needed for solving the exercise during the online session.

Resources
For an online training program, it is recommended that there is moderator. The moderator’s job is to put together different elements of the session together and introduce to the participants. Moderator also plays an important role in case there is technical glitch at the resource person’s end.

For each session of the training program, it is recommended to have at least 2 resource persons. While one
resource person is engaged in the delivering the session, the other resource person can answer the queries, which the participants are posting in the chat box. Clarifying the queries of the participants when they are raised is important to maintain their interest in the session. The questions, which are not related to the topic of discussions are noted by the moderator and discussed with the lead trainer after the presentation is done.

**Assessment**

Assessment in the form of quizzes is important. Ideally short quizzes (up to 10 questions) with multiple choice questions should conducted on each session. The formation of the questions is dependent on the level of the blooms’ taxonomy. There should be a time duration for each quiz. For multiple choice questions, 1 to 1.5 min per questions (depending upon the difficult level) is suggested.

In case of orientation training program, the aim is to introduce the participants to the concept and make them aware about certain approaches. For such training the questions should be direct. This allows the organizers to check, the participants have grasped and retained the key message from the session.

In case of advanced courses, the aim is to enable the participants not only to grasp and retain but to apply the concepts for solving a problem. Hence, in this case, indirect questions should be used in the quiz. This requires the participant to retrieve the information from memory, analyse the question at hand, apply the concept and solve the question.

It is recommended that the session quizzes be conducted offline in order to save time during the online session.

The final quiz consisting of all the questions on all the topics covered in the online training program can be conducted online. In this case, the time duration given should be not more than 1 min per question. This ensures that the difficulty level is not increased when compared to usual session quiz.

**Platform**

The platforms used for conducting the online sessions, quiz and feedback play an important role to determine the user experience of the participants. A good user experience ensures and maintains interest of the participants in the various elements of the training program.

Microsoft Team was tested during the first training. The platform is user friendly and was easy for the participants to adapt. Despite this, the participants were frequently facing issues with the audio and video quality due to network issues which was also mentioned in the feedback.

Another popular platform is Zoom. Zoom does not consume higher bandwidth and also gives an option to switch off the audio/video of the participants by the host. Thus, improving the audio/video quality of the online sessions. It also has features such as breakout rooms, white board, dedicated Q&A box and chat box for participants.

Classmarker proved to be very resourceful platform for conducting quizzes. The summary of the quizzes was provided on dashboard and could also be exported in various formats for further use.

For online polling, Mentimeter is a good platform. The representation of the polling is through interactive illustration which is nice for the participants and the organizer to see.

For feedbacks, there are multiple platforms, however Google Forms are the most convenient platform. Feedbacks can be used not only to improve the further training but also to allow the participants to self-assess their individual learnings from the training program.

**Learning Management System**

A Learning Management System (LMS) or a portal can be developed which will eliminate the need of using different tools and platforms. The LMS can integrate the following tools:

- Training calendar with brief information about each training consisting of Introduction to the course, resource persons, profile of the organizers etc.
- Registration portal with online payment gateway.
- A repository of the resources pertaining to all the trainings (accessible only after registration to the training).
- Integrated online training platform to live delivery of the sessions.
- Question and answer section/discussion forum dedicated for participants to post queries during the training.
- Exercise can be also converted in to an online format where in the participants have tools such as calculator ready on the screen for use.
- To reduce the number of queries, hints can be provided at certain stages of the exercise which will help the participants to smoothly carry out the exercise.
- Forums on discussing the topics and sharing of knowledge during and after the training.
- Quiz platform for the participants to attempt the quizzes.
- Feedback portal for the training.

The LMS not only improves the user experience for the participants during the training but also eases the efforts of the organizer to put together various lists containing information of the participants and the results from various platform. Such a platform can be also made mobile friendly, so that participants can use the forum and other tools easily.
## Annexure 1: List of Resource Persons

### Table 3: List of Resource Persons

<table>
<thead>
<tr>
<th>SR NO.</th>
<th>NAME OF THE RESOURCE PERSON</th>
<th>ORGANIZATION</th>
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<td>1.</td>
<td>Ms Sreevidya Satish</td>
<td>Ecosan Services Foundation</td>
<td>Moderator</td>
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<td>2.</td>
<td>Mr Dhawal Patil</td>
<td>Ecosan Services Foundation</td>
<td>Lead Trainer</td>
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<td>3.</td>
<td>Mr Saurabh Kale</td>
<td>Ecosan Services Foundation</td>
<td>Lead Trainer</td>
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<tr>
<td>4.</td>
<td>Mr. Santhosh Ragavan K V</td>
<td>Indian Institute of Human Settlement (IIHS)</td>
<td>Guest Speaker</td>
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<tr>
<td>5.</td>
<td>Ms. Arwa Bharmal</td>
<td>Centre for water and Sanitation (C-WAS)</td>
<td>Guest Speaker</td>
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<td>Mr. Binod Kumar Sahoo</td>
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<td>Guest Speaker</td>
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Annexure 2: List of Participants

The following table presents the details of the officials, staff with whom we have discussed about the design of treatment systems for Faecal Sludge and Septage Management (FSSM).

Table 4: List of Participants

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<thead>
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<tr>
<td>1</td>
<td>RCUES Lucknow</td>
<td>Dr. Rajeev Narayan</td>
<td><a href="mailto:narayanrajeev1963@gmail.com">narayanrajeev1963@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Alka Singh</td>
<td><a href="mailto:alka.rcuesiko@gmail.com">alka.rcuesiko@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr. Ajit Mishra</td>
<td><a href="mailto:ajit.rcuesiko@gmail.com">ajit.rcuesiko@gmail.com</a></td>
</tr>
<tr>
<td>2</td>
<td>UP Jal Nigam/Jal Sansthan</td>
<td>Mr Naushad Ahmed</td>
<td><a href="mailto:naushad.kaif7@gmail.com">naushad.kaif7@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr Sani Singh</td>
<td><a href="mailto:up30j9400@gmail.com">up30j9400@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr Ajmal Hussain</td>
<td><a href="mailto:azmalhussain2390@gmail.com">azmalhussain2390@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr Mohd Adeem</td>
<td><a href="mailto:adeem.jn@gmail.com">adeem.jn@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Jharkhand State Sewerage Department</td>
<td>Mr. Navneet Kumar</td>
<td><a href="mailto:navneetmswm@gmail.com">navneetmswm@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr. Brajesh Ranjan</td>
<td><a href="mailto:ranjan1001057@gmail.com">ranjan1001057@gmail.com</a></td>
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<tr>
<td></td>
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<tr>
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<td></td>
<td>Ms Pushpa Martin</td>
<td><a href="mailto:martin_pushpa@yahoo.com">martin_pushpa@yahoo.com</a></td>
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<td></td>
<td>KILA/ Suchitwa Mission</td>
<td>Er Resmi PS</td>
<td><a href="mailto:aeresmi@gmail.com">aeresmi@gmail.com</a></td>
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<tr>
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<td>ATI Mysore</td>
<td>Mr Chandra Naik O</td>
<td><a href="mailto:chandranayaksid@gmail.com">chandranayaksid@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
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<td><a href="mailto:aleclobo@gmail.com">aleclobo@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>ATI Nanital</td>
<td>Mr Manoj Pande</td>
<td><a href="mailto:manojpande64@gmail.com">manojpande64@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>UDD Uttarakhand</td>
<td>Mr Ankit Bhandari</td>
<td><a href="mailto:amrutuk.udd@gmail.com">amrutuk.udd@gmail.com</a></td>
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<tr>
<td></td>
<td>Uttarakhand Jal Nigam (Uttarakhand Peyjal Nigam)</td>
<td>Mr Madhukant Kautiyal</td>
<td><a href="mailto:eepeyjalnigam_ksp@yahoo.in">eepeyjalnigam_ksp@yahoo.in</a> <a href="mailto:eepiuamrutksp@gmail.com">eepiuamrutksp@gmail.com</a></td>
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<td>Uttarakhand Jal Santhran</td>
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<td></td>
<td>ATI Kolkata</td>
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<td></td>
<td>EY Odisha</td>
<td>Mr Shougat Sathapathy</td>
<td><a href="mailto:Shougat.Satpathy@in.eey.com">Shougat.Satpathy@in.eey.com</a></td>
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<td>OWSSB, Odisha</td>
<td>Mr Basanta Prased Dakua</td>
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<tr>
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<td>IPE Global</td>
<td>Mr Muqthar Ahmed</td>
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<td>Mr Ranjit Kumar</td>
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<td>58</td>
<td>IIHS</td>
<td>Mr Sivaraj</td>
<td><a href="mailto:sivarajcedebe@gmail.com">sivarajcedebe@gmail.com</a></td>
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<td>Mr Shrinivas Tarnalkar</td>
<td><a href="mailto:shrinivastvg@gmail.com">shrinivastvg@gmail.com</a></td>
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<td>Delhi Jal Board</td>
<td>Mr. Ashish Kumar Gupta</td>
<td><a href="mailto:ashishkr.gupta88@gov.in">ashishkr.gupta88@gov.in</a></td>
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<tr>
<td>66</td>
<td>Athena</td>
<td>Mr. Arjun Sharma</td>
<td><a href="mailto:arjun.sharma2011@vitalum.ac.in">arjun.sharma2011@vitalum.ac.in</a></td>
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<tr>
<td>67</td>
<td>Ecosan services</td>
<td>Mr Abhishek Sakpal</td>
<td><a href="mailto:abhishek.sakpal@ecosanservices.org">abhishek.sakpal@ecosanservices.org</a></td>
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<td><a href="mailto:radhika.boargaonkar@ecosanservices.org">radhika.boargaonkar@ecosanservices.org</a></td>
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<td>Mr Shantanu Padhi</td>
<td><a href="mailto:spadh@niua.org">spadh@niua.org</a></td>
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<td></td>
<td>Mr. B. Ashwin</td>
<td><a href="mailto:bashwin@niua.org">bashwin@niua.org</a></td>
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<td>71</td>
<td>Consultant</td>
<td>Mr Parth V Kamath</td>
<td><a href="mailto:parthvk@outlook.com">parthvk@outlook.com</a></td>
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## Annexure 3: Detailed Session wise Agenda

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<th>Date</th>
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<th>Contents</th>
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<td>17 June 2020</td>
<td>S1a</td>
<td>Introduction</td>
<td>Introduction to the training module&lt;br&gt;Getting acquainted with the training platform&lt;br&gt;Setting up the ground rules</td>
<td>Ms. Sreevidya Satish</td>
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<td>S1b</td>
<td>Introduction to Faecal Sludge and Septage Management</td>
<td>Sanitation System Approach&lt;br&gt;Wet Sanitation Systems&lt;br&gt;Sanitation Service Chain&lt;br&gt;Challenges in Sanitation Services</td>
<td>Mr. Dhawal Patil</td>
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<td>Characterisation of Faecal Sludge and Septage</td>
<td>Parameters for characterizing Categories of sludges&lt;br&gt;Operational factors affecting the characteristics</td>
<td>Mr. Dhawal Patil &amp; Mr. Saurabh Kale</td>
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<td>Question and answer</td>
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<td>Mr. Dhawal Patil &amp; Mr. Saurabh Kale</td>
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<td></td>
<td>Q1</td>
<td>Quiz (Multiple choice questions)</td>
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<td>Ms. Sreevidya Satish</td>
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<td>Introduction to the exercise</td>
<td>Profiling the region for FSSM,&lt;br&gt;Understanding the demographic and climatic conditions&lt;br&gt;Realizing the constraints for FSSM</td>
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<td>18 June 2020</td>
<td>S2</td>
<td>Quantification of Faecal Sludge and Septage</td>
<td>Need of quantification of sludge, Methods of quantification of sludge, Operational factors to be considered while quantification</td>
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<td>C2</td>
<td>Case study - Port Blair, Andaman and Nicobar Islands</td>
<td>Quantification Approach based on Sludge Collection Method.</td>
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<td>Quantification of faecal sludge and septage at the city scale</td>
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<td>Q3</td>
<td>Emptying and Conveyance of Faecal Sludge and Septage</td>
<td>Types of desludging methodologies, Technical options for emptying and conveyance, Optimising emptying and conveyance</td>
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<td>Case study - Wai &amp; Sinnar, Maharashtra</td>
<td>Planning of scheduled desludging, Number and types of vehicles used, Contracting and financing, Learnings and challenges.</td>
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<td>Treatment of Faecal Sludge and Septage</td>
<td>Treatment targets and specific objectives, Approaches for faecal sludge and septage management, Treatment mechanisms, Driving factors for selection of treatment mechanisms</td>
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<td>Case study - Co treatment of septage at STP</td>
<td>Mode of addition of faecal sludge &amp; septage, Standard operating procedure, Impacts of co treatment at STP, Financial aspects of co treatment</td>
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<td>Decision making criteria for components of treatment at the treatment plant. Do we need a digester or a stabilization tank?</td>
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<td>Septage Receiving Station</td>
<td>Objectives and Design of septage receiving station, Components of septage receiving station, Type of septage receiving station</td>
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<td>Informational videos</td>
<td>Septage receiving station, Integrated Mechanized Septage Receiving Station</td>
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<td>Non-mechanized Treatment Units of Faecal Sludge and Septage &amp; its Design</td>
<td>Stages of treatment of faecal sludge and septage Non mechanized treatment units Designing of - Settling Thickening Tank Anaerobic Digester Unplanted Drying Beds</td>
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<td>Case study - Septage Treatment Plant, Bhubaneshwar, Odisha</td>
<td>Selection of treatment technology, Scaling up of technology, Implementation, O&amp;M of the plant, Financial aspects</td>
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<td>Mechanized Treatment of Faecal Sludge and Septage</td>
<td>Stages of treatment of faecal sludge and septage Mechanized treatment units Selection of - Dewatering technology, Drying technology Thermal treatment</td>
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<td>Siting and Layout Planning of Treatment Plant</td>
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<td>Construction and commissioning of Treatment Plant</td>
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<td>Operation and Maintenance of Treatment Plant</td>
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