Workshop on Septage Treatment Technology

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Government of Maharashtra

pas performance assessment system

CEPT UNIVERSITY

ALL INDIA INSTITUTE OF LOCAL SELF-GOVERNMENT

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Workshop on Septage Treatment Technology: Overview

Overview

A convening of prominent stakeholders in the urban sanitation sector, with the objective of providing a platform for the exchange of ideas, information and lessons learnt from different sanitation technologies, with the aim of creating a body of shared knowledge that can be leveraged to accelerate further growth in the sector.

Link to video coverage of the sessions

Context:

- With the Government of India's Swachh Bharat Mission and AMRUT scheme gaining momentum and placing sanitation at the forefront of the nation's development agenda, the workshop on Septage Treatment Technologies was held at a critical moment in India's sanitation journey.
- Creating awareness on the links between sanitation and public health, eradicating Open Defecation (OD), and strengthening sewerage infrastructure have been high on the agenda for several years now.
- Stakeholders have been pushing for stronger policy, more robust investment and innovative, out-of-the-box, sustainable solutions that are low cost, eco-friendly and require low energy consumption.
- The workshop in October was designed to operate as a forum with representation from different nations and different stakeholder categories grappling with sanitation.

Highlights:

- Discussions on emerging trends in septage management, comparing conventional sewerage and septage management methods to more recent, experimental technological interventions.
- Cases studies from diverse geographies helped identify common themes and problems, while also acknowledging the need to customize solutions to suit immediate circumstances.
- Sessions examined different parts of the sanitation value chain, identifying weak links and cogitating on ways of strengthening them; different roles played by public and private entities.
- Several projects have tried to leverage the post-collection phase to generate valuable by-products such as compost, biogas.
- Policy recommendation, regulation, and capacity building were identified as keys aspects of successful Fecal Sludge Management (FSM).

Day 1

Setting the Stage: Need for Septage Management in India

Presenter: **Aasim Mansuri** (CEPT University, India)

Format: An introductory presentation that set the tone for ensuing sessions, providing a comprehensive overview of existing septage management modalities in India.

Link to the presentation

Highlights:

- A survey of existing sanitation systems in urban India, including: fully sewage systems or FSM, fully onsite sanitation systems, and mixed sanitation systems.
- Brief on the prevailing discourse surrounding FSM and on-site sanitation, with stress on effluent flow, sludge, septic tanks, soak pits, and crude septage disposal techniques still in use in India.
- Trends in septage management, comparing conventional sewerage and septage management methods against factors like water requirement, capital costs, O&M costs, implementing challenges etc.
- Difference between ODF, ODF+, ODF++, incentives provided for ODF cities.
- The Swachh Maharashtra Mission (SMM) launched by Government of Maharashtra (GOM) and its mission objectives; CEPT University has signed MoU with GOM for technical support for SMM in urban areas.

Key Insights:

- The need for proper use of funds to progress in the ODF>ODF+>ODF++ chain.
- The sanitation situation in Maharashtra, where only 33 cites have partial sewer networks, 20 cites have wastewater treatment facilities, and only 20% of treated wastewater is reused.
- The existing sanitation value chain – Pour Flush Toilets > Septic Tanks > Suction emptier trucks > No treatment > Disposal – and the need to include treatment, which will result in safe dumping and compost generation for agricultural use.
- It is important to choose appropriate septage treatment technologies in different settings, since there are vast variations in septage quality from city to city and from source to source.
- Question posed to audience: Should septage collected from community toilets (emptied once a week) be mixed with other septage (emptied once in 3-5 years)? Idea of demand v/s scheduled desludging ?

Session 1

Successful Implementation of Septage Treatment Options

a) Septage Management Case Studies in Philippines and Indonesia

Presenter: **David Robbins** (Ex-USAID)

Format: A knowledge-sharing session on the experience of septage management in Philippines and Indonesia.

Link to the presentation

Highlights:

- The key categories involved in the septage treatment process (Receiving station> preliminary treatment> solid-liquid separation > solid and liquid phase treatments, and discharge).
- The components of a scheduled desludging program – treatment and collection equipment, promotional campaigns, regulations, incentives and fees.
- The experience of septage management in different parts of Indonesia (refer to table).

San Fernando	Baliwag	Bay Laguna	Dumaguete
Managed by local governing unit, through contractors. Uses passive technology, i.e no electricity.	Managed by the water utility. Uses mechanized technology for treatment.	Run by the private sector, with LGUs passing local ordinance and fee schedules.	Jointly managed by water utility and city. Uses constructed wetlands.

Key Insights:

- In Indonesia, the absence of a fully-integrated service chain, regulations, monitoring and allocation of roles, resulted in poor investment for septic treatment plants, contamination of surface/ground water, and dumping in rivers by the private sector.
- Discussion on Desludging techniques used in densely populated Jakarta. Asked how septage is transferred from small to large vehicles in Jakarta, he explained that due to inaccessibility of septic tanks, motorcycle tankers were used to transfer septage, which is then emptied into large trucks.
- In Bangladesh, desludging is done in low-cost, scalable construction of vertical and horizontal flow wetlands.
- Discussions on treatment options like vertical and horizontal flow constructed wetlands, technologies available for solid and liquid separation and points to be considered during direct burial of septage

Note : Line diagrams of septage treatment technology discussed during this session is provided in Annexure

b) Malaysia's Sanitation and Sewerage Journey - Lessons Learnt

Presenter: **Dorai Narayana** (Indah Water, Malaysia)

Format: A knowledge-sharing session on Malaysia's journey in developing and managing sanitation and sewerage systems.

Link to the presentation

Highlights:

- Brief background on sanitation statistics in Malaysia, which is largely OD-free (urban areas use sewers, septic tanks, and pour flushes, while rural areas use pits with pour flushes).
- Changes were made to the governance structure for handling sanitation services in the year 1994, when it changed hands from local authorities to a private entity – Indah Water – through a concession agreement.
- Indah Water Private had to start from scratch, in the absence of a database, emptying schedules, tankers or treatment facilities.
- Privatization led to investment in refurbishment, upgrading, operations, septic tank services, sludge management, developer guidelines, awareness, training, capacity building, legal and institutional frameworks, catchment planning, land preservation.
- Key reasons for success were identified as policy, regulation, political push, guidelines, defined responsibilities, monitoring and enforcement, awareness and capacity building.

Key Insights:

- Information on the main fecal sludge treatment systems in Malaysia, which include trenching, drying beds, sludge lagoons, Geobag, semi-mechanized AVC, mechanical dewatering and centralized sludge treatment.
- Sludge disposal and reuse strategies for soil improvement, land reclamation, composting, construction material, fertilizers and landfills.
- The need to consider public health, dignity, environment, aesthetics, affordability, and the local situation while devising strategies for interventions
- Interventions should involve simple, reliable, energy-efficient solutions, and take an incremental approach to achieve gradual improvement.
- For trenching, sites should be selected where ground-water table is low so that no contamination takes place.

c) Fecal Sludge Management, Devanahalli, Karnataka, India - A case study

Presenter: **Rajesh Pai** (BORDA/CDD, Bangalore, India)

Format: A knowledge-sharing session on the experience of fecal sludge management in the small town of Devanahalli, in Karnataka, India.

Link to the presentation

Highlights:

- Analysis of the sanitation situation in Devanahalli, a 16-sq-km airport town, with attention to different segments of the sanitation value chain:

  User interface: Fully dependent on on-site sanitation, with 90% of its households connected to individual toilets and the rest dependent on community toilets, public toilets or resorting to OD.

  Collection: Marred by poor monitoring, irregular sludging intervals, inaccessible collection systems, poor soil condition, lack of awareness on design/construction standards for septic tanks.

  Transport: Services erratic and expensive, marred by poor maintenance, unskilled operators, lack of financial accountability or safety guidelines, complicated procedures.

  Treatment: Lack of facilities for treatment of fecal sludge, often directly dumped on fields, without monitoring, or consideration of health risks.

Key Insights:

- CDD's interventions, which included door-to-door and app-based surveys, resulted in sanitation safety planning, standardized containment systems, fecal sludge management and a fecal sludge treatment plant.
- Policy recommendations included toilet construction in OD areas, standardization of septic tanks and pits design, creation of a database of onsite systems, regular desludging guidelines, training of local masons, etc.
- Implementation involved regular data collection, engagement with locals, use of daily dashboards for monitoring, workshops for policy, legal/institutional frameworks.
- Details provided on the FSTP technology installed in Devanahalli, along with design considerations.
- Questions answered on how to approach municipal councils, business models used, sludge collection and emptying methods.

Note : Line diagrams of septage treatment technology discussed during this session is provided in Annexure

d) Overview of Septage Treatment Learning from Nepal, China and Bangladesh

Presenter: **Kalidas Neupane** (University of Science and Technology, Beijing University, China)

Format: A knowledge-sharing session on the experience of septage treatment in Nepal, China and Bangladesh, surveying and comparing septage management techniques and technologies used in the three Asian nations.

Link to the presentation

Highlights:

- Background on sanitation management practices and ODF status in Nepal
- Problems brought on in the sector by haphazard urbanization, massive population growth, poor waste management systems and FSM management practices.
- FSM management practices in Nepal, which include pit latrines, sewerage systems, night soil work, septic tanks, co-composting.
- A case study from Nepal, discussing challenges faced while converting household waste to energy through slurry chamber and reed bed treatment system. Benefits included GHG emission, reduced surface water pollution, production of biogas and organic manure.
- Fecal sludge treatment technologies in Beijing, elucidated through three case studies.

Key Insights:

- **Hegezhuang biogas plant**
  An agricultural model for fecal sludge treatment for hygiene and bio-slurry use). Technologies include preheated water tanks, digestate storage tank with stirrer, biogas generators, biogas heater in greenhouses.
- **CGEET**
  An EPC model for fecal sludge and kitchen waste treatment for composting, biogas and diesel generation. Techniques include pre-treatment of kitchen waste, pulping, sand removal, clean discarding of fecal sludge, solid liquid separation, anaerobic digestion, biogas torch, composting.
- **Canfit**
  An R&D model for fecal sludge and kitchen waste treatment for by-products such as biofuel, bio-char, compost. Interventions include five-ton kitchen waste trucks, post-treatment of waste water, odor control, laboratory for process control, workshop for experiments.

e) Improved Treatment, Disposal and Re-use of Fecal Sludge

Presenter : **Sahidul Islam** (SNV, Bangladesh)

Format: A knowledge-sharing session on the experience of fecal sludge management in three cities in Bangladesh – Khulna, Kushtia and Jhenidah

Link to the presentation

Highlights:

- Brief on existing sanitation frameworks in Bangladesh through a data-based analysis of sanitation coverage in the country. Types of toilets used in project areas included septic tanks, pit latrines, open pits, covered pit latrines, bucket latrines, etc.
- Brief on existing national policies in Bangladesh on FSM.
- Secondary information was collected by KUET, Bangladesh, and AIT, Thailand, when they were engaged for the design of a fecal treatment plant (FTP) for Khulna city corporation (KCC). It included demographic data, economic data, access to services, government plans and strategies.
- The three options compared for the FTP were a) constructed wetland CW+CW, b) drying bed + CW, c) anaerobic digester + drying bed. Of these three options, CW+CW (pre-treatment and post-treatment) was accepted by the KCC council for a short-term FTP.

Key Insights:

- Brief on the features of the FSTP constructed in the Jhenidah municipality in 2012, using the CW technology. Drawbacks of the project were discussed, such as under-utilization and lack of percolate treatment.
- Drying bed with coco-peat filter and compost plant was used for fecal sludge treatment technology at the Kushtia municipality.
- Brief on ongoing action research on the use of co-compost for agriculture in Jessore, and re-use of treated sludge in aquaculture at Kushtia.
- In response to their questions, members of the audience were told that fecal sludge can be calculated on the basis of population and survey. They also learnt about the process of technical analysis used to arrive at a technology suitable for the project. The presenter Mr Sahidul Islam explained that the parameters of Cost and O&M were given highest priority in the planning stages.

Note : Line diagrams of septage treatment technology discussed during this session is provided in Annexure

f) Fecal Sludge Treatment Plant in Faridpur, Bangladesh

Presenter : **Sumon Ali** (Practical Action, Bangladesh)

Format: A knowledge-sharing session on the experience of building a fecal sludge treatment plant in Faridpur, a city in Bangladesh.

Link to the presentation

Highlights:

- Overview of the sanitation situation in Faridpur, which has a population of 1,50,000, and an area of 17.38 sq km.
- Faridpur, which was fully dependent on on-site sanitation system (pits and septic tanks), had a moderate sludge collection and transportation system (using vacutug), but lacked treatment facilities, or fixed dumping sites.
- The plan was to install a PPP FS treatment plant just outside the city, which could serve the city in its entirety and also generate compost.
- Brief given on the basis for selection of technology for treatment of fecal sludge, the design criteria applied, the design of components (planted sludge drying bed and unplanted sludge drying beds, cesspool, maturation pond) and considerations made for the operations and maintenance of the plant. The treated sludge was reused for cultivation and horticulture.

Key Insights:

- Fielding queries from the audience, the presenter, Mr Ali, revealed that septage from community toilets and household toilets are mixed in Bangladesh.
- He also explained the difference between planted sludge drying beds and unplanted sludge drying beds, and clarified that a revenue-cum-management model was applied for the treatment plant.

Note : Line diagrams of septage treatment technology discussed during this session is provided in Annexures

g) ADB's work on Septage Management

Presenter: **Puskar Srivastava** (ADB, New Delhi, India)

Format: A knowledge-sharing session on ADB's work in the septage management sector.

Link to the presentation

Highlights:

- Overview of the initiatives undertaken by ADB in the sanitation sector; the Government of India requested ADB for technical assistance (TA) in the septage management sector.
- A fact-finding mission resulted in the subsequent draft of a plan to assist several urban local bodies (ULBs) establish an appropriate implementation scheme for septage management.
- The initiative entailed providing city sanitation plans, septage management plans, a design for pilot implementation, a manual of practice for septage management, etc.
- The plans culminated in a partnership program undertaken with the Japan Sanitation Consortium represented by the Japan Environmental Sanitation Centre.
- Four ULBs were selected in the states of Himachal Pradesh (Mandi and Parwanoo) and Mizoram (Aizawl and Lunglei). These ULBs were exposed to prevalent septage management technologies and best practices.

Key Insights:

- Septage treatment options included land treatment, sub-surface treatment, co-treatment with STPs, independent treatment facilities such as lagoon, composting, biological treatments, integrated systems, and waste to energy systems.
- Attendees took a keen interest in the discussion on Biodigester – a low-cost eco-friendly alternative to the septic tank.
- Biodigester was viewed as a suitable treatment option for Aizawl city, with around 285 units planned for its population of 24,000.
- The audience asked several questions about Johkasou, a Japanese treatment technology. Johkasou decomposes fecal matter using a high-grade bacteria, converting it to methane and water, based on anaerobic biodegradation of organic waste. It needs uninterrupted power supply, and involves high consultancy and capital cost.

- Photo Gallery – Session 1

Group Work

After the presentations made in session 1, a group work was organized where participants were asked to imagine themselves as a Chief officer of a city and they were asked to reflect on the following questions :

- **After critically assessing the features and challenges of the city related to topography, climate and considering the challenges and strengths, suggest appropriate fecal sludge treatment**

- Photo Gallery – Group work






Session 2

Potential and Emerging Septage Treatment Options (Presentations by Service Providers)

a) Systematic Commercialization of FSM using Technology and Science

Presenter : **Rajeev Kher** (Sara Plast Private Limited, Pune, India)

Format: A knowledge-sharing session on the contributions made by Sara Plast Pvt Ltd in the sphere of fecal sludge management.

Link to the presentation

Highlights:

- Brief on recent work done by Sara Plast in the sanitation sector.
- A detailed description of a septic tank and guidelines on how it should be cleaned.
- Discussion on different aspects of sludge management, including RFID tags, use of additives, use of applications to bring together septic tank cleaners under an FSM program, and post-collection systems.
- Analysis of the post-collection phase, in which waste is treated in sludge drying beds or in waste treatment facilities, with the latter generating sellable treated water and biogas when fitted with modern technology.

Key Insights:

- The DEWATS concept generated considerable interest. It allows for reuse of treated water.
- Many advantages, including the regulation of FSM, uniform pricing and safe disposal of septic waste, back-end vigilance, incentives for disposal, GPS-enabled vehicles.
- The facilitator, Mr Kher, also provided a brief on the work done in the area of drafting policy and setting standards: Sara Plast recently presented the Rural Development Ministry with a draft sanitation policy – with complete reports on sanitation, application, costs, and best practices.

b) DRDO Bio-digester Toilets

Presenter : **Nishikant Rai** (BSA Group, Pune, India)

Format: A knowledge-sharing session on the Bio-Digester technology.

Link to the presentation

Highlights:

- Bio-Digester is a low-energy, low-cost, eco-friendly alternative to conventional septic tanks, which meets CPCB standards and can be used for sewage treatment under diverse geo-climactic conditions.
- The Bio-Digester system comprises master bio-tanks, which are fed with fecal matter and bacterial inoculum for sewage treatment, to produce usable water and gas, through the anaerobic process.
- A flow-chart was used to explain the anaerobic biodegradation process involved in the Bio-digester technology.
- Bio-digester can be used to replace STPs and reduce their load by 70%.
- The benefits of Bio-digester as the most efficient and economic sewerage system, which can produce 90% of reusable water, reduce water consumption by 50%, requires minimal maintenance, has a long lifespan of 40 years, and produces byproducts such as Methane.

Key Insights:

- The presenter, Mr Rai, fielded several questions from participants. He was asked about the conversion of existing old tanks into bio-tanks (surveys should be conducted to find these tanks and the tank should be cleaned before retrofitting); how the system deals with solid waste (no solid-liquid separation required), cost implications for installation and whether sludge and slurry is formed in the system.
- Participants were told that that bacteria breaks down the larger molecules of waste matter, preventing the formation of slurry. The bacteria in the tank are immobilized.

c) Community Scale Fecal Sludge and Septage Processor in an Urban Indian Environment

Presenter: **Arun Kumar** (Tide Technocrats, Bangalore, India)

Format: A knowledge-sharing session on the work done by Tide Technocrats in the areas of solid waste management, sanitation and renewable energy.

Link to the presentation

Highlights:

- The four components of the chemical energy processor used for septage treatment: a **dewatering unit** (integrated with pathogen kill), a **sludge drier**, a **charring unit** for dried sludge, and an **exhaust treatment** system to produce biochar.
- All four components are integrated into a single container (packaged system).
- Raw septage is dewatered and reduced till it has 75% moisture content. This is passed through a sludge drier. The dried sludge is fed into the a charring unit and converted to biochar. The flue is treated through a catalyst and a heat recovery unit, while the hot water is passed through a belt drier, treated in a carbon filter, and then discharged.
- The reject water, devoid of any pathogens, is suitable for use in nurseries and farms. The proposed project locations for this technology include Wai in Maharashtra, Nelamangala in Karnataka, and TBD in Tamil Nadu.

Key Insights:

- Participants had several questions about on the technology. Asked about O&M cost, Mr Kumar, the facilitator, explained that it is expected to be low.
- At present, the technology is only equipped to treat septage with 4% solids.
- Operations can be remotely managed, through an operator.
- Unwanted solids are eliminated by being burnt.

d) Emerging Technologies: RTI Water Closet

Presenter: Myles Elledge (RTI International, USA)

Format: A knowledge-sharing session on the RTI water closet, an 'off-grid' treatment technology devised by RTI International.

Link to the presentation

Highlights:

- Details of an experimental technology that was developed under the 'Reinvent the Toilet' Challenge, funded by the Bill & Melinda Gates Foundation.
- The aspirational waste treatment and toilet system does not require an external source of electricity, water or sewer, treats all pathogens on-site, and is low-cost.
- An RTI toilet was installed at CEPT University, Ahmedabad, for field testing, to understand how the system operates in realistic conditions.
- The different public places where the technology can be used include schools, bus stops, and construction sites.

Key Insights:

- There were questions on how the technology needs to be customized in schools and other public places, where solid percentage in septage would be low. The solids being considered are menstrual hygiene and food waste.
- Asked about O&M, Myles Elledge, the presenter, explained that it is fairly easy, and a single person can be hired for the task and trained.
- The treated water is odor-free and safe for hand-washing, but is being used only for flushing purposes, to avoid user discomfort. The water is slightly discolored and has a pungent odor similar to chlorine.

e) ESBR Technology

Presenter: **Ravindra Vichare** (Addvantage, Pune, India)

Format: A knowledge-sharing session on the EcoTec SBR Technology, devised by Addvantage.

Link to the presentation

Highlights:

- ESBR produces high-quality treated water, is equipped to meet the CPCB norms in future, can operate with low loads, is low-maintenance and low-energy.
- It is 20% costlier than traditional solutions.
- The technology works on the sequence batch reactor technology, which does not involve electrical parts, mechanical parts or pumps in wastewater.
- It works in four phases: the loading phase, the aeration phase, the rest phase and the clearwater phase.
- The ESBR airlift technology allows for low power consumption and ongoing costs, needs less mechanical parts, and can be installed simply and quickly.

Key Insights:

- The technology does not require pumps, chemicals, or operators and has a low-load operating capability. In fact, it can be can be designed for even six-seven people.
- The design has been kept modular at present, but has scope for future expansion. The technology has another advantage in that it requires very little space.
- The treatment process culminates in extraction of clearwater, which can be applied in farms.

- Photo Gallery – Session 2

Day 2

Session 3

AIT Toolbox on Technology Options

Presenter: **Nitasha Arora** (AIT, Thailand)

Format: A knowledge-sharing session on the FSM toolbox and its technology assessment tool.

Link to the presentation

Highlights:

- A toolbox that provides decision-making support to donors, city planners and consultants who are planning FSM interventions.
- An overview of the toolbox, which helps benefactors support communities by considering local needs and problems to arrive at customized solutions.
- The toolkit provides FSM-specific expertise ranging from policies to treatment to disposal and is aimed at increasing and improving the capability of key players to work towards sustainable FSM.
- The toolbox contains sheets on FS volume, number of trucks, Treatment Technology, Cost & Financing, Debt, Revenue, and CS BS & IS.
- The flow of selection for treatment technologies in the tool: primary treatment options, dewatering options, pre-effluent treatment options, post-effluent treatment options and sludge treatment options.

Key Insights:

- FS volume can be calculated on the basis of septic tank volume or by FS generation for households & commercial establishments; growth rates need to be factored in to get projections for 10 years.
- The required number of trucks can be computed based on vacuum truck characteristics and volume of FS emptied per day.
- Specifications related to each technology were examined against factors such as costs, removal efficiency, land required, reuse, advantages and disadvantages.
- The technology assessment tool allows the user to select options based on site conditions, view the possible options provided on the screen, and then choose a combination of technologies from a dashboard that displays selected technologies and their capital costs, O&M costs and land requirements.

Note : Line diagrams of septage treatment technology discussed during this session is provided in Annexure

Session 4

NFSSM partners and others on their work in Sanitation and Septage Management

a) Septage and Fecal Sludge Management: Work Carried out at IIT Madras

Presenter: **Dr. Ligy Philip** (IIT, Madras, India)

Format: A knowledge-sharing session on the work done by IIT Madras in septage and fecal sludge management.

Link to the presentation

Highlights:

- The institution's experience of working in the sanitation sector, and some of its most significant findings.
- Discussion on composting as a sustainable solution and details of the composting methodology.
- Results of the institution's analysis of septage samples from Chennai, solid liquid separation in septage, and sustainable septage dewatering options (for eg, solar drying).
- Methods employed for quality evaluation of in-vessel co-composting methods of septage technology, and analysis of the test results on parameters such as temperature profile, compost dynamics, pathogen reduction, greenhouse gas emission, compost maturity and seed germination test.
- The analysis revealed that retention at temperatures greater than 55°C for more than five days ensures 3 log pathogen reduction, and that the active system is superior to the passive system.

Key Insights:

- Findings of IIT Madras' experiments with various septage treatment technologies – including reed drying beds, sand drying beds – through pilot plants in the IIT campus.
- Results from the evaluation of the DRDO bio-digester treatment system, on system performance, usability and acceptability along with quality tests analysis.
- Fifteen bio-digester DRDO toilets were observed under various conditions (Control, increasing inoculation, adding chemicals like phenyls, bleach).
- Details on the design and development of a solar thermal energy system for domestic sewage treatment, on a pilot scale.

b) Solar Septic Tank Developed by AIT

Presenter: **Isha Basyal** (AIT, Thailand)

Format: A knowledge-sharing session on the solar septic tank developed at AIT.

Link to the presentation

Highlights:

- A close look at the solar septic tank, an innovative on-site wastewater treatment technology that uses free energy from the sun to attain the high temperatures necessary for pathogen deactivation.
- The components of the system, including the septic tank, the disinfection chamber and heat transfer equipment.
- The concept design for the solar septic tank, and different aspects of its system performance.
- Comparative analysis of a conventional septic tank with a solar septic tank.
- Helpful statistical data (Sludge accumulation reduction of 50%, treatment performance COD - 88%, BOD - 81% and TS -50%).

Key Insights:

- Cost implications ($2,580), desludging period (5-6 years) and potential customer-base (real estate developers, middle-class households).
- A unit of the solar septic tank can serve more than 10 users per day, making it appropriate for an individual house, public toilet, condominium, or apartment.
- In the absence of solar energy, electricity can be used.

c) FSSM - Action Research towards Developing Low Cost Products

Presenter: **Arumugam Kalimuthu** (WASH Institute, Delhi, India)

Format: A knowledge-sharing session on ongoing research at the WASH Institute on a number of sanitation solutions.

Link to the presentation

Highlights:

- Aspects of three different solution projects in the works at the WASH Institute. They are as follows:

  Modular Toilet: A pre-fabricated toilet.

  Life stretcher/pit life extender (Septguard): A membrane-based system is fitted in the septic tank, and the extracted water is treated. Efforts are on to make this solution commercially viable by lowering the cost.

  Mobile fecal sludge treatment unit: The solid and liquid parts get separated and the liquid is treated by passing it through a membrane system. The apparatus is being tested by DUKE University, and efforts are on to lower its price.

Key Insights:

- Attendees asked questions about the technology used in the mobile FSM treatment unit, which involves a separation, a centrifuge, and fabric filters.
- Cost and life of the membrane is still in the testing stages.

d) Fecal Sludge Management Scenario in Odisha

Presenter : **Pragyan P Nayak (**Practical Action, Odisha, India)

Format: A knowledge-sharing session to discuss lessons learnt from Project Nirmal, spearheaded by Practical Action and funded partially by the Gates Foundation, for the delivery of sustainable sanitation solutions in two towns in Odisha.

Link to the Presentation

Highlights:

- Overview of sanitation situation in India – where 626 million practice OD – with problems such as overflowing sewers, open washing spaces, unhygienic toilets, and polluted open water sources.
- Data-based review of sanitation status in Odisha, where 35% of the population does not have access to individual household toilets and 98% of septage and wastewater is not disposed safely.
- The lack of a regular FSM, and dumping of untreated FS in the open are two of the primary problems.
- Project Nirmal, funded by the Gates Foundation and Arghyam Trust, was aimed at improving existing sanitation infrastructure in the towns of Angul and Dhenkanal.
- Objectives included: demonstration of sustainable sanitation service delivery in small towns, providing better access to sanitation services, building capacity of states and improving planning approaches.

Key Insights:

- The presenter, Ms Nayak, used precise calculations to illustrate how discharging a single cesspool's worth of fecal sludge from each of the 110 ULBs in Odisha indirectly promoted 5,50,000 urban citizens defecating in the open each day.
- Institutional arrangements required at different levels for the project: stakeholders such as the local NGOs, donors, municipal and government bodies were roped in.
- Detailed account of the project's progress, right from city selection, through requests from ULBs and MoUs to GIS mapping and capacity building.
- Challenges were faced owing to the absence of best practices, models, regulations, or administrative/infrastructural support, other political and socio-cultural issues faced.
- Plans afoot to enlist the government's support in mobilizing civil society and the private sector to accelerate progress.

e) Swachh Varanasi

Presenter: **Sarith Sasidharan** (EY, Delhi, India)

Format: A session on EY's sanitation facilities plan and implementation support for the city of Varanasi.

Link to the Presentation

Highlights:

- An overview of the demographics and sanitation standards of Varanasi, one of the oldest living cities in the world, an urban agglomerate spread over 112 sq km – with a sewer network coverage of only 32%.
- The key objectives of the project: prepare and implement plans to address challenges relating to OD and inadequate sewage treatment in the city, leverage technologies to create replicable models, promote the use of toilet facilities.
- A discussion on primary pain points (lack of toilets, behavior patterns, poor O&M), project outputs (toolkits and collaterals, incubation programs), project outcomes (reduction in OD, rise in demand for safe sanitation, reliable technology).
- The impact of the project, which include improvement in health, reduction in child mortality, alternative non-network sewage treatment systems, creation of a private sector ecosystem in sanitation.

Key Insights:

- The key interventions for the project included decentralized waste water treatment through an aerobic biodigester, and other solutions such as Enviro Loo, DEWATS, Soil Biotech.
- Other significant interventions included a localized IEC program for demand generation, new toilet features (gender and age sensitivity, natural light entry, pad incinerators) and operation models.
- EY's attempts to create an enabling environment for entrepreneurship in sanitation through a social entrepreneur incubation training program.
- The highlights of a Behavior Change communication program, which uses facilitator training, formation of sanitation champion groups, exposure visits to effect behavior change in sanitation patterns.

f) Capacitating Urban Local Bodies and Other Stakeholders in the Ganga Basin on On-site Wastewater and Septage Management Systems

Presenter: **Ramesh Nair** (CSE, Delhi, India)

Format: A knowledge-sharing session on CSE's project, which aims to build capacity for sanitation management in several ULBs, in the states of Bihar, Uttar Pradesh and West Bengal.

Link to the Presentation

Highlights:

- The project, helmed by the National Mission for Clean Ganga, will focus on 12 cities in 3 states in the Gangetic basin, and help their respective ULBs draw up City Sanitation Plans in keeping with the National Urban Sanitation Policy.
- Approaches planned by CSE to capacitate urban local bodies and other stakeholders for on-site wastewater and septage management systems.
- CSE to provide research-based solutions on available technologies for better septage management; offer knowledge support on demonstration projects; help develop protocols.
- Final objective is to capacitate small and medium towns in the Gangetic basin, which might otherwise remain outside the purview of the AMRUT mission.

Key Insights:

- One of the project objectives was the setting up of a state-of-art, independent laboratory that would develop testing protocols and validation systems for wastewater and fecal sludge treatment.
- This prompted several questions, with several participants wanting to know why CSE was not capacitating existing accredited private labs, but creating a new lab at a staggering cost of Rs 4-5 crore to the exchequer.
- Mr Nair responded that the lab will not just be used for fecal sludge testing, but serve a slew of other research requirements for the Ganga Monitoring Plan, regularly monitoring key pollution parameters from targeted sites in the Ganga basin, and subsequently helping build capacities for a wide range of stakeholders.

g) Tamil Nadu Urban Sanitation Support Program

Presenter: **Anantha Moorthy** (IIHS, Chennai, India)

Format: A knowledge-sharing session to discuss a massive project helmed by BMGF in collaboration with the Tamil Nadu state government and four partners, to improve sanitation infrastructure in the districts of Coimbatore and Trichy.

Link to the Presentation

Highlights:

- Details of the work done by IIHS on a support program designed for urban sanitation in Coimbatore and Trichy, districts in the state of Tamil Nadu.
- The project was funded by the Bill and Melinda Gates Foundation in collaboration with the Tamil Nadu government. Along with IIHS, the project partners were Gramalaya, the Keystone Foundation and CDD.
- The objectives of the project were to achieve 100% OD-free status for the two districts, construct sanitary toilets and safe containment systems, create infrastructure for safe collection, conveyance, treatment, disposal and reuse of waste, provide sanitary facilities, and establish a strong fecal sludge value chain.
- Challenges faced over ill-maintained public sanitary conveniences and poorly-managed collection and transportation mechanisms for fecal waste.

Key Insights:

- Plans for Fecal Sludge Treatment Plant to be built.
- Project outcomes include a baseline survey, sampling and analysis exercises, community interaction and awareness campaigns.
- Planned interventions include preparing a City Sanitation Plan, program for sanitation in schools, FSTP awareness campaigns for ULBs, training women from self-help groups on toilet management, building capacity for masons.
- Asked about the specific interventions implemented to achieve OD-free status at the two districts, Mr Moorthy explained that the initial focus of the project was on the provision of toilets – especially community toilets – to cater to the sanitation needs of the floating population.
- Mr Moorthy also explained the role played by IIHS in supporting the government's interventions for on-site FSM in Trichy and Coimbatore.

h) Septage Management Training of ULBs undertaken by MEETRA

Presenter: **Prashant Kulkarni** (MEETRA, Nashik, India)

Format: A knowledge-sharing session on MEETRA's experience of imparting septage management training in ULBs in Maharashtra.

Highlights:

- MEETRA is the state-level training center for capacity building, in the Government of Maharashtra's water supply and sanitation sector.
- The presentation summarized key takeaways from a workshop conducted by MEETRA in collaboration with CEPT University and AIILSG.

Key Insights:

- The training was imparted to 320 SIs on solid waste management, but also included knowledge dissemination on septage management.
- MEETRA is now planning more interventions for enhancing capacity in this sector, in collaboration with technology providers.

i) Situation Specific Planning of Sanitation System for Septage Management

Presenter: **Ankita Rathor** (IIT, Mumbai, India)

Format: A knowledge-sharing session on IIT Mumbai's collaboration with the Centre for Technology Alternatives for Rural Areas (CTARA) for research on innovative technological solutions for sanitation management.

Link to the Presentation

Highlights:

- The Centre for Technology Alternatives for Rural Areas (CTARA) enlists the support of engineers for multi-disciplinary, multi-dimensional and grounded policy studies on useful technologies in development sectors such as water, sanitation, energy.
- CTARA collaborates with various public and private bodies and evaluates technology, based on multi-criteria decision-making tools.
- Analysis of the key components of a sanitation system value chain, including user interface, collection and storage, conveyance, treatment, reuse and disposal.
- The need for situational analysis, before selecting a particular sanitation technology. This takes into account the availability of water and space, sanitation habits of users, soil and groundwater characteristics, storage and conveyance technologies in place.

Key Insights:

- Attendees took keen interest in the institute's ongoing research on SANIZONES, a technology that uses an algorithm to create 'sanitation zones' for decision-making on choice of technology.
- The institute's ongoing research on septic tank redesign is aimed at discouraging human scavenging, enhancing solid liquid separation; also in the works is a monitoring system for regular cleaning of septic tanks.
- Asked for tips for superior design of septic tanks, the facilitator recommending a circular structure, for easy implementation and minimal leakage.

j) Sanitation Activities by CDD

Presenter: Amresh Sinha (CDD, Bangalore)

Format: A knowledge-sharing session on the different kinds of interventions designed by CDD for sanitation management.

Summary:

- A detailed discussion on the Fecal Sludge treatment plant in Devanahalli, an airport town near Bangalore, the capital of the Indian state of Karnataka.

Key Insights

- CDD has prepared a dashboard which is used to track every component of all the treatment modules.
- CDD is also working on the design for a new FSTP, helping draft policy and testing the policies on ground.
- CDD has also been conducting studies to compare on-demand FS emptying systems with scheduled FS emptying systems.
- Also in the works is a training program for FSTP technology and FSM policy.
- The facilitator shed light on the desludging operator association.

k) Support to Government of Maharashtra in Implementing Swachh Maharashtra Mission

Presenter: **Utkarsha Kavadi** (AIILSG, Mumbai)

Format: A session explaining the objectives of the Government of Maharashtra's Swachh Maharashtra Mission (SMM), measures taken to achieve the objectives, and the progress made so far in the mission.

Link to the Presentation

Highlights:

- Statistics on the sanitation situation in Maharashtra; notably, 29% urban households do not have latrine facilities within their residential premises of which 22% households depend on public toilets, and 8% households resort to OD.
- The mission aims to make cities in the state sustainably ODF, and transform ODF cities into ODF+ and ODF++ cities.
- Regional workshops were conducted under the chief minister's leadership, to provide necessary impetus to the mission. CEPT is providing technical support for the mission's implementation in urban areas.
- State accelerating the mission through financial, administrative and legislative means and other efforts undertaken at the ULB level.
- Various methods adopted to sustain OD-status in cities – training for local contractors, toilet fairs, conversion of OD spots into recreational spaces, theme-based workshops, review meetings with ULBs, field visits.

Key Insights

- A planned incentive scheme is introduced, which will push for ODF++ status in cities through a unique 'carrot and stick' method; for instance
- Under planned scheme, it will be imperative for all elected members of the state legislature to have toilets; subsidies will be given for construction of toilets, and NoCs will be waived for toilets built on government land.
- There will also be a disincentive scheme, with ULBs that fail to maintain their ODF status losing their grants.
- Other unique approaches to eliminate OD include mock-felicitations of people caught defecating in the open, 'good morning squads' with children, and gift payments for those who expose people defecating in the open.
- ODF handbooks and septage management guidelines have also been published. As a result of these efforts, 100 cities were declared ODF.

I) Sanitation Work Under PAS Project

Presenter: **Dhruv Bhavsar** (CEPT University, India)

Format: A knowledge-sharing session on the development of the Performance Assessment System (PAS) in a massive project launched in 2009 to monitor the progress of sanitation management initiatives in several Indian states.

Link to the Presentation

Highlights:

- A major action research project was funded by a grant from the Bill and Melinda Gates Foundation for UWSS assessment and improvement through a Performance Assessment System (PAS) in Maharashtra and Gujarat.
- The project, which was launched in 2009, was subsequently extended to Chhattisgarh, Telengana, Assam, Jharkhand.
- The three main components of the project include performance assessment using key indicators, performance monitoring of state and local bodies and civil society, and performance improvement through various tools and innovative financing.
- The project resulted in a national database for 1,800 cities and 18 states, created over three years.
- CEPT is supporting state government of Maharashtra for implementing “Swachh Maharashtra mission” and supporting two small-medium towns to develop and implement plans to become open defecation free and implement septage management plan.

Key Insights:

- CEPT is also developing a CSR strategy for the state and following up with corporates for sanitation CSR in the state.
- Asked for details of this initiative, Mr Bhavsar admitted that the work is in its nascent stages, with corporates being contacted directly or through the mediation of the state government.
- Sanitation planning and monitoring tools have been devised:
  - **SAN benchmarks** provide a framework for performance assessment of city-wide sanitation
  - A **dashboard** was devised by CEPT to monitor progress made in the Swachh Maharashtra Mission.
  - **SaniPlan,** which takes a service-based approach to sanitation management tools and focusses on developing integrated sectoral solutions
  - **SaniTab**, a generic mobile application that ULBs can use to create a databases for onsite sanitation systems.
  - **IFSM toolkit** was developed for citywide assessment of various key areas that need to be studied for developing IFSM plan

- Photo Gallery – Session 3 & 4

- Photo Gallery – Session 3 & 4

Closing Session

The workshop came to a close with a group activity, in which participants were asked to reflect on the following questions:

- **WHAT DID YOU LEARN FROM EACH OTHER?**
- **HOW WOULD YOU LIKE TO WORK WITH SOMEBODY/ORGANISATIONS IN THIS ROOM?**
- **HOW WILL YOU GO ABOUT IT?**

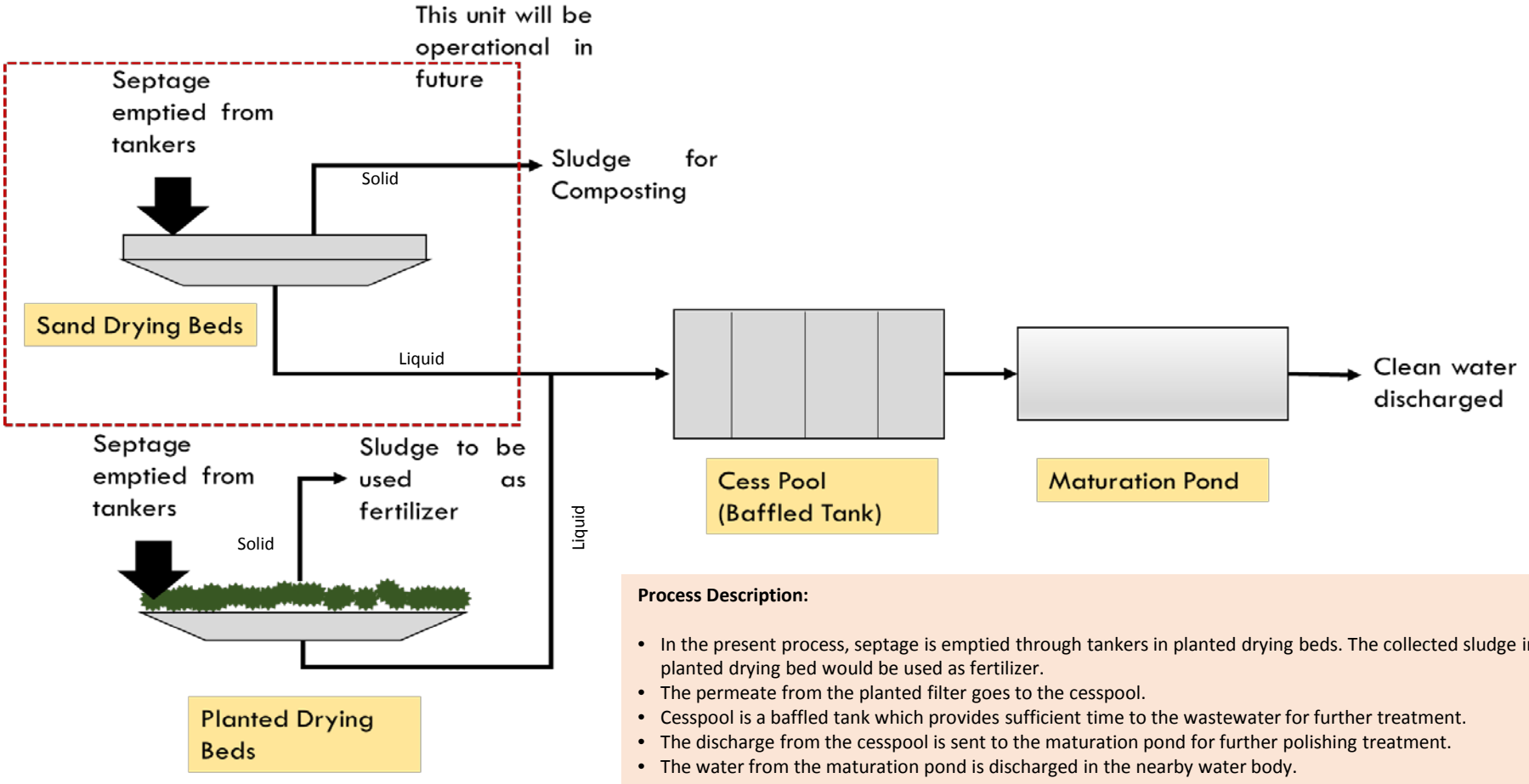
Professor Meera Mehta addressed the audience, expressing satisfaction over the fact that the workshop had gone beyond its objective of surveying sanitation technologies. She said, “More than technology, the links formed in this workshop are important. The learning from this is that we need to start small, and only then look to be the best. We need to balance both. We need to keep learning and interacting.”






Annexure -
Line diagrams of various septage treatment options

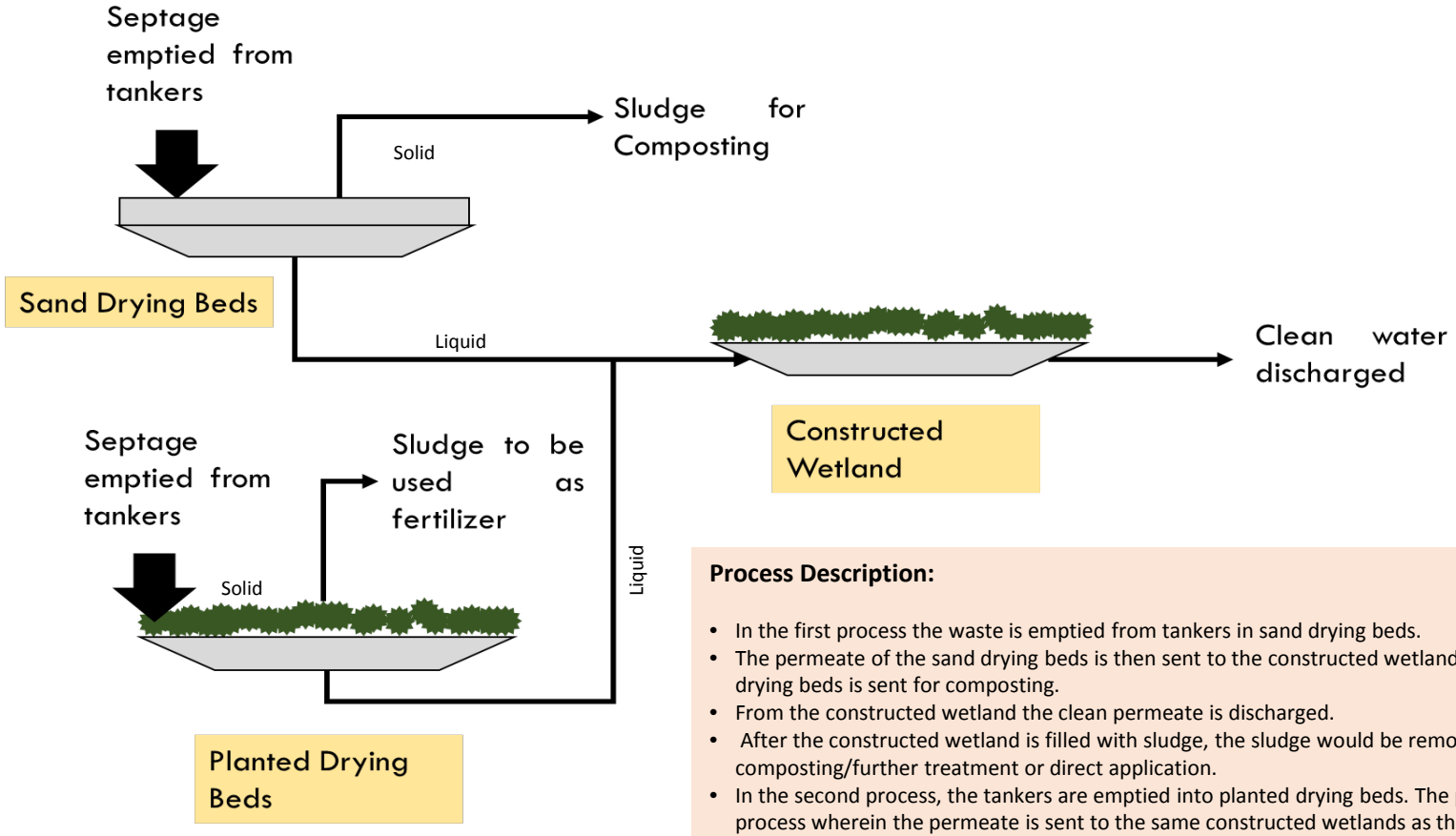
Faridpur, Bangladesh



Process Description:

- In the present process, septage is emptied through tankers in planted drying beds. The collected sludge in the planted drying bed would be used as fertilizer.
- The permeate from the planted filter goes to the cesspool.
- Cesspool is a baffled tank which provides sufficient time to the wastewater for further treatment.
- The discharge from the cesspool is sent to the maturation pond for further polishing treatment.
- The water from the maturation pond is discharged in the nearby water body.

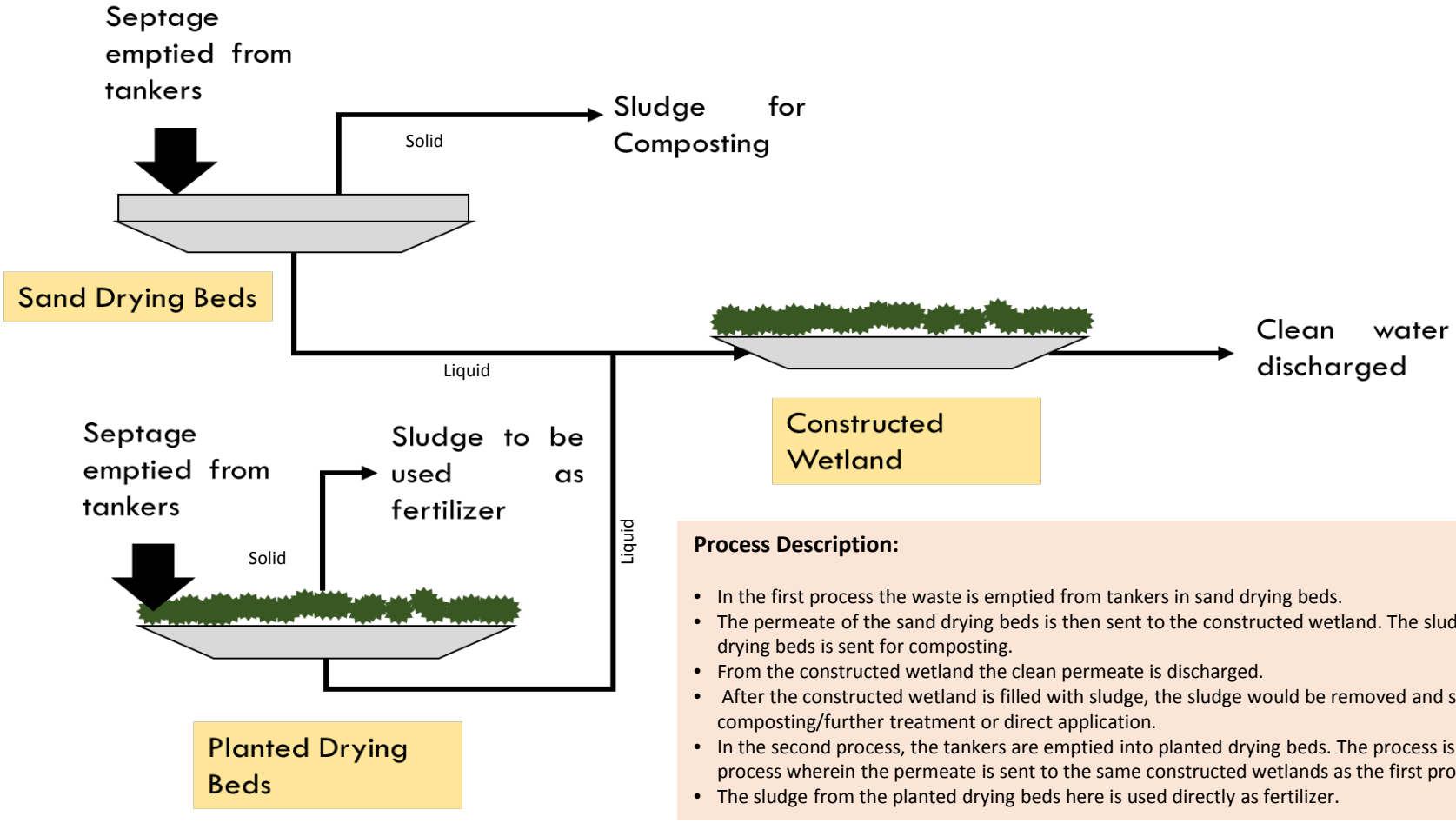
Jhenaidah, Bangladesh



Process Description:

- In the first process the waste is emptied from tankers in sand drying beds.
- The permeate of the sand drying beds is then sent to the constructed wetland. The sludge from the sand drying beds is sent for composting.
- From the constructed wetland the clean permeate is discharged.
- After the constructed wetland is filled with sludge, the sludge would be removed and sent for composting/further treatment or direct application.
- In the second process, the tankers are emptied into planted drying beds. The process is similar to the first process wherein the permeate is sent to the same constructed wetlands as the first process.
- The sludge from the planted drying beds here is used directly as fertilizer.

Khulna, Bangladesh



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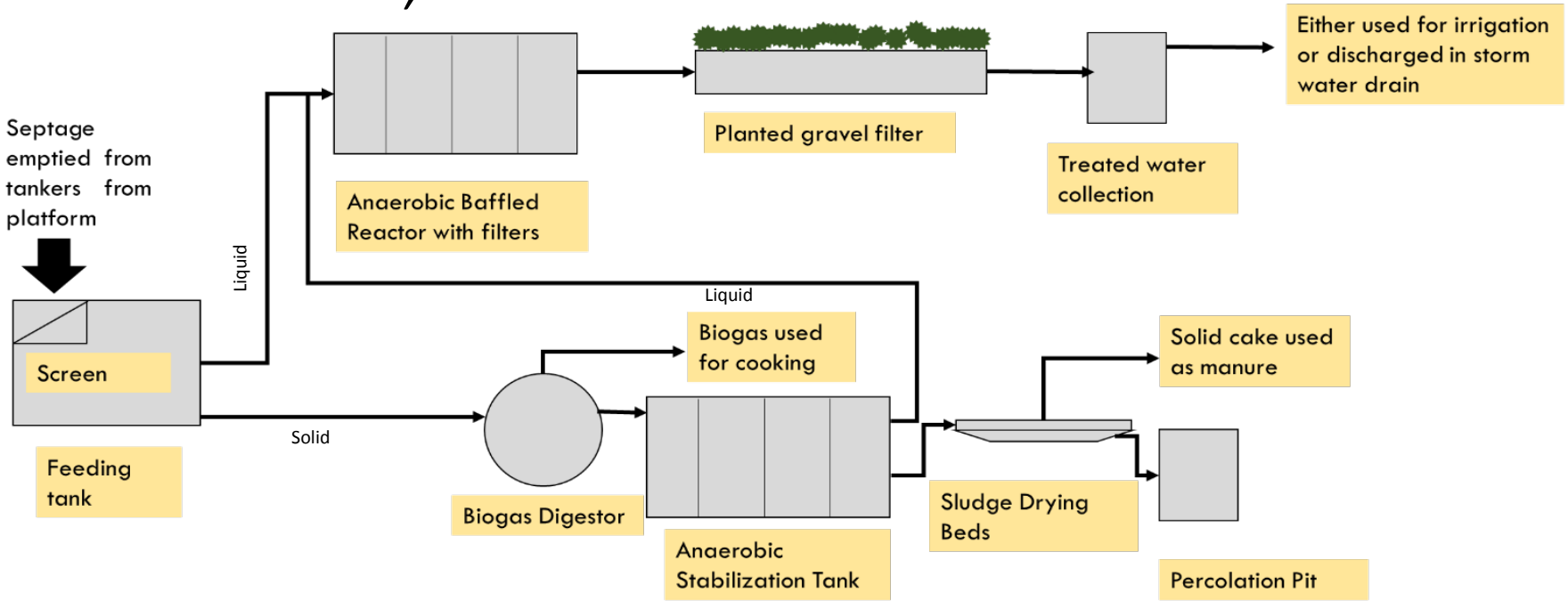
Devanahalli, Karnataka



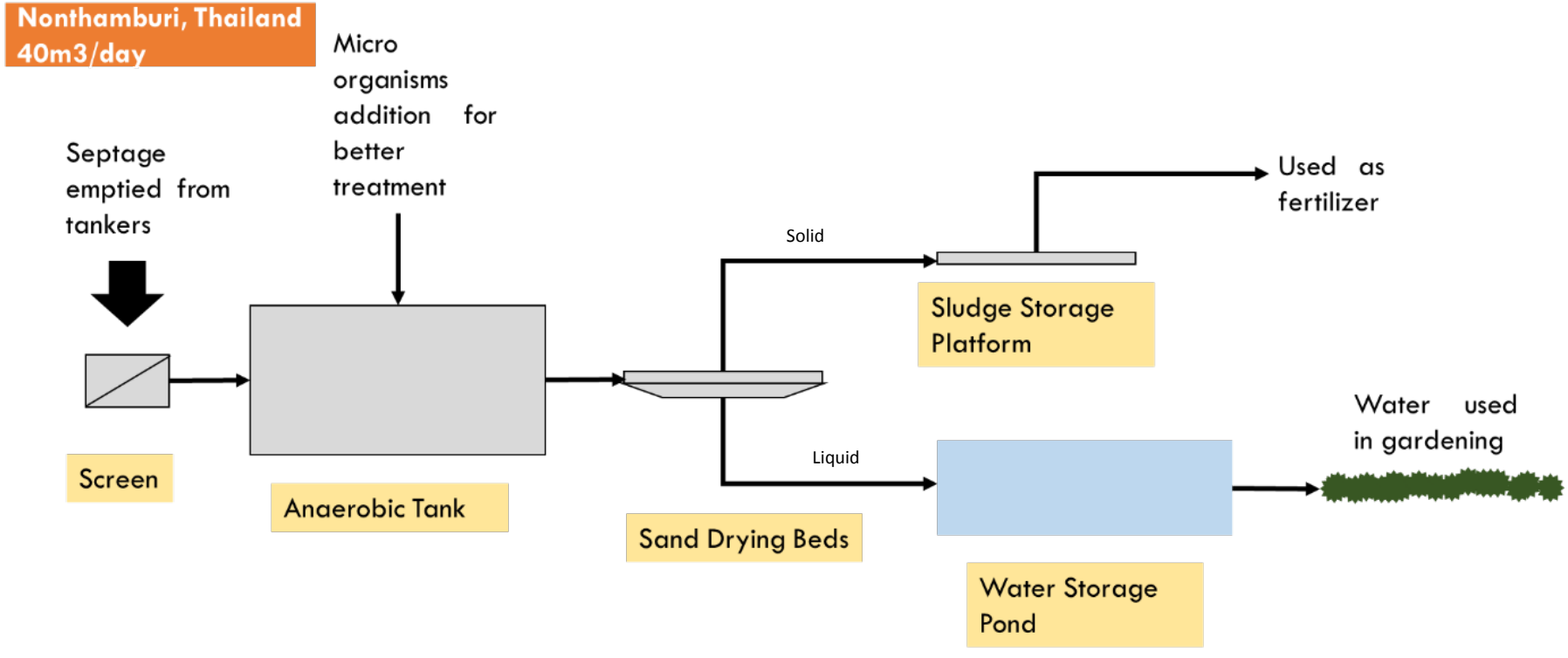
Process Description:

Trucks discharge into the feed tank. The screenings are stored in a plastic container and disposed with municipal solid waste once the container is full. The faecal sludge is stored in the feeding tank for 3-4 hours which causes separation of liquid and solid layers.

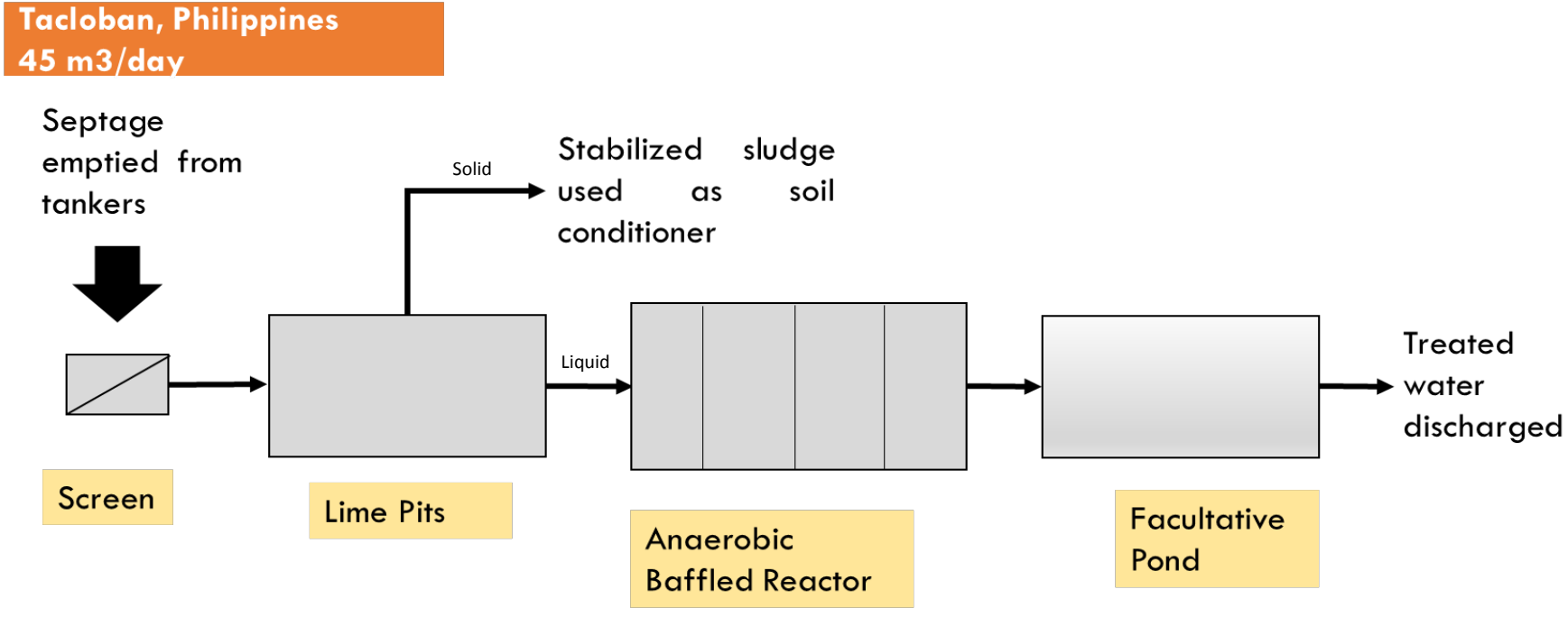
The liquid part of the faecal sludge is discharged first into the anaerobic baffled reactor. The treated liquid from the anaerobic baffled reactor is then polished through the planted gravel filter and stored in collection tank. The water from the collection tank is used for gardening, or discharged in storm water drains.

The solids from the feed tank are discharged in biogas digester. The digested solids are sent to the stabilization tank. The stabilized solids are then sent to the sludge drying beds.

Nanthamburi, Thailand



Tacloban, Phillipines



Dumaguete, Phillipines

Dumaguete, Philippines
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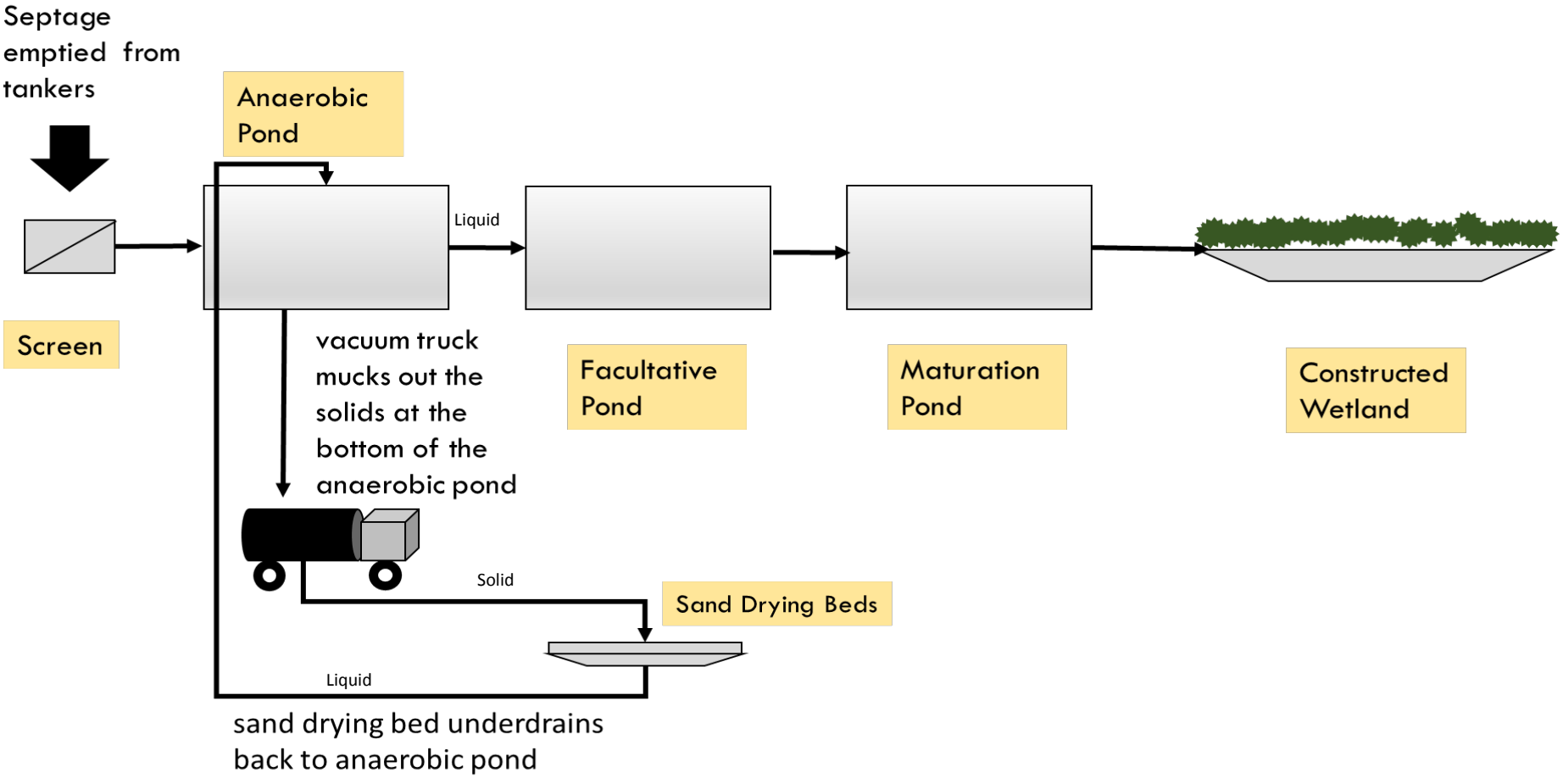
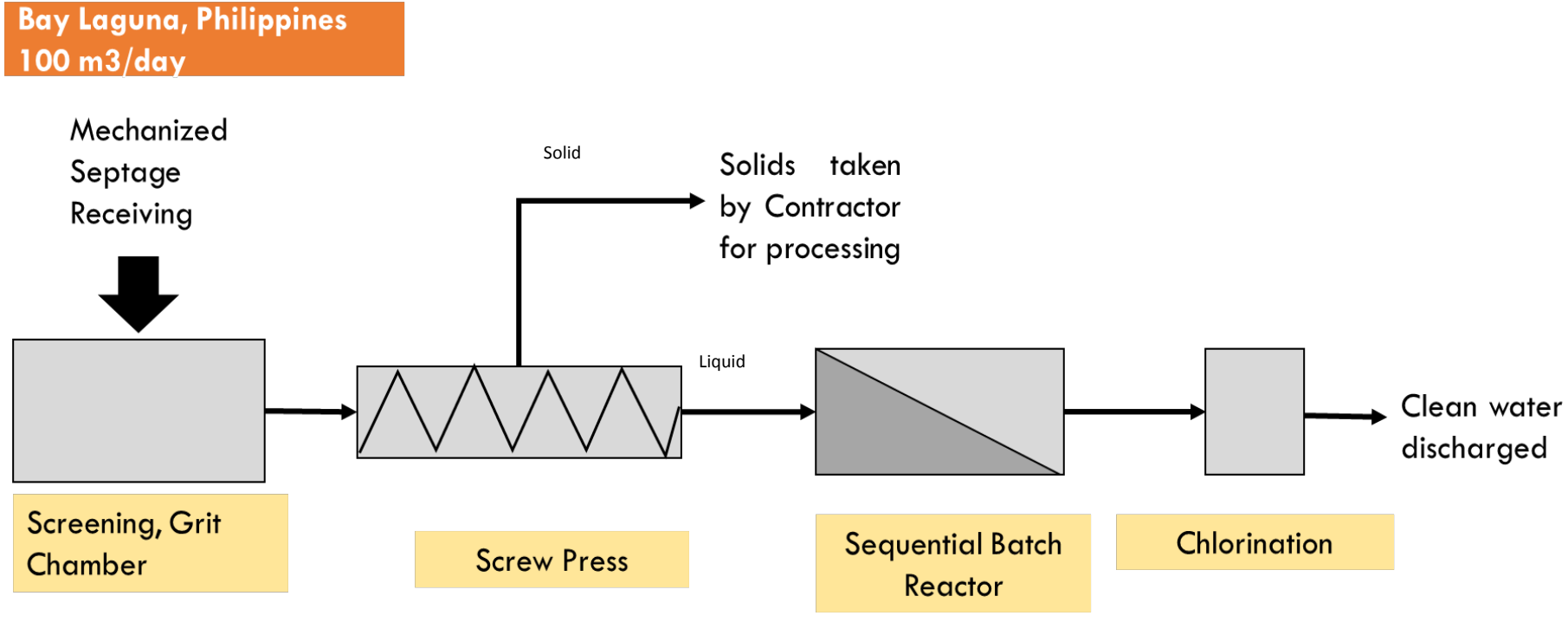


Bay Laguna, Phillipines



Workshop Agenda

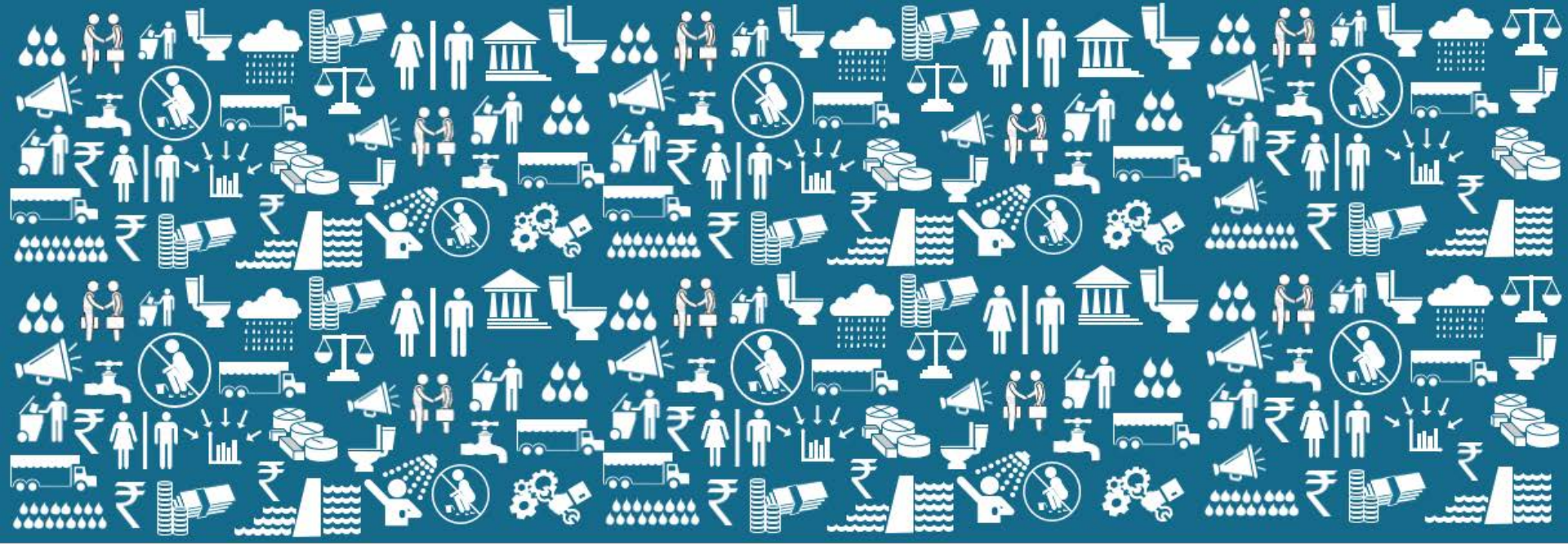
Time	Sessions
Day 1 – Thursday 20th October, 2016	
10:00 – 10:30	Welcome – CEPT, AIILSG and Government of Maharashtra
10:30 – 11:00	Setting the Stage: Need for Septage Management in India – CEPT University
11:00 – 13:00	**Successful implementation of septage treatment options** Many Asian countries have successfully implemented FSM plans. This session is devoted to presentations of experiences from these countries and India. - Dave Robbins, ex-USAID (Indonesia/Philippines) - Dorai Narayana, Indah Water Malaysia - Kalidas Neupane, University of Science and Technology, Beijing University - Rajesh Pai, CDD, Bangalore
13:00 – 14:00	**Lunch**
14:00 – 15:00	**Successful implementation of septage treatment options (contd.)** - Sahidul Islam, SNV, Bangladesh - Sumon Ali, Practical Action, Bangladesh - Puskar Srivastava, Asian Development Bank, Delhi office
15:00 – 15:45	**Panel Discussion: Cities from Maharashtra to speak about issues related to septage treatment** - Moderator CEPT
15.45 – 16.00	**Tea Break**
16:00 – 18:00	**Potential and emerging septage treatment options** (5 min. podium presentation by various technology providers)
18:00 – 18:15	**Wrap up**

Time	Sessions
Day 2 – Friday 21st October, 2016	
10:00 – 10:15	**AIT toolbox on technology options (AIT)**
10.15 – 11.30	**Panel Discussion on experiences/challenges in other states – NFFSM partners and others**
11.30 – 11.45	**Tea Break**
11.45 – 12.15	Table based group discussions: choosing septage technology Discussion among Cities, experts, NFSSM partners and technology providers
12.15 – 12.45	Presentations by each group
12.45 – 13.15	Closing remarks and vote of thanks - CEPT
13:15 – 14:00	**Lunch**
14:00 – 18:00	Field visit – Public Private Partnership for Community Toilets

Participants

	List of Participants	Organization	Designation
1	Mr Uday Tekale	Government of Maharashtra	Mission Director, SMMUA
2	Mr. David Robbins		Consultant
3	Mr. Dorai Narayana	IWK, Malaysia	Consultant
4	Ms. Nitasha Arora	AIT , Thailand	Research Associate
5	Ms. Isha Basyal	AIT , Thailand	Researcher
6	Mr. Kalidas Neupane	University of Science and Technology Beijing, China	Civil Engineer
7	Mr. Sahidul Islam	SNV, Bangldesh	Engineer Advisor
8	Mr. Sumon Ali	Practical action, Bangldesh	Technical Officer
9	Mr Ramakant Sahu	CSE, Delhi	Dy Programme Manager
10	Mr. Ramesh Nair	CSE, Delhi	Programme Manager
11	Mr. K V Dinesh		Consultant
12	Mr. Rajesh Pai	CDD/BORDA , Bengaluru	Senior Technical Advisor
13	Ms. Bakul Rao	IIT,Mumbai	Associate Professor
14	Ms. Ankita Rathor	IIT,Mumbai	Research Associate
15	Mr. Satish Deshpande	Ex-Chief Engineer and GM (Tech.), CIDCO	
16	Mr. Dinesh Kumar Pandey	IIHS, Chennai	Senior Specialist
17	Mr. Anantha Moorthy	Keystone Foundation,Coimbatore	Environmental Engineer
18	Dr. Ligy Philip	IIT, Madras	Professor
19	Ms. Utkarsha Kavadi	AIILSG, Mumbai	Director
20	Mr. Alok Shirish Gogate	AIILSG, Mumbai	Research Associate
21	Mr. Sanket Thorat	AIILSG, Mumbai	Research Investigator
22	Ms. Lavanya Madhyanam	Dasra , Mumbai	
23	Mr. Pushkar Srivastava	ADB , Delhi	Urban Specialist
24	Mr. Arumugam Kalimuthu	Wash Institute, Delhi	Program Director
25	Mr. Rahul Sachdeva	CDD, Bengaluru	Co-ordinator
26	Mr. Satchit Bhandarkar	CDD, Bengaluru	Regional Co-Ordintor
27	Mr. Amresh Sinha	CDD, Bengaluru	Project Manager
28	Ms. Pragyan Paramita Nayak	Practical Action, Odhisa	WASH Consultant
29	Mr. Amit Oturkar	KPMG, Pune	Associate Director
30	Mr. Pritish Nanda	E & Y, Delhi	Project Manager
31	Mr. Ananya Ghosh	E & Y, Delhi	Project Consultant

	List of Participants	Organization	Designation
32	Mr. Sarith Sasidharan	E & Y, Delhi	Senior Co ordinator
33	Mr. Depinder Kapur	NIUA, Delhi	Santation Expert
34	Mr. Prashant Kulkarni	MEETRA, Nashik	Co ordinator
35	Ms. Shilpa Bobade	MEETRA, Nashik	Co ordinator
36	Mr. Myles	RTI International, USA	Sr.Director
37	Mr. Arun Kumar	Tide technocrats, Bengaluru	Lead Santitaion
38	Mr. Shriram	Tide technocrats, Bengaluru	Lead Ecosystem
39	Mr. Nishi Kant Rai	BSA Corporation Ltd , Pune	Zonal Manager
40	Mr. Ravindra Vichare	Addvantage Vi Solis Pvt Ltd , Pune	Director-Marketing
41	Mr. Rajeev Kher	3s – Saraplast, Pune	Director
42	Mr. Yogesh Zambre	3s – Saraplast, Pune	Sales Manager
43	Mr. Chandra Chincholkar	Proactive Management Consultants, Pune	Director
44	Ms. Pradnya Thakur	Shashwat,Pune	Director
45	Mr. Shivdas Sakhale	Satara Municipal council	Sr.Sanitary Inspector
46	Mr. Randiv	Satara Municipal council	Sanitary Inspector
47	Mr. Nitin Kamble	Kagal Municipal council	Sanitary Inspector
48	Mr. Sunil Vashvant Mali	Kagal Municipal council	Municipal Engineer
49	Dr. Dinesh Mehta	CEPT University, Ahmedabad	Program Director
50	Dr. Meera Mehta	CEPT University, Ahmedabad	Program Director
51	Mr. Dhruv Bhavsar	CEPT University, Ahmedabad	Sr. Research Associate
52	Mr. Aasim Mansuri	CEPT University, Ahmedabad	Sr. Research Associate
53	Mr. Tushar Bose	CEPT University, Ahmedabad	Associate Professor
54	Ms. Upasana Yadav	CEPT University, Ahmedabad	Research Associate
55	Ms. Dhara Shah	CEPT University, Ahmedabad	Research Associate
56	Ms. Dhanashree Zende	CEPT University, Ahmedabad	Research Associate
57	Ms. Kasturi Kulkarni	CEPT University, Ahmedabad	Research Associate
58	Ms. Arpita Bansal	CEPT University, Ahmedabad	Research Associate
59	Ms. Arwa Bharmal	CEPT University, Ahmedabad	Research Associate
60	Mr. Omkar Kane	CEPT University, Ahmedabad	Research Associate
61	Ms. Manasi Ranade	CEPT University, Ahmedabad	Research Associate
62	Ms. Mrudula Mankikar	CEPT University, Ahmedabad	Research Associate



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