APPROACHES TO TREATMENT TECHNOLOGY FOR FAECAL SLUDGE AND SEPTAGE MANAGEMENT
The National Faecal Sludge and Septage Management (NFSSM) Alliance was convened in January 2016 to build consensus around faecal sludge and septage management.

The Alliance with support from the Bill and Melinda Gates Foundation works in close collaboration with the Ministry of Housing and Urban Affairs and helped design a national policy on FSSM.

The Alliance comprises of numerous national and international organizations across the country working towards sanitation solutions for India.

**VISION**
Create an enabling environment that amplifies scaling of safe, sustainable and inclusive FSSM through knowledge, partnerships and innovative solutions by 2024.

**GUIDING PILLARS**

- INCLUSIVITY
- INFRASTRUCTURE AND TECHNOLOGY
- SYSTEM STRENGTHENING AND CAPACITY BUILDING
- BEHAVIOUR CHANGE COMMUNICATION
- POLICY
ON SITE SANITATION (OSS) DEPENDENCE

About 67% of urban HHs have Onsite Sanitation Systems (OSS) likely to increase to 70% by 2020 [CDD estimate]

THE BURDEN ON SAFE WATER

Nearly 70% of faecal sludge is untreated in India, and 38,791 MLD untreated sewage (62% of total sewage) is discharged directly in water bodies [CPCB report]

THE BURDEN ON AGRICULTURE

79% water used for irrigation would fail faecal coliform standards in Ganga Catchment [UN Environment, 2019], while demand for water for irrigation increases

SANITATION SERVICE CHAIN - CURRENT STATUS

Key Facts

30 million of 79 million urban HHs (nearly 40%) with septic tanks, have no clear method for sewage disposal (WaterAid, 2016)

Diarrhoeal diseases (most of them due to poor sanitation services) contribute to 20% of deaths in children under the age of 5 (USAID, 2010)

Lack of proper and functional service chain causes an estimated loss of US$ 54 Billion to India annually.
NEED FOR FAECAL SLUDGE AND SEPTAGE MANAGEMENT (FSSM) IN INDIA

Low Cost, High Impact

Advantages of Non-Sewered Sanitation:
- Requires low investment & operations as compared to Sewered Sanitation
- It is water saving and does not need large scale infrastructure
- Cost-effective solution for treatment and reuse

Even the CPHEEO manual defines the high capital and O&M costs of centralized STPs as hurdles for small towns, and mentions: STPs remain a highly resource inefficient technology with high capital and O&M costs, thereby prohibiting widespread adoption in all sizes of urban areas in the country.

Open Discharge of Faecal Matter

One truck of faecal sludge and septage carelessly dumped = 5,000 people defecating in the open!

1 Gram of Faeces may contain:
- 100 parasites eggs
- 1000 Protozoa
- 1,000,000 Bacteria
- 10,000,000 Virus

Lack of Services leads to manual scavenging

Since 2017, one manual scavenger has died on the job every five days!
WATER IN URBAN INDIA

According to the Government of India, India has 17.74% of the world’s population, but only 2.45% of the world’s land resources and 4.5% of fresh-water resources.

About 67% of urban HHs have Onsite Sanitation Systems (OSS) likely to increase to 70% by 2020 [CDD estimate]

40 Lpcd – 81% all households have access through some source

135 Lpcd – water supply quantity in 2030

65 Lpcd – basic services standard

80% of water bodies are polluted

By 2030, the country’s water demand is projected to be twice the available supply, implying severe water scarcity for hundreds of millions of people and an eventual ~6% loss in the country’s GDP.

Source: Various sources; NITI, MoWR.
SANITATION IN URBAN INDIAN

According to UNICEF, 37.7 million Indians are affected by water-borne diseases annually. In 2015, an estimated 117,000 under-5 children died of diarrhea alone, representing 13% of all deaths amongst under-5 children, and 22% of the global burden.

Source: JMP. WHO 2017

HHs that have been shifted to either septic tank or twin pit systems under SBM

Source: * Census of India 2011; # CPCB, Inventorization of STPs (2015)
SANITATION ACHIEVEMENTS

The Swachh Bharat Mission is addressing toilet access successfully. But urban sanitation goes beyond ODF. Two thirds of India is semi-arid and arid. Is there enough water for conventional sewerage systems for 7000 towns/cities of India?

Therefore, a paradigm shift is needed to reduce urban water demand and waste water footprint

6,160,812
individual toilets constructed (93% coverage achieved)

4,324 of 4,378 urban cities have been declared ODF

5,93,338
community and public toilets constructed (100% coverage achieved)

ODF
At any point of the day, not a single person is found defecating in the open

ODF+
All CTs and PTs are functional and well maintained

ODF++
Faecal sludge/septage and sewage is safely managed and treated

Source: SBM Urban MIS; National Annual Rural Sanitation Survey 2018-19

Journey from ODF to ODF+ and ODF++ has begun
UNDERSTANDING NUTRIENT CYCLES AND SANITATION

Science of Sanitation
INTERACTION OF WATER AND NUTRIENT CYCLES

Concept Source: Kramer, Pedro; (20th Jan 2014). Workshop on ‘Establishing Operation & Maintenance Services for Decentralized Urban Sanitation Infrastructure in Karnataka’, CDD Society-BORDA, Bangalore, India
INTERACTION OF WATER AND NUTRIENT CYCLES
SANITATION SYSTEMS: CASE OF BANGALORE

SANITATION SYSTEM IN PRACTICE

- Centralised sanitation system (offsite system)
- Decentralised sanitation system (Hybrid system)
- Onsite sanitation system
# HOW IS SEPTAGE DIFFERENT FROM SEWAGE

**Physical and chemical characteristics of septage**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical Oxygen Demand</td>
<td>6,480</td>
<td>440 - 78,600</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>31,900</td>
<td>1,500 - 703,000</td>
</tr>
<tr>
<td>Total Solids</td>
<td>34,106</td>
<td>1,132 - 130,745</td>
</tr>
<tr>
<td>Total Volatile Solids</td>
<td>23,100</td>
<td>353 - 71,402</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>12,862</td>
<td>310 - 93,378</td>
</tr>
<tr>
<td>Volatile Suspended Solids</td>
<td>9,027</td>
<td>95 - 51,500</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen</td>
<td>588</td>
<td>66 - 1,060</td>
</tr>
<tr>
<td>Ammonia-Nitrogen</td>
<td>97</td>
<td>3 - 116</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>210</td>
<td>20 - 760</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>970</td>
<td>522 - 4,190</td>
</tr>
<tr>
<td>Grease</td>
<td>5,600</td>
<td>208 - 23,368</td>
</tr>
<tr>
<td>pH</td>
<td>1.5 - 12.6</td>
<td></td>
</tr>
</tbody>
</table>

**Effluent discharge standards: Order by NGT**

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Parameters</th>
<th>MoEFCC notification</th>
<th>NGT Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bio-chemical Oxygen Demand (mg/l)</td>
<td>&lt;30 and &lt;20 (metro cities)</td>
<td>&lt;10</td>
</tr>
<tr>
<td>2</td>
<td>Chemical Oxygen Demand (mg/l)</td>
<td>&lt;250</td>
<td>&lt;50</td>
</tr>
<tr>
<td>3</td>
<td>Total Suspended Solids (mg/l)</td>
<td>&lt;100 and &lt;50 (metro cities)</td>
<td>&lt;50</td>
</tr>
<tr>
<td>4</td>
<td>Total Nitrogen (mg/l)</td>
<td>No limit</td>
<td>&lt;10</td>
</tr>
<tr>
<td>5</td>
<td>Total phosphorus</td>
<td>No limit</td>
<td>&lt;2</td>
</tr>
<tr>
<td>6</td>
<td>Faecal Coliform MPN/100 ml</td>
<td>&lt;1000</td>
<td>&lt;230</td>
</tr>
</tbody>
</table>

Source: Advisory note on Septage management in Urban India, MoUD Jan 2013
CONTAINMENT AND CONVEYANCE: CONSIDERATIONS FOR DECISION MAKERS

Safety Aspects and Business Models for Success
TYPES OF CONTAINMENT SYSTEMS

Pour flush latrine

90.71% urban India is ODF and verified.

Single Pit

Twin Pit

Ecosan

Septic Tank with Soak Pit

Biodigester
EMPTYING AND CONVEYANCE OPTIONS

**Manual diaphragm pump**

Source: Fecal Sludge Management System and Approaches

**Vacutug**

Source: Fecal Sludge Management System and Approaches
SCHEDULED EMPTYING: SOLUTION FOR INDIA

Performance Linked Annuity Model (PLAM) for scheduled desludging

All properties in the city

Desludging service once in 3 years

Sanitation / property tax

Bank

Escrow account

Scheduled Desludging service provider

Capital costs

O&M costs

Annuity payment as per performance based contract

Regular transfers and a 3-month Contract Fee Reserve Fund

Local government

Deliver collected sludge to treatment facility

Financial flow

Service delivery

Source: CEPT.
Scheduled desludging in Wai city, Maharashtra

On May 30, 2018, Wai Municipal Council in Maharashtra became the first city in India to start a Scheduled Desludging service. Wai is a small municipality with a population of 45,000 in Maharashtra. If Wai can do this, it is possible for most cities in India to adopt this practice. This presentation is about how Wai did this and how other cities in India can adopt this practice.

Source: CEPT
ACHIEVEMENTS OF WAI, MAHARASHTRA

Results after 1 year of scheduled emptying

- 645 service visits
- 1921 properties in the city covered
- 89% properties serviced (11% properties refused)
- Unique database of 572 septic tanks in the city
- 464 scheduled desludgings
- 108 emergency desludgings
- 85% prepared with access covers open
- ~5.5 Million litres of septage delivered safely to treatment facility

Source: CEPT.
SELECTING TREATMENT OPTION FOR THE CITY

Factors to Consider
TREATMENT OBJECTIVES

Selection of treatment options

Priority

Highest

Organic Load Reduction

Pathogen Removal

Reuse

Lowest

Source: CDD.
# SELECTION OF TREATMENT MECHANISM

<table>
<thead>
<tr>
<th>Performance</th>
<th>Local Context</th>
<th>O&amp;M Requirements</th>
<th>Costs</th>
</tr>
</thead>
</table>
| Effluent waste water and solid: Meet the discharge / reuse standards | • Characteristics of sludge (dewaterability, solids concentration, stabilisation, spread ability)  
• Quality & Frequency of the sludge received at treatment facility  
• Climate  
• Land availability  
• End-use | • ULB has human resources and can finance O&M  
• Availability of skilled persons for more complex technology | • Investment  
• O&M  
• Affordability for households and ULB |
PROCESS OF TREATMENT

Liquid treatment

Effluent discharged to watercourse or used for agriculture

Anaerobic

Aerobic

Simple separation

Separation with sludge digestion

Solids/liquid separation

Drying Pressing

Separated solids

Dried sludge disposed of to landfill or used as soil conditioner

Solids dewatering

Lime stabilization

Screening

Grit removal

Preliminary treatment

Septage reception

Raw septage

Receiving chamber
FAECAL SLUDGE TREATMENT PLANT

Source: CDD
CO-TREATMENT: SEPTAGE WITH SEWAGE

Good option where STPs exist or are being planned, when done properly

Source: Dorainarayana 2019
FEASIBILITY OF CO-TREATMENT

How much FS can be discharged

- Max 1-2% of STP capacity

Distance

- Within 15-20 KMS of drive to STP

Discharge Location

- Pumping station
- An inlet of STP
- Manhole (trunk sewer)*
CO-TREATMENT AT PURI, ODISHA

Receiving Station
Settling Thickening Tank
Sludge Drying Bed
Headworks STP
Desludging Process
Screens
WSP

Source: Dhawal Patil, ESF
CO-COMPOSTING (WITH ORGANIC WASTE/SAWDUST)
INDIA STEPS-UP SEPTAGE TREATMENT

Growth of FSSM
FSSM UPTAKE IN INDIAN STATES

5 STATES WITH A TOTAL POPULATION OF OVER HALF A BILLION HAVE INITIATED FSSM

- **Maharashtra**: FSSM planned in 100 towns
- **Tamil Nadu**: FSSM planned in 285 towns
- **Odisha**: FSSM planned in 114 towns
- **Uttar Pradesh**: FSSM planned in 31 towns
- **Andhra Pradesh**: FSSM planned in >140 towns

LESSONS AND BEST PRACTICES

- **Policy and Strategy**
  - State Scale Up and Investment Strategy
  - Institutional Arrangements, Norms and Regulations for FSSM at State Level

- **Operational Sustainability**
  - Integration of FSTP operations with local livelihood- integrating SHGs in routine operation and management
  - Scheduled Desludging of Septic Tanks, Cluster Operations Systems

- **Replication**
  - Capacity Building of all Stakeholders
  - Creating Awareness through Advocacy, Workshops
  - Recognizing Government Champions and advocating for larger political buy-in
STEPS IN SOLVING THE FSSM CHALLENGE

What can you do for India’s Sanitation Story?

Awareness generation, campaigning and leveraging social media

Policy interventions at available legislative and administrative spaces

Influence and seek an increased budget for FSM and monitor allocations for FSM

Set up stronger dispute redressal mechanisms
Presentation Credits

CDD Society (Centre for DEWATS Dissemination), Bangalore
Ecosan Services Foundation, Pune
Rajesh Pai and Praveen Nagaraj: Treatment Technology
CEPT-CWAS Society: Scheduled Desludging Priority
BBC Media Action (India)
All Members of the NFSSM Alliance

Compiled by SCBP Team at NIUA: Shantanu Kumar Padhi
THANK YOU!