

# APPROACHES TO TREATMENT TECHNOLOGY FOR FAECAL SLUDGE AND SEPTAGE MANAGEMENT







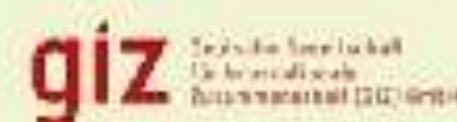
ATHENA  
INFONOMICS



BILL & MELINDA  
GATES foundation



CEPT  
UNIVERSITY



# THE NFSSM ALLIANCE

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.

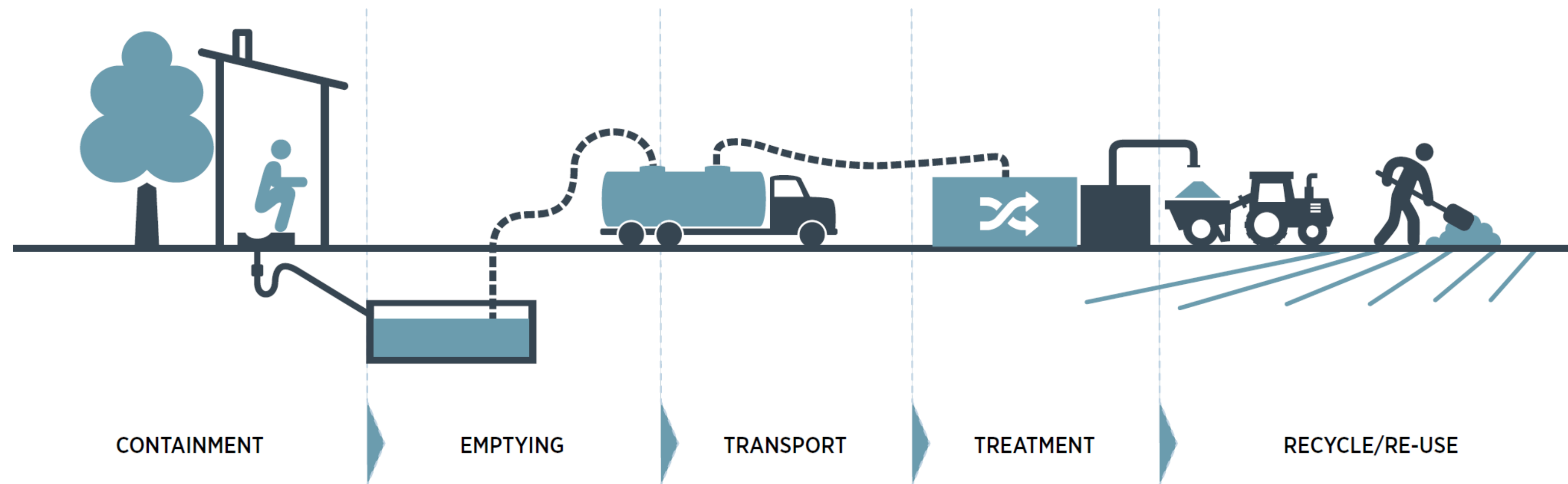
## VISION

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

# SANITATION SERVICE CHAIN- CURRENT STATUS



## 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

## 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]

**80%** of water bodies are polluted

40

Lpcd – 81% all households have access through some source

135

Lpcd – water supply quantity in 2030

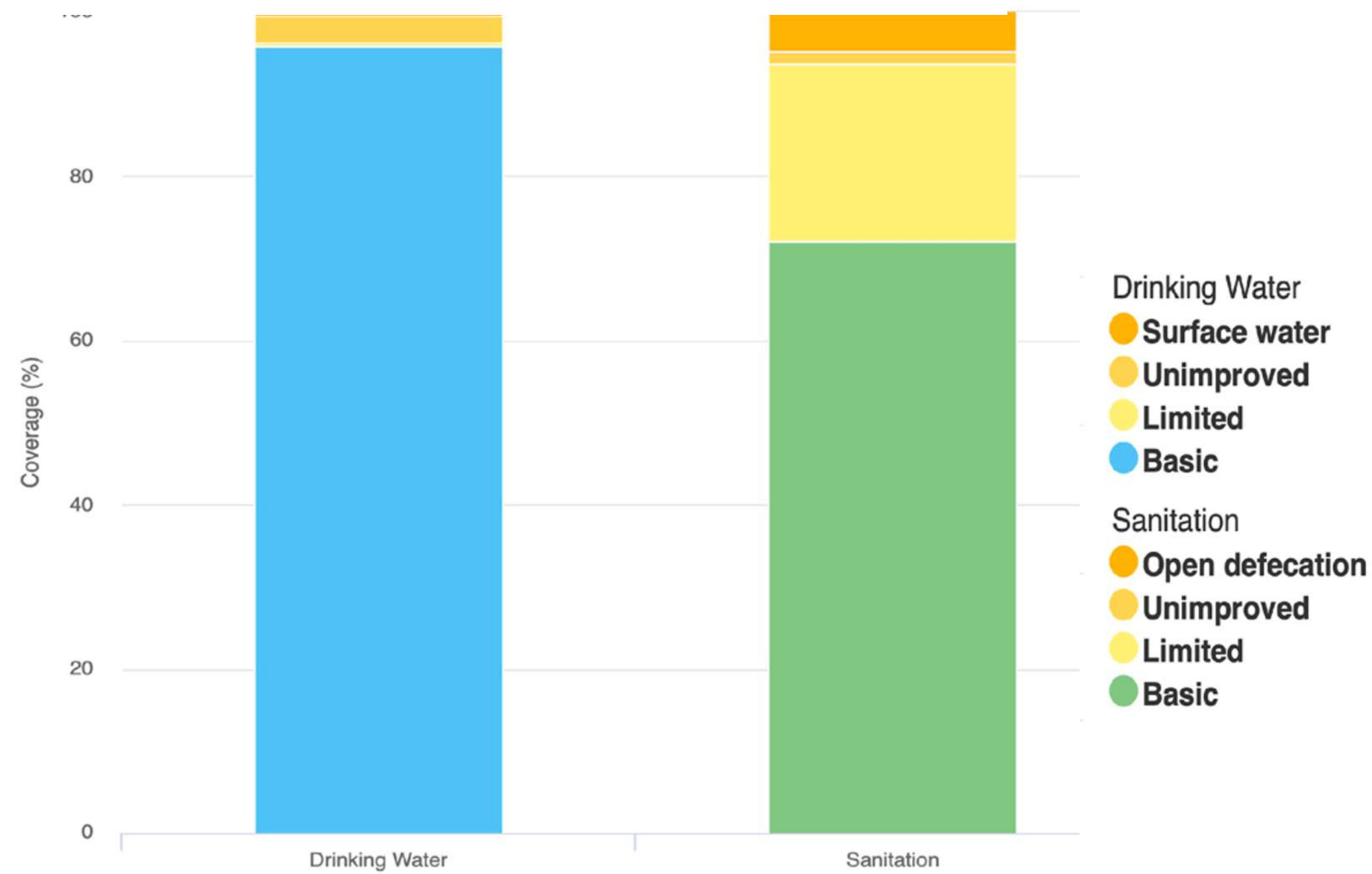
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Lpcd – basic services standard

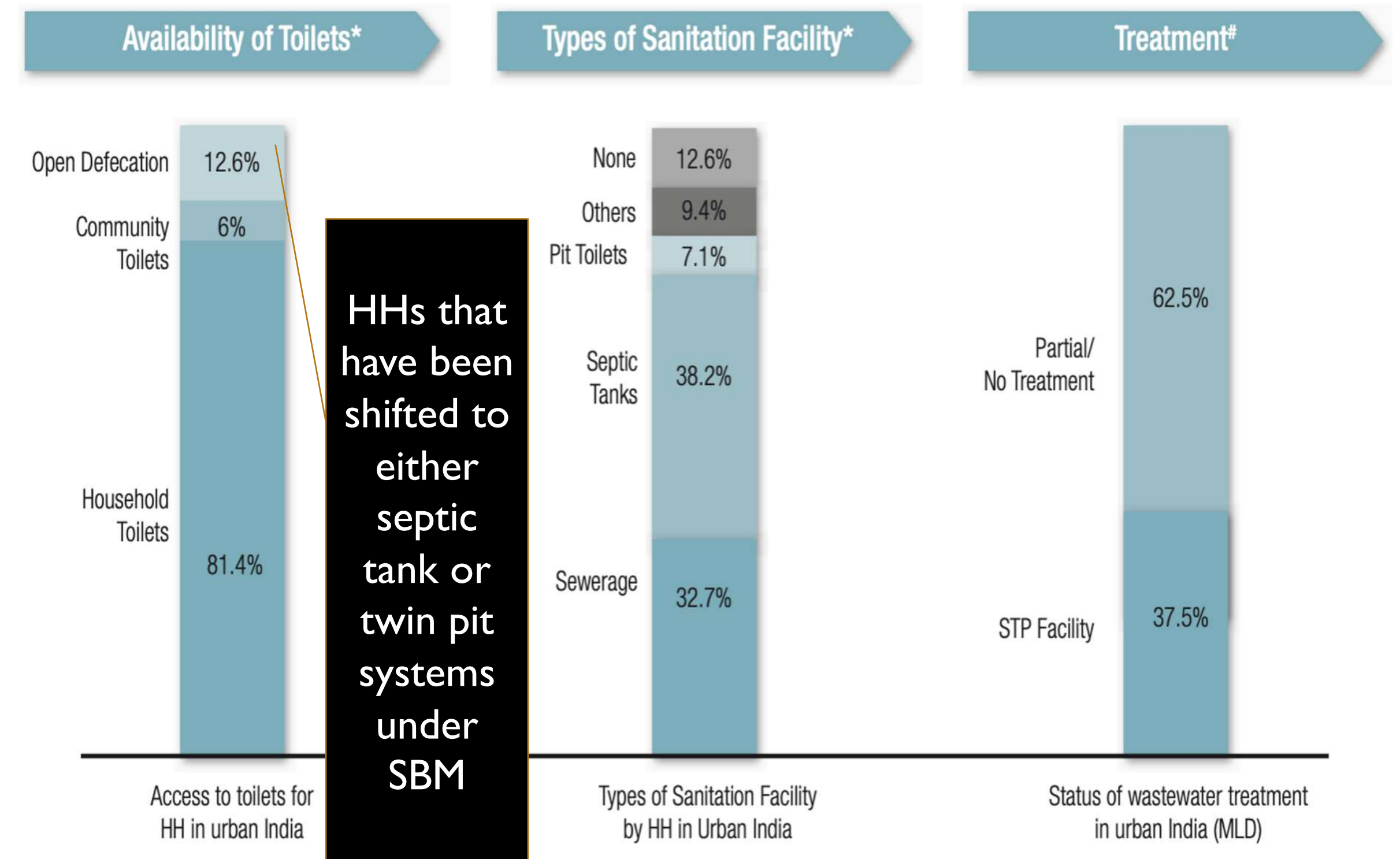
*By 2030, the country's water demand is projected to be twice the available supply, implying severe water scarcity for hundreds of millions of people and an eventual ~6% loss in the country's GDP.*

# SANITATION IN URBAN INDIAN

Household data - India - Urban - 2017 - Service Levels



Source: JMP. WHO 2017



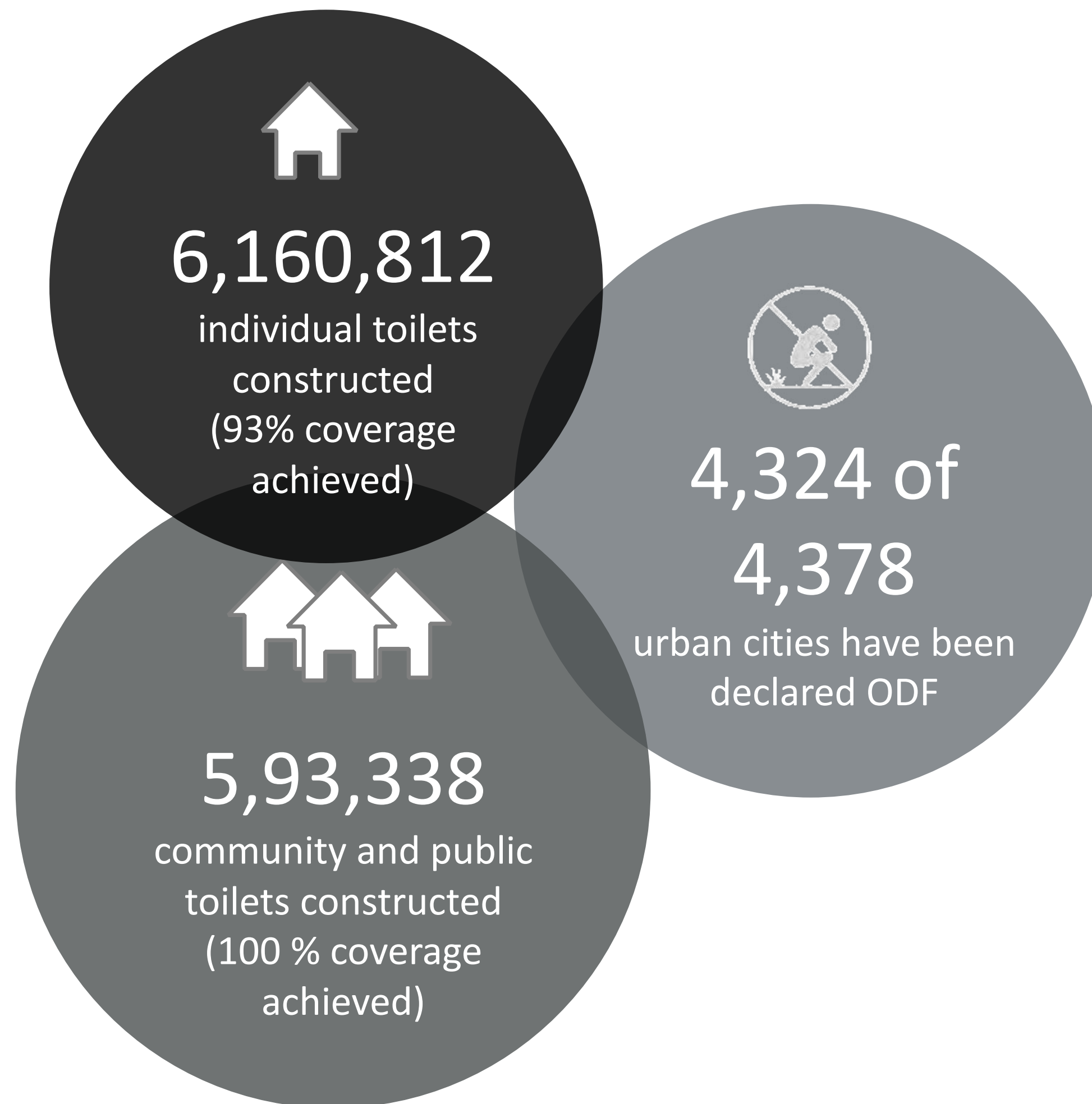
Source: \* Census of India 2011; # CPCB, Inventorization of STPs (2015)

*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*

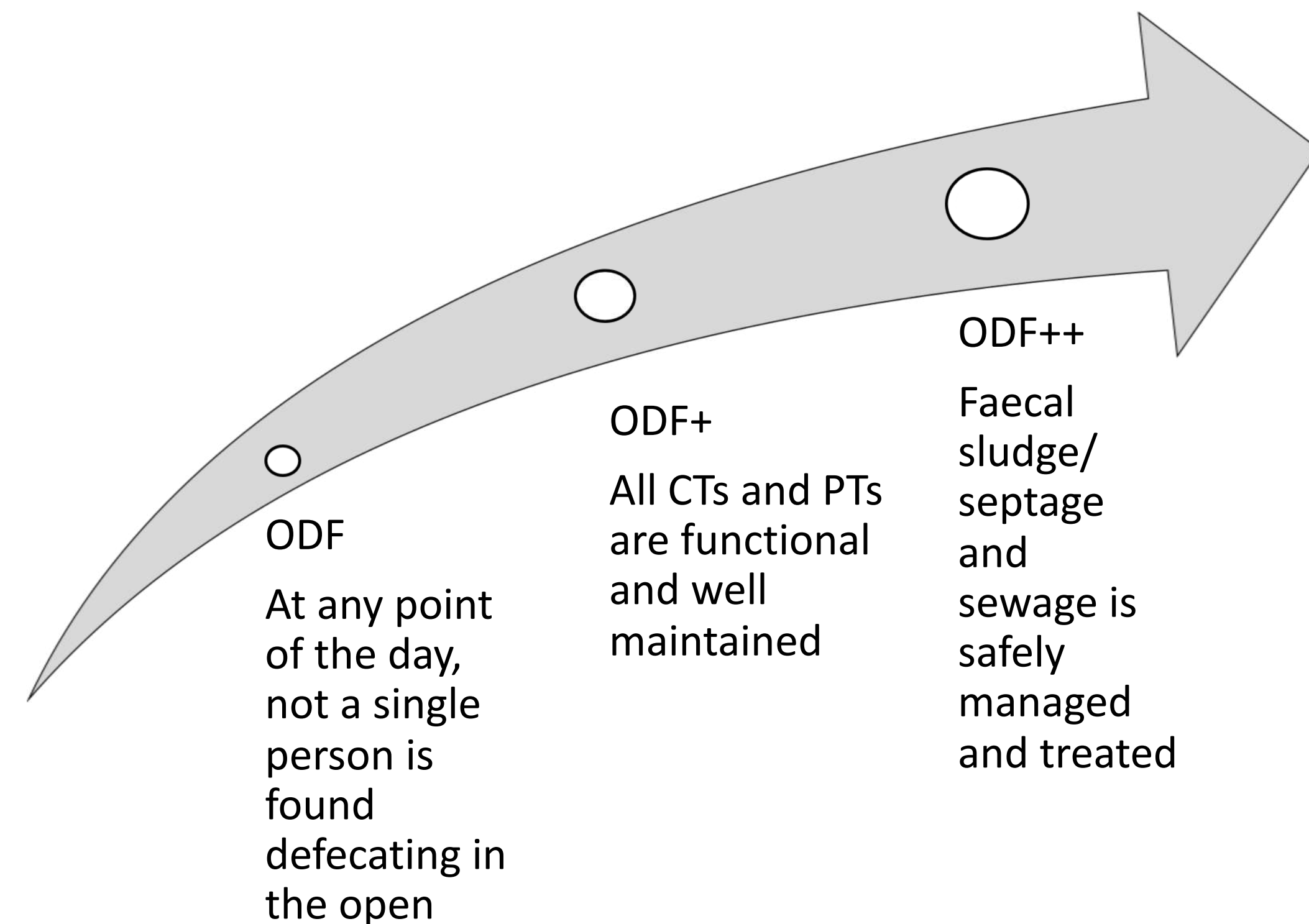
# SANITATION ACHIEVEMENTS

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*



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



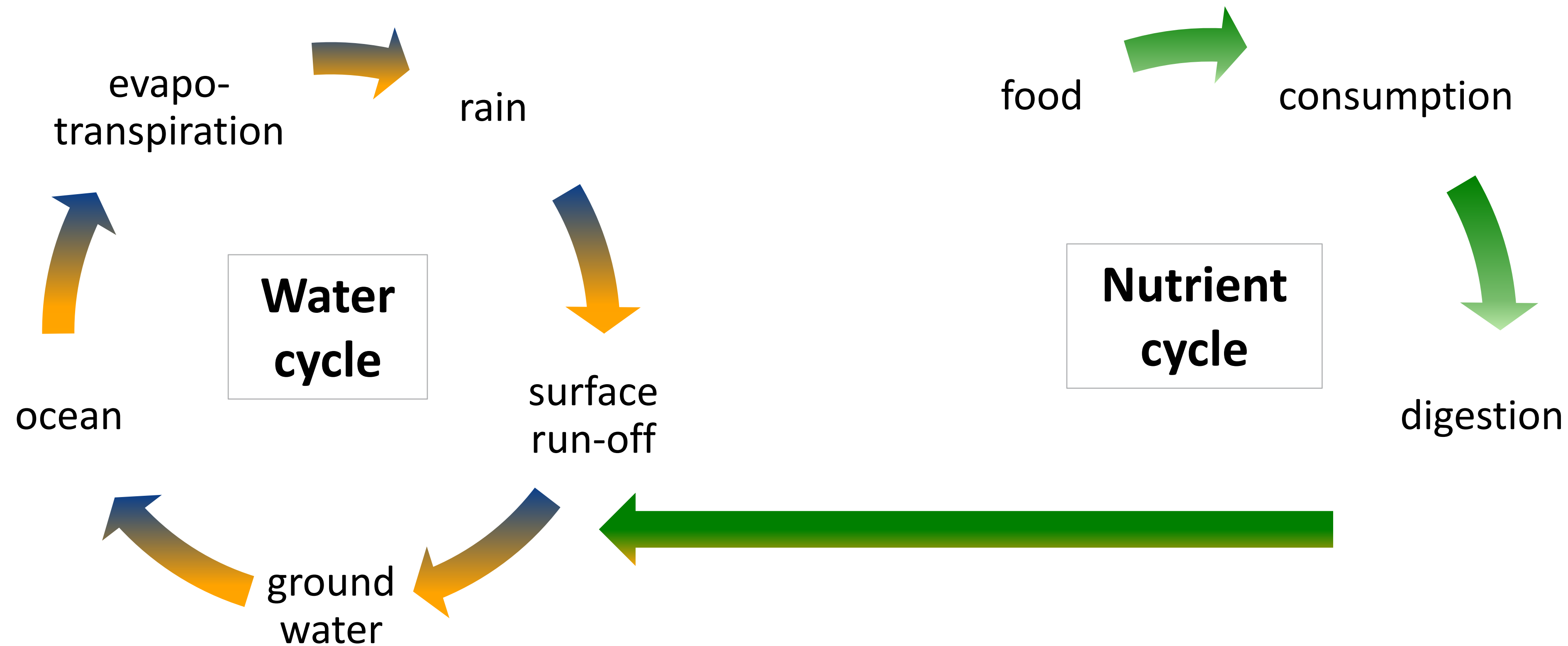
Journey from ODF to ODF+ and ODF++ has begun

# UNDERSTANDING NUTRIENT CYCLES AND SANITATION

*Science of Sanitation*

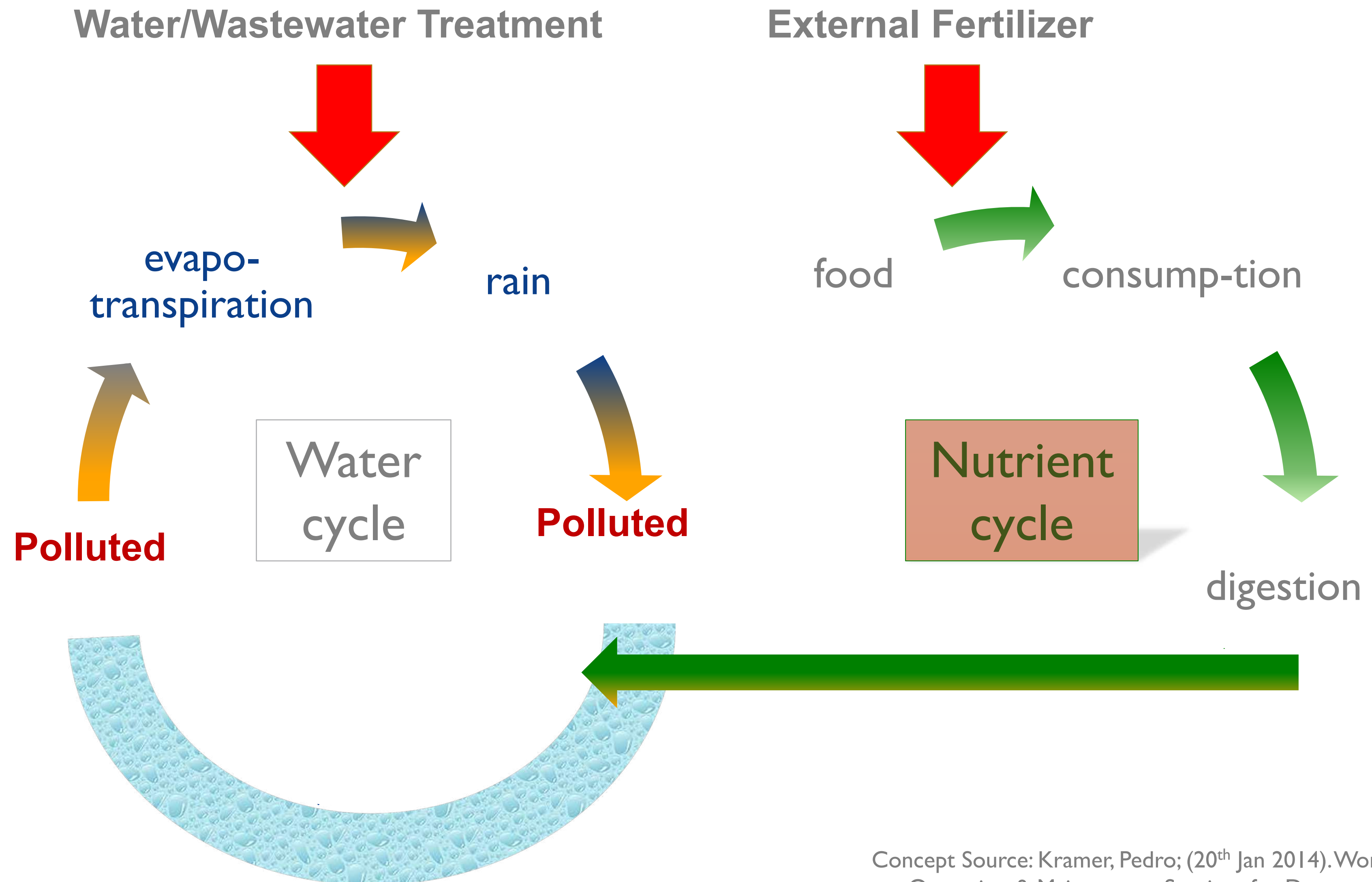


# INTERACTION OF WATER AND NUTRIENT CYCLES



# INTERACTION OF WATER AND NUTRIENT CYCLES

10



Concept Source: Kramer, Pedro; (20<sup>th</sup> Jan 2014). Workshop on 'Establishing Operation & Maintenance Services for Decentralized Urban Sanitation Infrastructure in Karnataka', CDD Society-BORDA, Bangalore, India

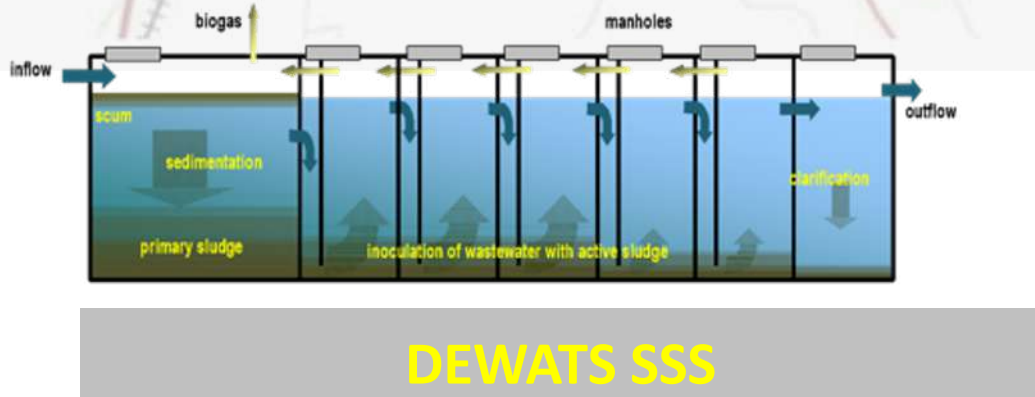
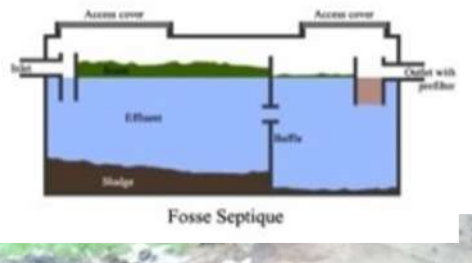
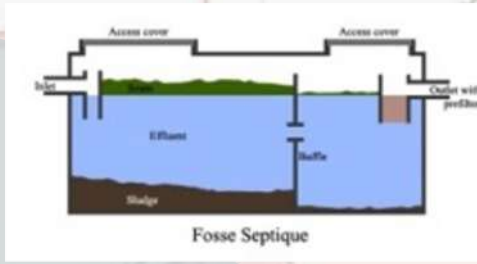
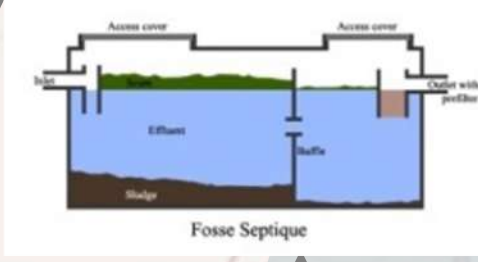
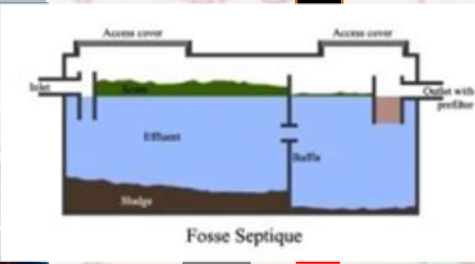
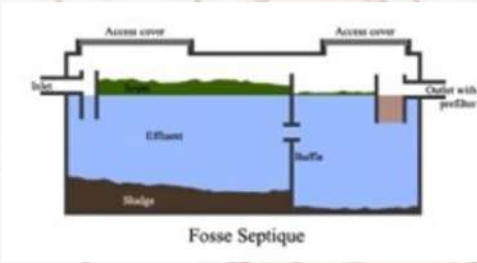
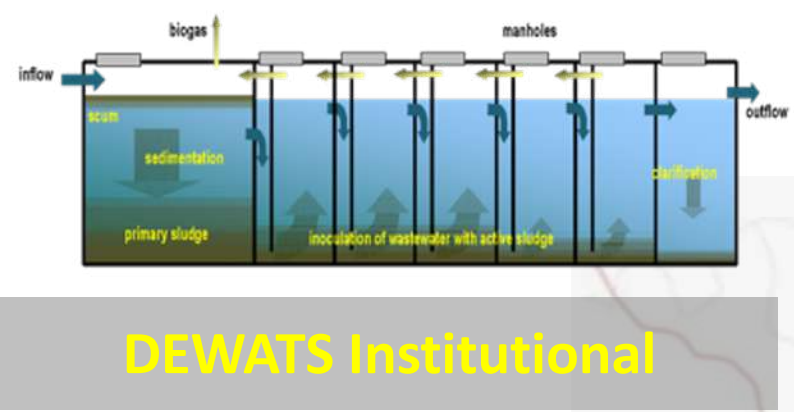


# SANITATION SYSTEMS: CASE OF BANGALORE

## SANITATION SYSTEM IN PRACTICE

- ① Centralised sanitation system (offsite system)
- ② Decentralised sanitation system (Hybrid system)
- ③ Onsite sanitation system







# HOW IS SEPTAGE DIFFERENT FROM SEWAGE

## Physical and chemical characteristics of septage

Constituent (all units but for pH are in mg/l)	Average	Range
Biochemical Oxygen Demand	6,480	440 - 78,600
Chemical Oxygen Demand	31,900	1,500 - 703,000
Total Solids	34,106	1,132 - 130,745
Total Volatile Solids	23,100	353 - 71,402
Total Suspended Solids	12,862	310 - 93,378
Volatile Suspended Solids	9,027	95 - 51,500
Total Kjeldahal Nitrogen	588	66 - 1,060
Ammonia- Nitrogen	97	3 - 116
Total Phosphorus	210	20 - 760
Alkalinity	970	522 - 4,190
Grease	5,600	208 - 23,368
pH		1.5 - 12.6

Actual quality  
that is being  
disposed off

## Effluent discharge standards: Order by NGT

Sr no.	Parameters	MoEFCC notification October 2017	NGT Order
1	Bio-chemical Oxygen Demand (mg/l)	<30 and <20 (metro cities)	<10
2.	Chemical Oxygen Demand (mg/l)	<250	<50
3.	Total Suspended Solids (mg/l)	<100 and <50 (metro cities)	<50
4	Total Nitrogen (mg/l)	No limit	<10
5	Total phosphorus	No limit	<2
6	Faecal Coliform MPN/100 ml	<1000	<230

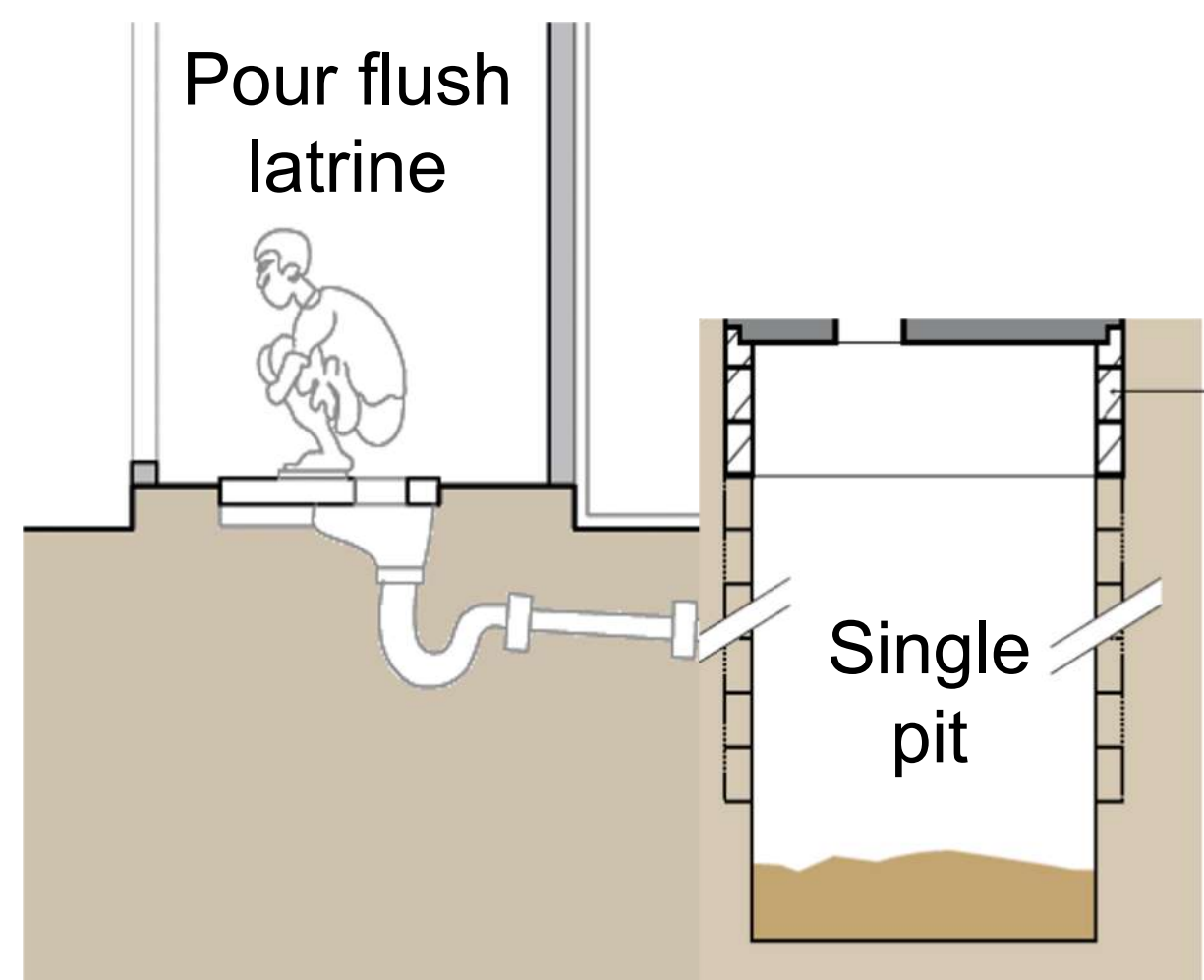
Standards  
for disposal

# CONTAINMENT AND CONVEYANCE: CONSIDERATIONS FOR DECISION MAKERS

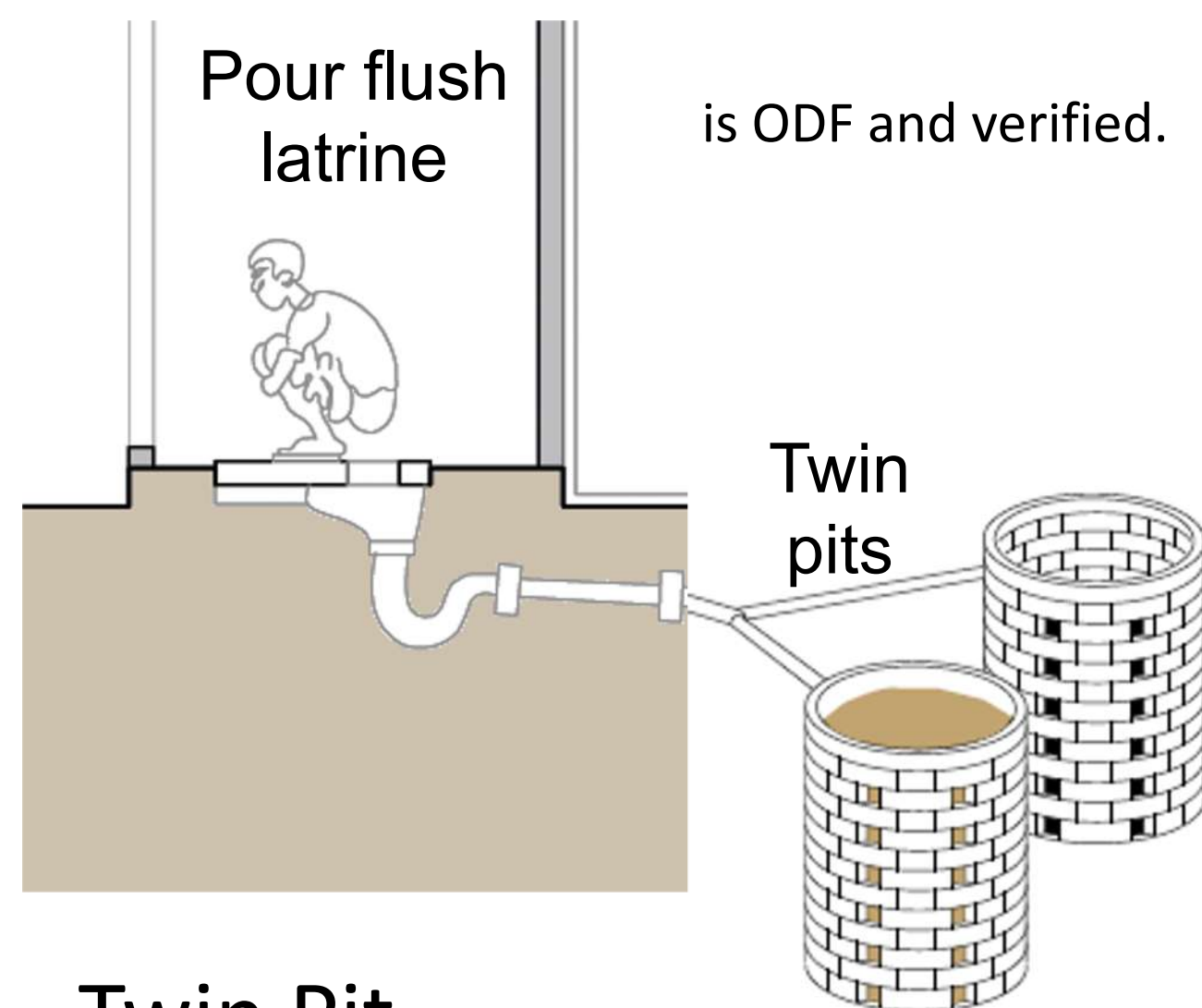
*Safety Aspects and Business  
Models for Success*



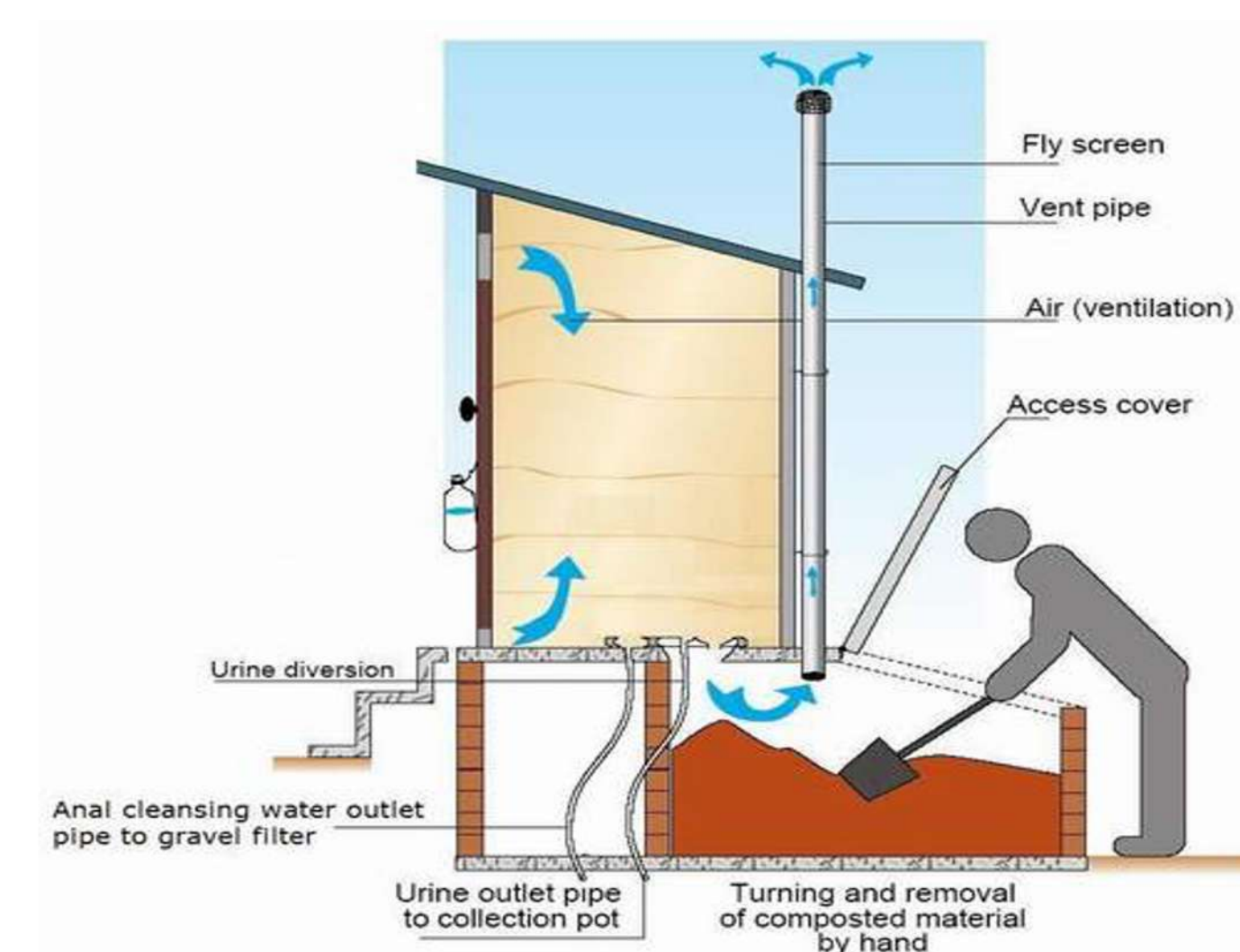
# TYPES OF CONTAINMENT SYSTEMS



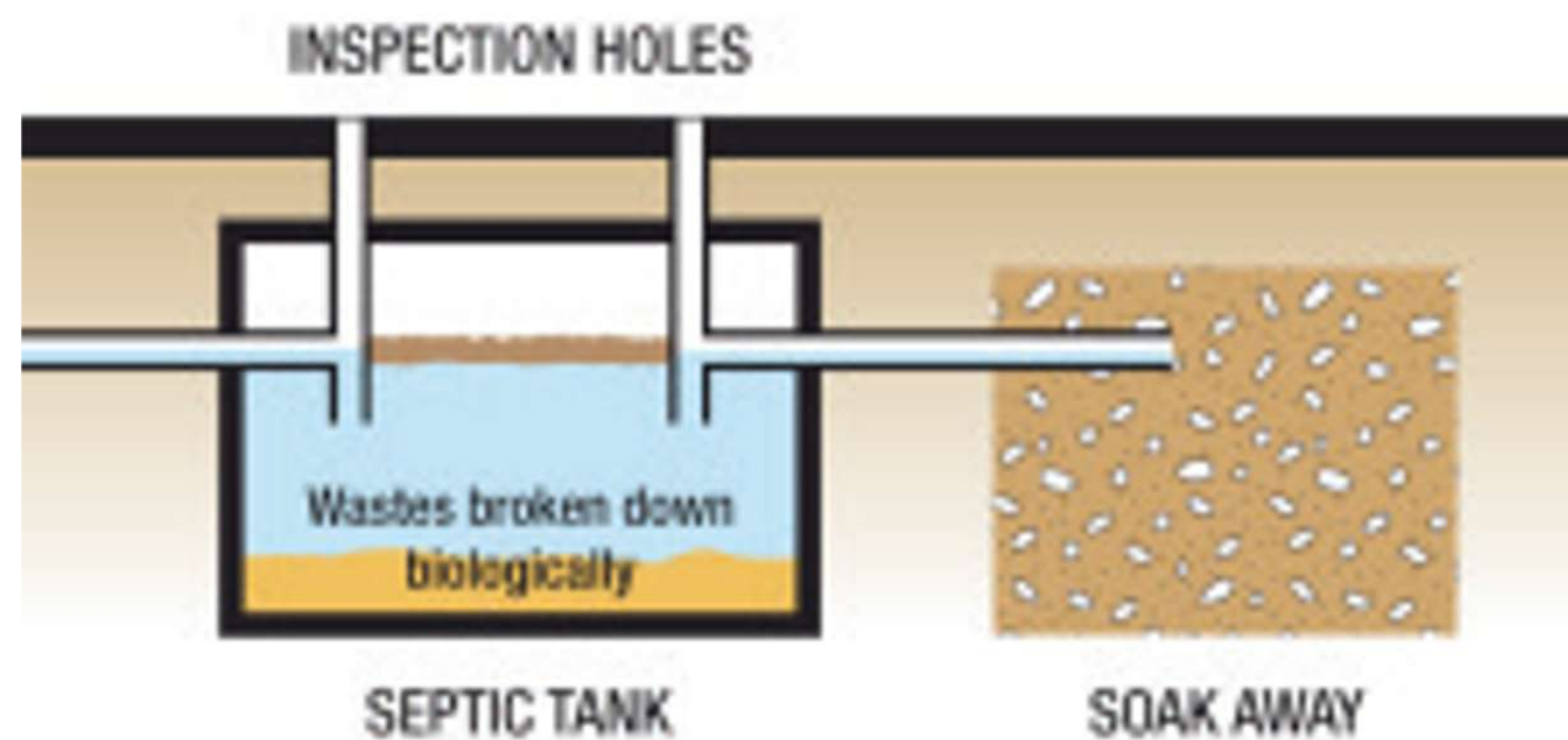
Single Pit



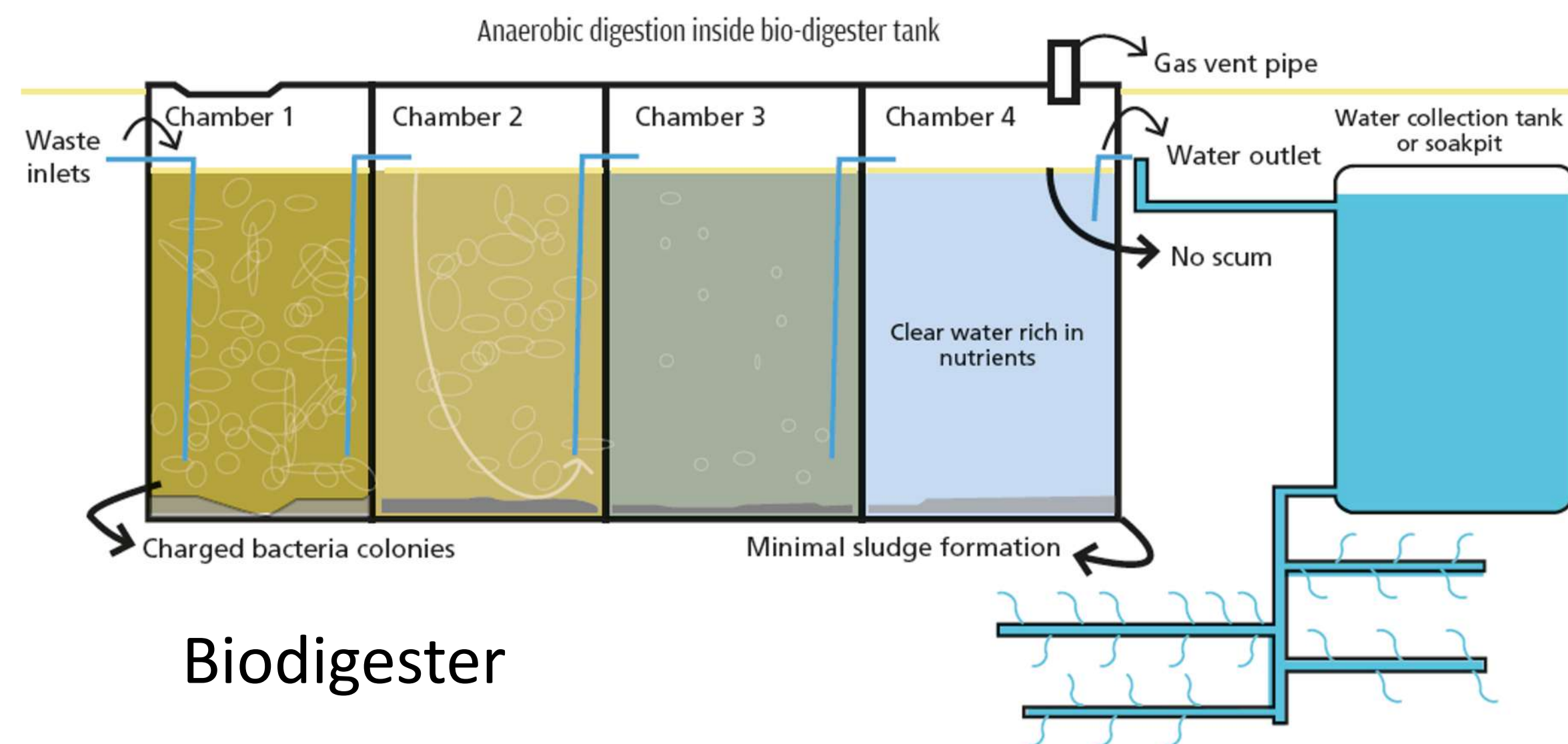
Twin Pit



Ecosan



Septic Tank with Soak Pit



Biodigester



# EMPTYING AND CONVEYANCE OPTIONS

## Manual diaphragm pump



Source: Faecal Sludge Management System and Approaches



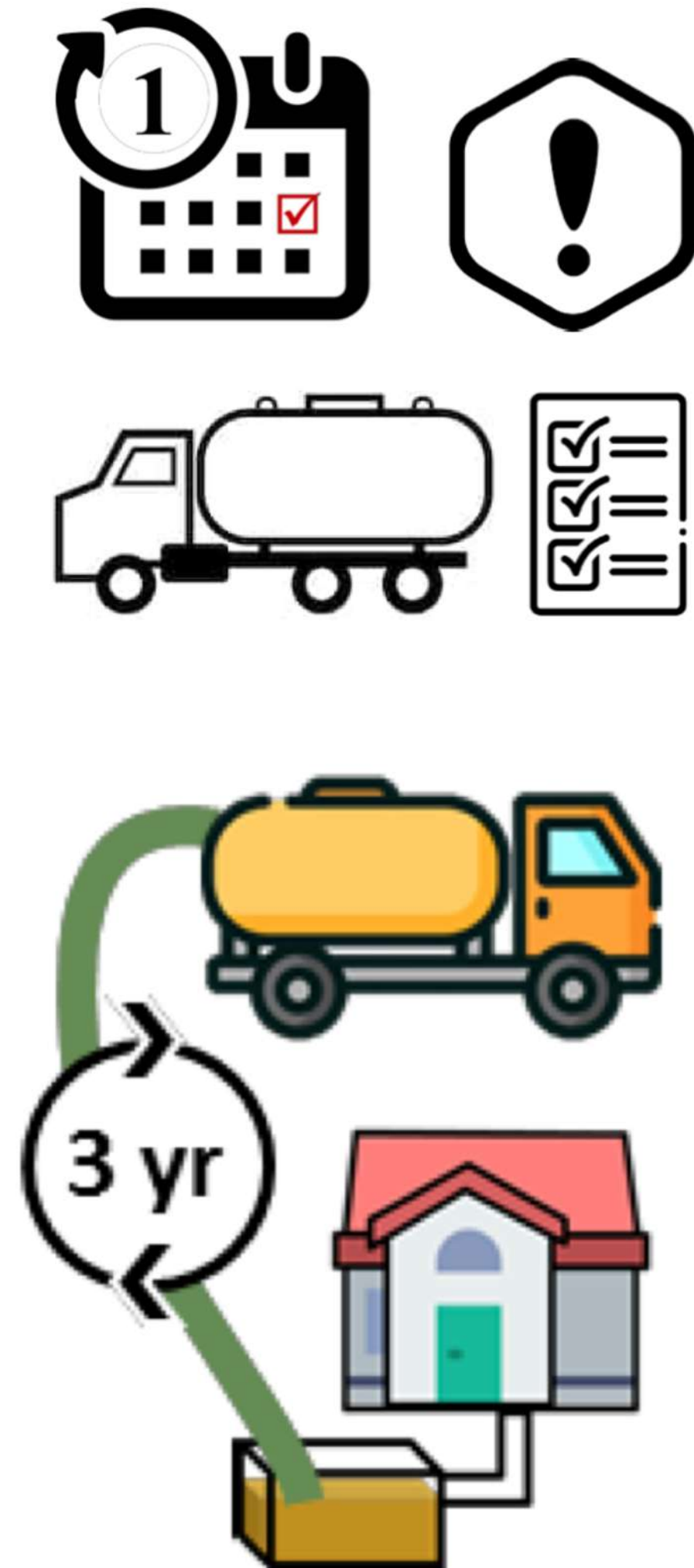
## Vacutug



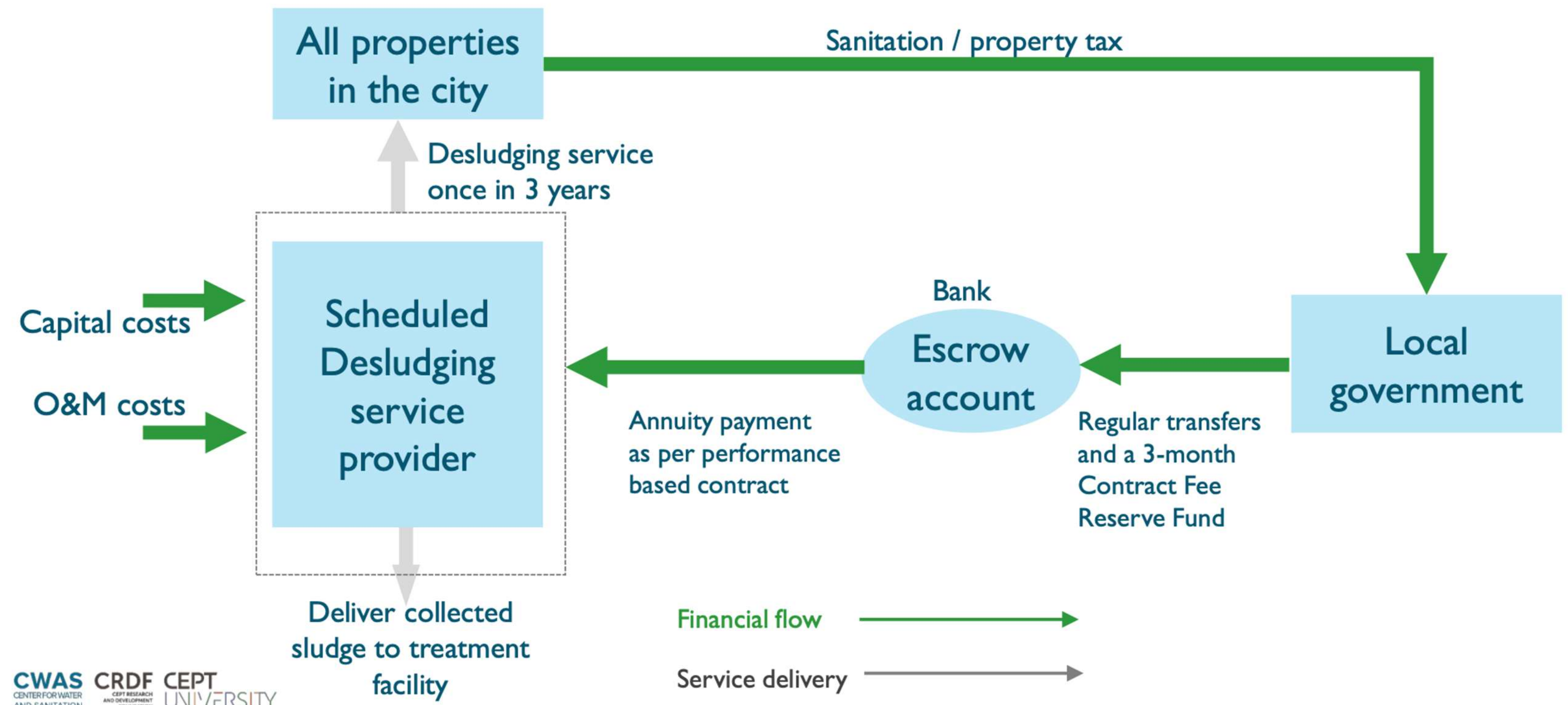
Source: Faecal Sludge Management System and Approaches



# SCHEDULED EMPTYING: SOLUTION FOR INDIA



## Performance Linked Annuity Model (PLAM) for scheduled desludging





# 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 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.



# ACHIEVEMENTS OF WAI, MAHARASHTA

**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

**28 Community**  
toilets serviced  
weekly

**85%**  
**prepared**  
with access covers open

**~5.5 Million litres**  
of septage  
delivered safely to  
treatment facility

# SELECTING TREATMENT OPTION FOR THE CITY

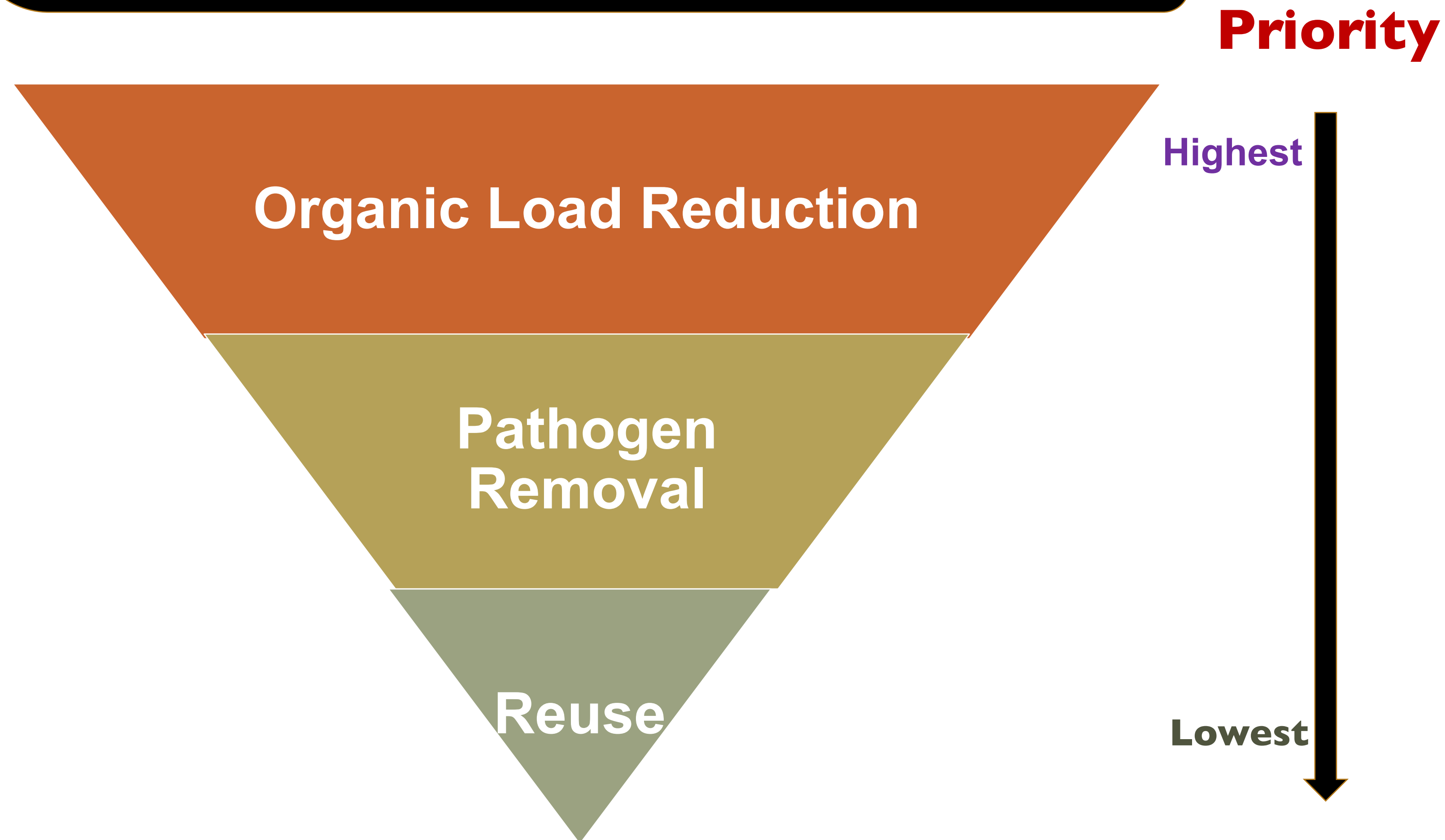
*Factors to Consider*





# TREATMENT OBJECTIVES

## Selection of treatment options

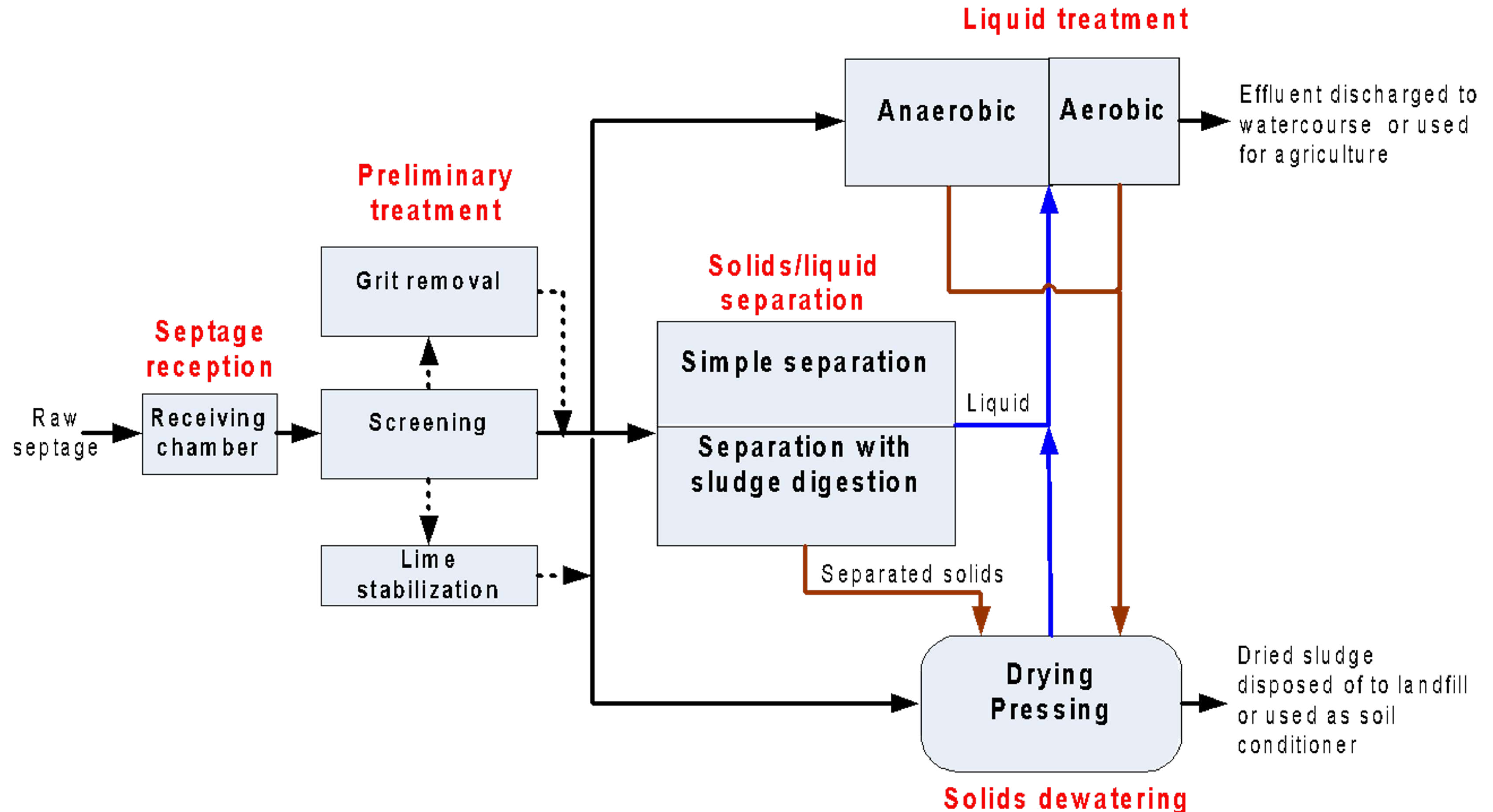


# SELECTION OF TREATMENT MECHANISM

Performance	Local Context	O&M Requirements	Costs
<p>Effluent waste water and solid:</p> <p>Meet the discharge / reuse standards</p>	<ul style="list-style-type: none"> <li>• Characteristics of sludge (dewaterability, solids concentration, stabilisation, spread ability)</li> <li>• Quality &amp; Frequency of the sludge received at treatment facility</li> <li>• Climate</li> <li>• Land availability</li> <li>• End-use</li> </ul>	<ul style="list-style-type: none"> <li>• ULB has human resources and can finance O&amp;M</li> <li>• Availability of skilled persons for more complex technology</li> </ul>	<ul style="list-style-type: none"> <li>• Investment</li> <li>• O&amp;M</li> <li>• Affordability for households and ULB</li> </ul>



# PROCESS OF TREATMENT



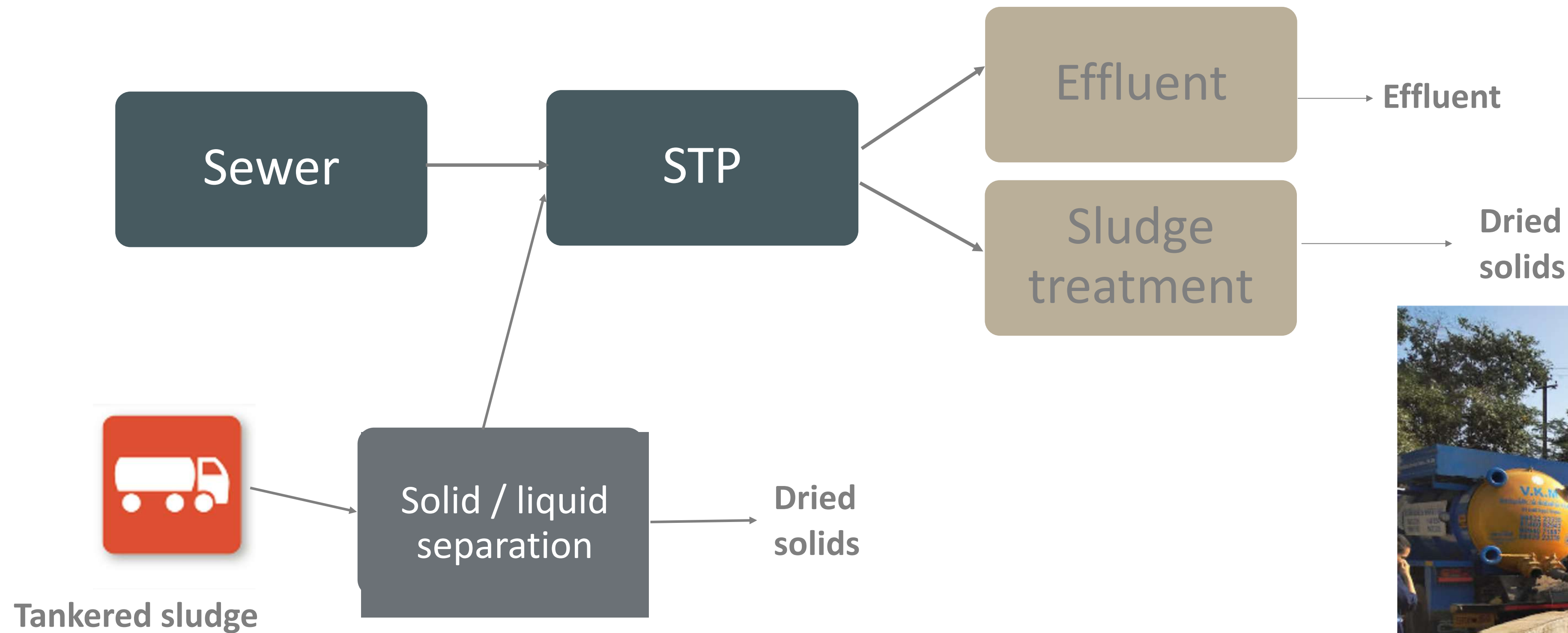


# FAECAL SLUDGE TREATMENT PLANT





# CO-TREATMENT: SEPTAGE WITH SEWAGE



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





# FEASIBILITY OF CO-TREATMENT

## How much FS can be discharged

- Max 1-2% of STP capacity



Source: ESF/Dhawal Patil

## Distance

- Within 15-20 KMS of drive to STP



Source: ESF/Dhawal Patil

## Discharge Location

- Pumping station
- An inlet of STP
- Manhole (trunk sewer)\*



Source: Faecal Sludge Management- Systems Approach for Implementation and Operation



# CO-TREATMENT AT PURI, ODISHA



Receiving Station



Settling Thickening Tank



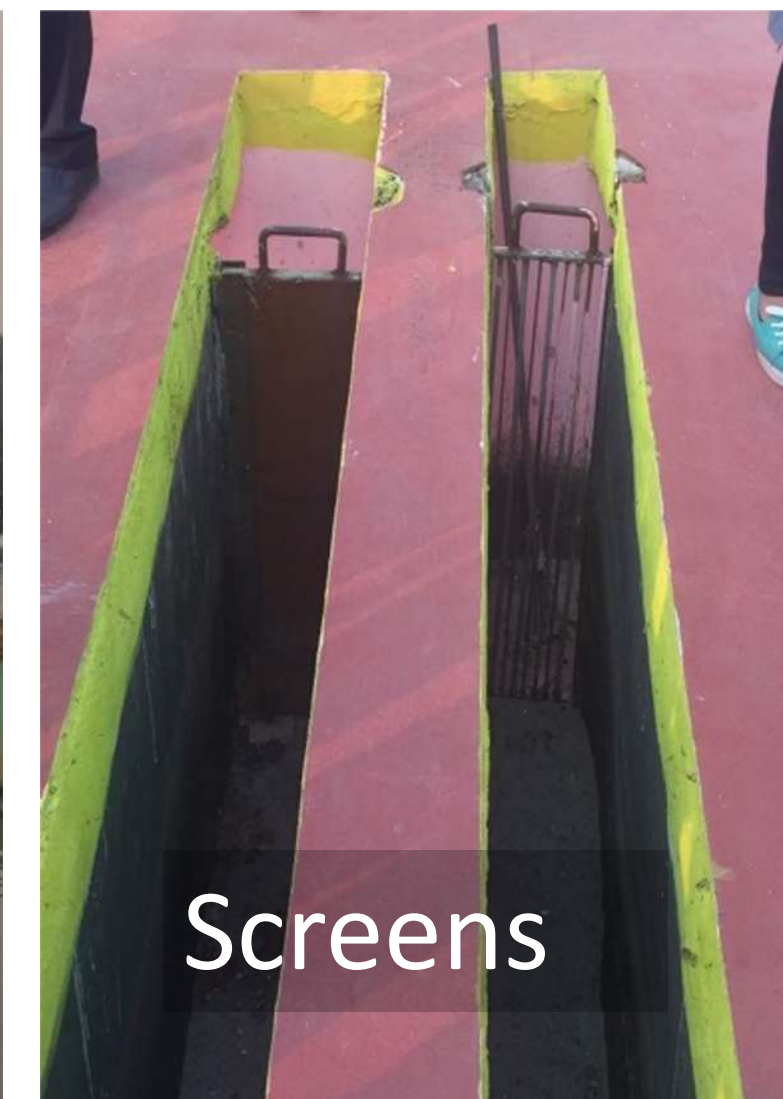
Sludge Drying Bed



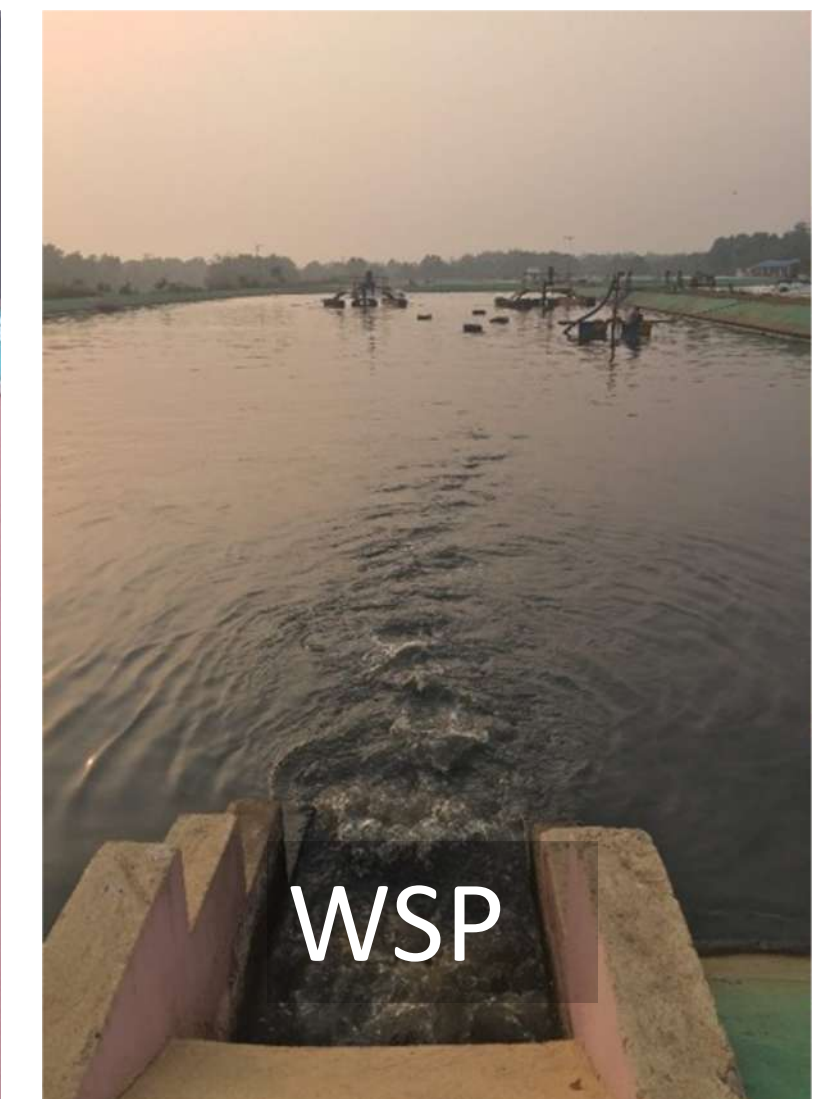
Headworks STP



Desludging Process



Screens



WSP



# CO-COMPOSTING (WITH ORGANIC WASTE/SAWDUST)



**First stages**



**Final stage**





# 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



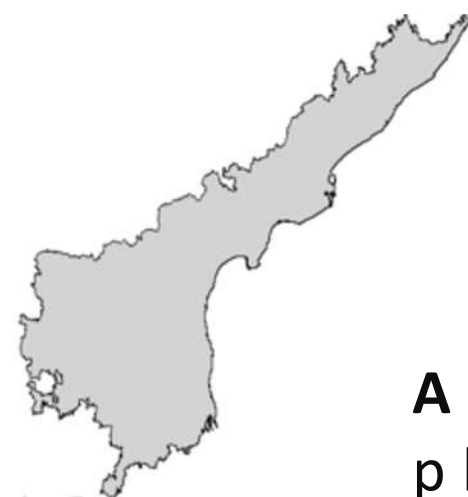
**Tamil Nadu:** FSSM planned in 285 towns



**Odisha:** FSSM planned in 114 towns

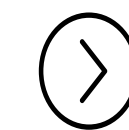


**Uttar Pradesh:** FSSM planned in 31 towns



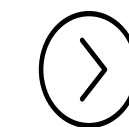
**Andhra Pradesh:** FSSM planned in >140 towns

## 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



Awareness generation, campaigning and leveraging social media



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



Set up stronger dispute redressal mechanisms



Policy interventions at available legislative and administrative spaces

What can you do for India's Sanitation Story?



# 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!

