MuNASS II

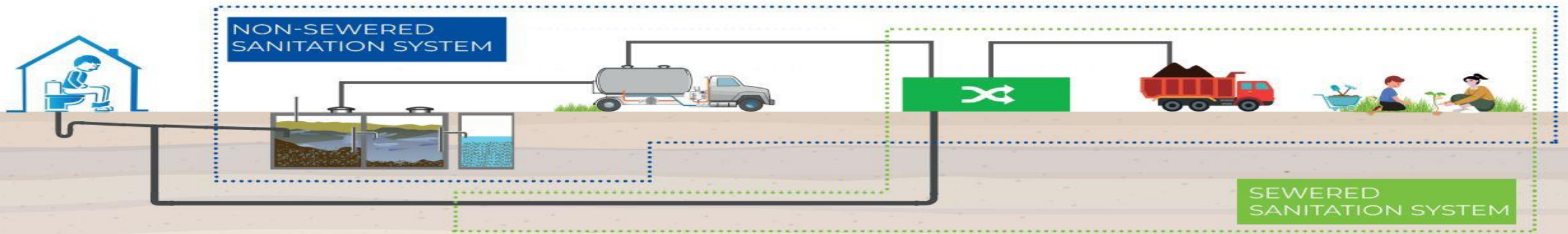**Municipalities Network Advocacy on Sanitation in South Asia**
दक्षिण एशियाका नगरपालिकाहरुको सञ्जालमा सरसफाइ पैरवी कार्यक्रम

Quantification and Characterization

Training on Introduction of Faecal Sludge Management (FSM)/CWIS

ENPHO

Learning Outcomes

Participants will be able to

- Discuss on faecal sludge quantification methods

- Explain characteristics of Faecal Sludge and factors affecting its characterization

Factors Affecting Quantity of FS

- **Location**

Location	Wet weight of faeces (g/person/year)
High income countries	100-200
Low income countries, rural	350
Low income countries, urban	250

Faecal Production rate

- **Processed food: lesser faeces than natural foods**

FSM book (Lentner et al.(1981): Feachem et al. (1983); Jonsson et al. (2005); Vinneras et al. (2006)

Factors affecting quantity of FS

- **Water usage:**

    Water used for anal cleansing and flushing?

- **Nos. of user**

    Higher the no. of user higher the quantity

- **Intrusion of groundwater**

    Quantity varies according to inflow or outflow of water

- **Sludge Accumulation rate**

    Based on the type of Anal cleansing material used

Sludge collection method

- **Sludge Collection/ Desludging/ Emptying based**
- **Population based**

Population based method

Estimates total sludge accumulated in the containments

Data required

- Population/No. of users
- Average Household Size
- Type of containment
- Sludge accumulation rate

Sludge collection method

Estimates total sludge collected by service provider in terms of number of trucks

Data Required:
- No. of vehicles
- Capacity of vehicle (m3)
- No. of trips

Individual Task
(Case study to calculate volume of FS)

Exercise : FS quantification (Population based method)

Data Available:

- Municipality Name: Sundarnagar
- Total household: 50,000
- Population: 250,000
- Average Household Size: 5

Nos. of Household with septic tank = 30,000

Nos. of Household with pit = 20,000

- **Sludge accumulation rate for septic tank = 0.03 m3/person/year**
- **Sludge accumulation rate for pit = 0.04 m3/person/year**

Exercise : FS quantification (Population based)

- Population using septic tank = HH with Septic Tank * Avg. HH Size = ?

- Population using pit = HH with Pit * Avg. HH Size = ?

- Total sludge accumulation in septic tank = population using septic tank * sludge accumulation rate of septic tank

   = ?

- Total sludge accumulation in pit = population using pit * sludge accumulation rate of pit

   = ?

- Total sludge volume = sludge accumulation in septic tank + sludge accumulated in pits tank

   = ?

Exercise : FS quantification (Population based)

- Population using septic tank= 30,000 * 5 = 1,50,000

- Population using pit=20,000 * 5 = 1,00,000

- Total sludge accumulation in septic tank = population using septic tank * sludge accumulation rate of septic tank

  = 1,50,000 * 0.03 = 4500 m3 per year

- Total sludge accumulation in pit = population using pit * sludge accumulation rate of pit

  = 1,00,000 * 0.04 = 4000 m3 per year

- Total sludge volume = sludge accumulation in septic tank + sludge accumulated in pits tank

= 4500+4000 = 8,500 m3/year ~ 24 m3/day

Exercise : FS quantification (Sludge Collection based)

- Municipality name: Sundari Nagar

- Nos. of desludging vehicles = 5

- Vol. of vehicle tank = 4 m3

- Nos. of trips per day = 3 trips/day/vehicle

- Vol. of FS generation per day = Nos. of vehicles * Vol. of vehicle tank * Nos. of trips per day = ?

- **Vol. of FS generation per day = 5 * 4 * 3 = 60 m3/d**
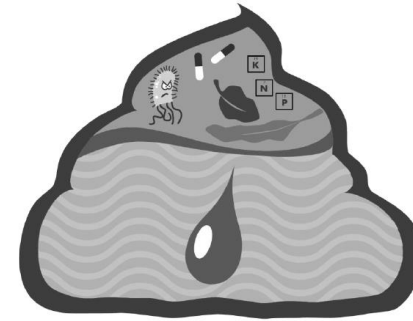
FS characterization

- Feaces
- Urine
- Flush Water
- Anal Cleansing Water
- Sanitary Pad
- Anal cleansing material
- Intrusion water
- Other solid waste

FS contents

Water:

- On average 91-96% of urine is water and 75% of faeces are water (Rose et. al. 2015);
- Liquid content in FS is about 97%.

Organic materials:

- 25% of faeces are solid, of which 84-93% is organic material;
- 4-9% urine is dissolved and suspended solids, of which 65-85% is organic material;

Physical - Chemical constituents

Of the total nitrogen, phosphorus and potassium consumed

- 10-20% of nitrogen, 20-50% of phosphorus, and 10-20% potassium is excreted in the faeces

- 80-90% of nitrogen, 50-65% of phosphorus, and 50-80% of potassium in the urine

Physical - Chemical constituents

- **Nutrients:**
  - Nitrogen (N), Phosphorous (P), Potassium (K)   *(Jonsson & Vinneras, 2004)*

Nutrients	Urine (%)	Feces (%)
Nitrogen	88	12
Phosphorous	67	33
Potassium	73	27
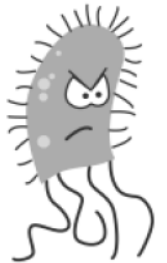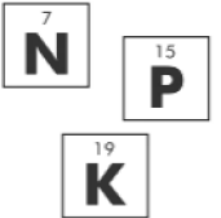
- **Pathogens:**
  - Bacteria, viruses, protozoa, helminths

- **Chemicals:**
  - Heavy metals, hormones and pharmaceuticals;
  - Usually not a big concern in FSM

BOD and COD

- **Biochemical oxygen demand** (BOD) – Amount of dissolved **oxygen** demanded by aerobic **biological** organisms to break down organic material present in Faecal sludge at certain temperature over a specific time period.

- **Chemical oxygen demand** (COD) - the capacity of water to consume **oxygen** during the decomposition of organic matter and the oxidation of inorganic **chemicals**.

NEPAL DISCHARGE STANDARDS FOR TREATED WASTEWATER
Nepal Population and Environment, 2003

Parameter	Limit		Parameter	Limit
BOD_5	50mg/L		TSS	50 mg/L
COD	250mg/L		pH	5.5-9.0
NH_4	50mg/L		Oil & Grease	10mg/L

Comparison between FS and Sewage

Item	Type "B" (Low-Strength)	Sewage (For comparison's sake)
Example	Septage	Tropical sewage
Characterization	**FS of low concentration; usually stored for several years; more stabilized than Type "A"**	
COD mg/l	<15,000	500-2,500
COD/BOD	5:1 - 10:1	2:1
NH4-N mg/l	<1,000	30-70
TS mg/l	< 3%	< 1%
SS mg/l	≈ 7,000	200-700
Helm. eggs, no./l	≈ 4,000	300-2,000

Faecal Sludge ≠ Wastewater

(Heinss et al., 1998)

Factors affecting FS characteristics

Tank emptying technology + pattern

Storage duration (months to years)

Performance of septic tank

Quality of Faecal Sludge

Admixtures to FS
(e.g grease, kitchen / solid waste)

Temperature

Intrusion of groundwater
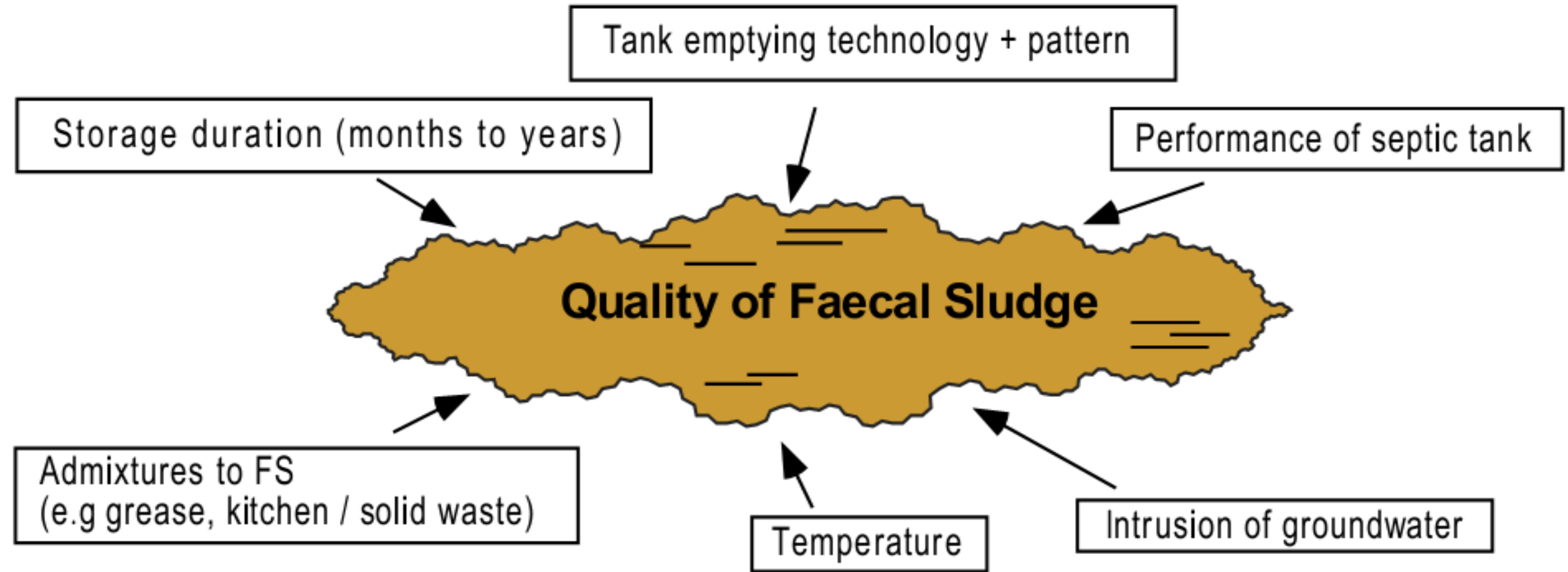
Source: Heinss et al., 1998
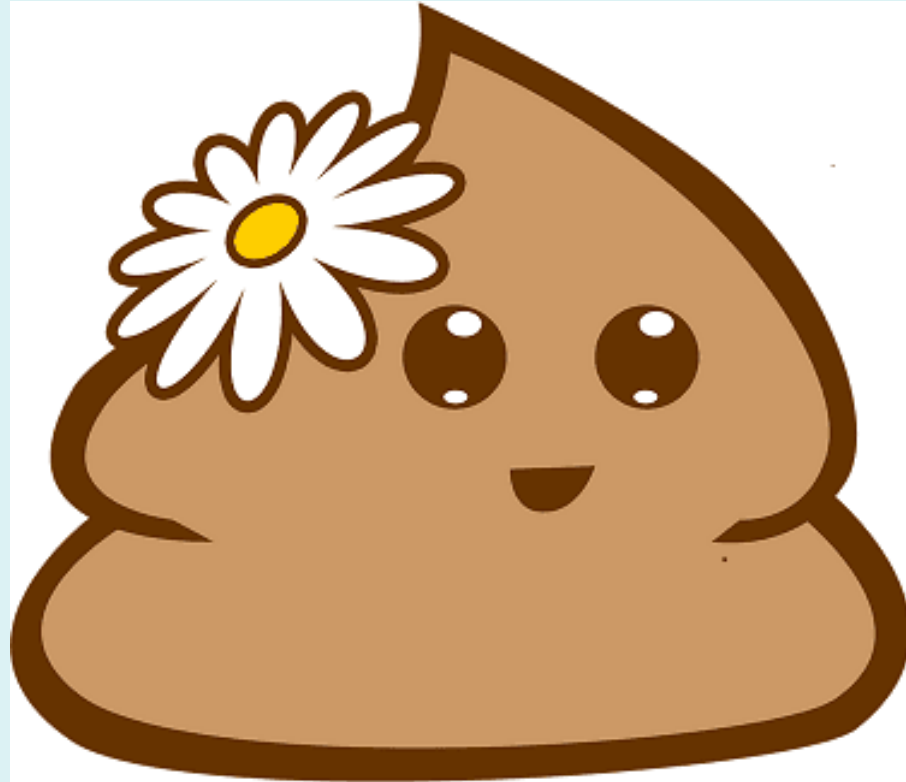
Challenges in FS characterization

- Requires skilled manpower for sampling and lab testing
- Lack of simple methods
- No guidelines or standards
- Time consuming and expensive

Session Recap

Participants will be able to

- Discuss on faecal sludge quantification methods.

  - Tell about Quantification methods

- Explain characteristics of Faecal Sludge and factors affecting its characterization.

  - Tell about characteristics of FS and factors affecting

Thank you very much!