Characteristics of Faecal Sludge generated from Onsite Systems located in Devanahalli

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Need for study

- Characteristics of Faecal Sludge (FS) differ widely between different households, cities and countries; and are influenced by many factors

- Research shows that with this heterogeneous nature, estimating FS characteristics for design is difficult

- In India, there is limited/No data available, to predict or estimate values of FS characteristics

Objective of study

- To assess the physical and chemical characteristics* of FS samples that are collected at the faecal sludge treatment plant (FSTP), Devanahalli

- To define ranges for different parameters of faecal sludge for design

- To study the effects of different factors like age, source, season on FS characteristics

* Parameters named in slide no 7

FSM4

Project location: Devanahalli

- Devanahalli is a Town located in Bangalore Rural District

- No sewer systems

- Suitable for FSM implementation

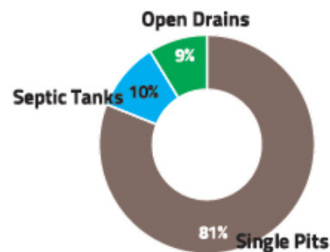- A baseline study has been conducted to understand the FSM Value chain

Population- 26309 (Census 2011)
Area -16 sq.km
Water supply- 60-80 lpcd

Project location: Devanahalli

Sanitation Value Chain
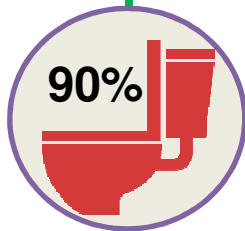
- Flush toilets **16.4%**
- Pour flush toilets **83.6%**

(90%)

Open Drains 9%
Septic Tanks 10%
81% Single Pits

- With bottom lining- 35%
- No outlets

- TMC- 1 No
- Private- 4-5 Nos

- FSTP- 6m^3

- Sludge – Compost

FSM4

Methodologies

- FS samples (composite samples) are collected at the inlet of the treatment system at the time the trucks are discharging FS to the FSTP

- Collected FS samples are analyzed for
  - Physical : Color, Odour, Solids (TS, VS) and Turbidity
  - Chemical: pH, COD, BOD, NH_3-N, PO_4, Alkalinity

- Source data collected using Manifest form

- In this study, 250 FS samples collected over Dec 2015- Dec 2016 are considered for analysis
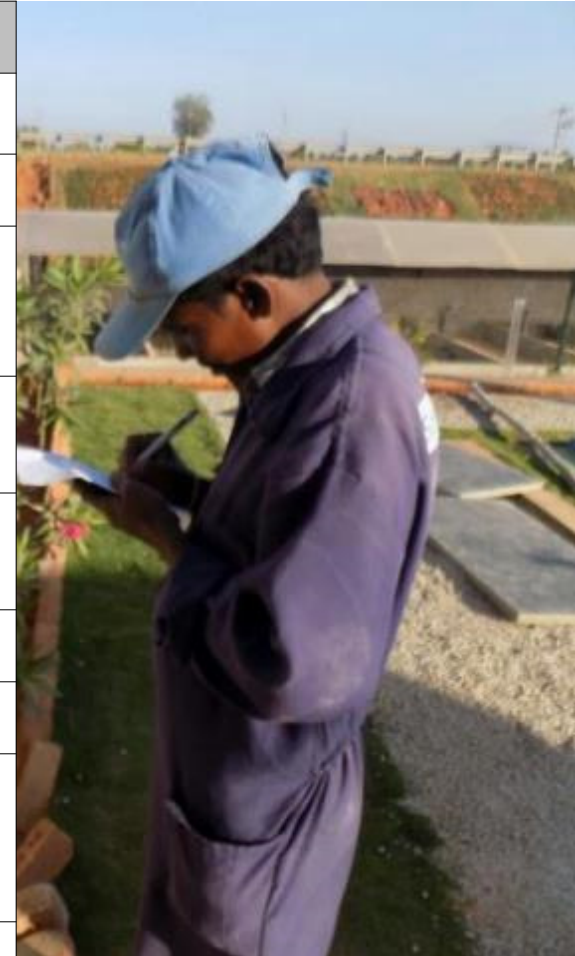
Sampling

Feed to FSTP - Samples
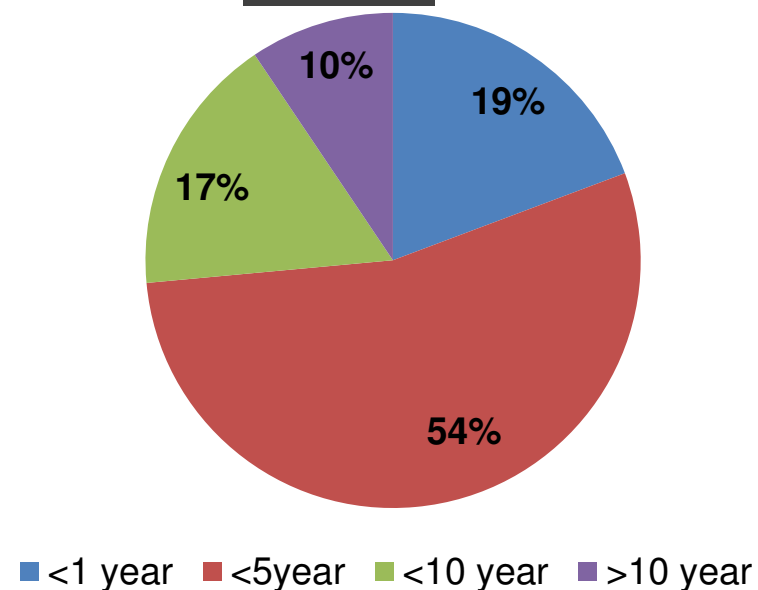
Manifest form: Source data collection

Particulars	Answers
Date of desludging	
Volume of FS, L	
Source	Household/ Commercial/ institute/ others
Type of containment system	Septic tank/Pit
Specifications of Containment system	
Age of FS	
Reasons of desludging	
Any additive added Type Quantity	
Address and contact details of source	

Source and Desludging frequency

Source to FSTP

Commercial, 4%

Public toilets, 3%
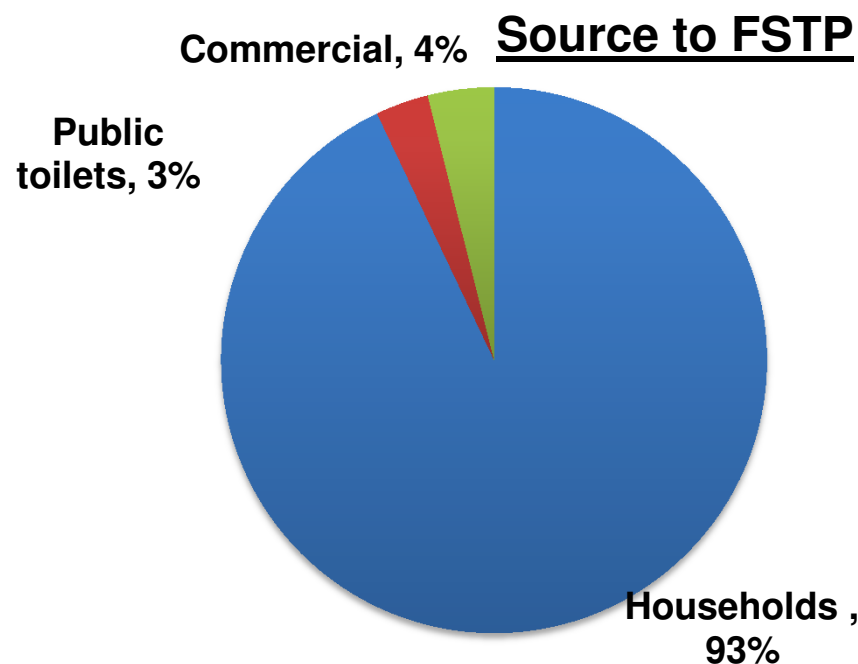
Households, 93%

Desludging frequency of samples

19%

54%

17%

10%

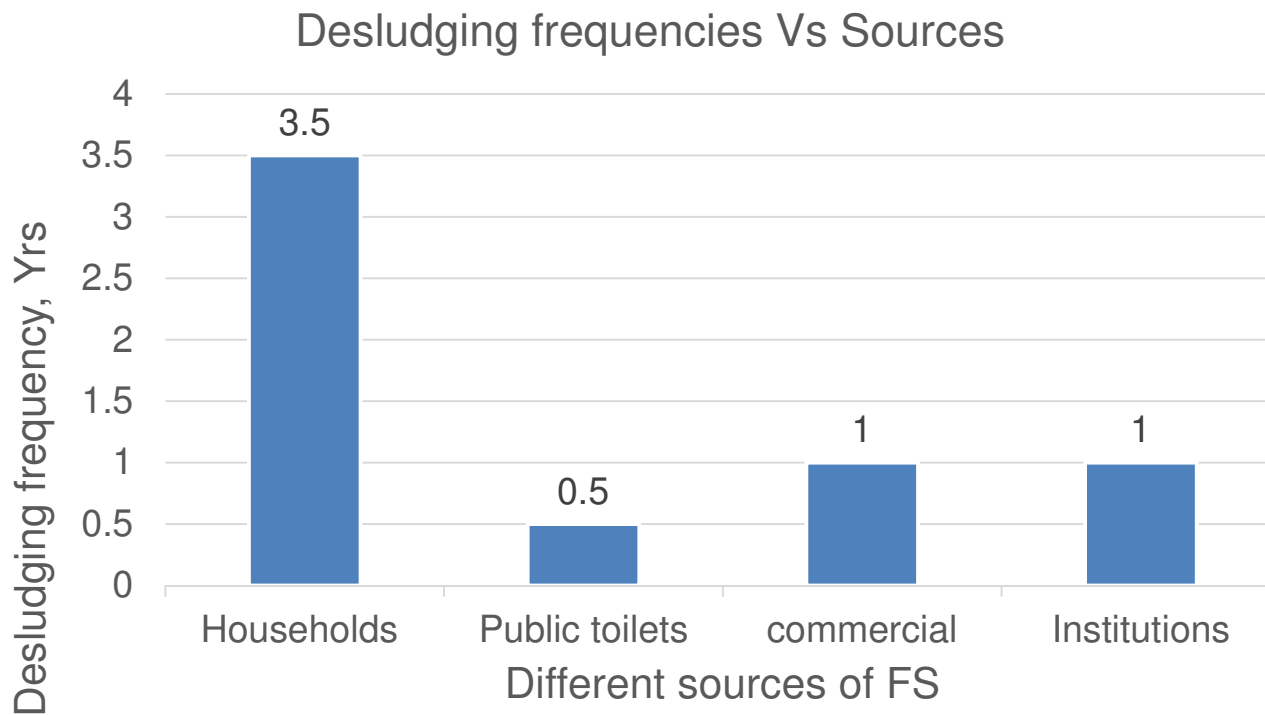■ <1 year ■ <5year ■ <10 year ■ >10 year

Key Observations
1. Majority of load has arrived from households
2. The majority of FS load delivery has age between 1-5 years

FSM4

Desludging frequency Vs Source

Desludging frequencies Vs Sources

Chart: Desludging frequency (Yrs) vs Different sources of FS
- Households: 3.5
- Public toilets: 0.5
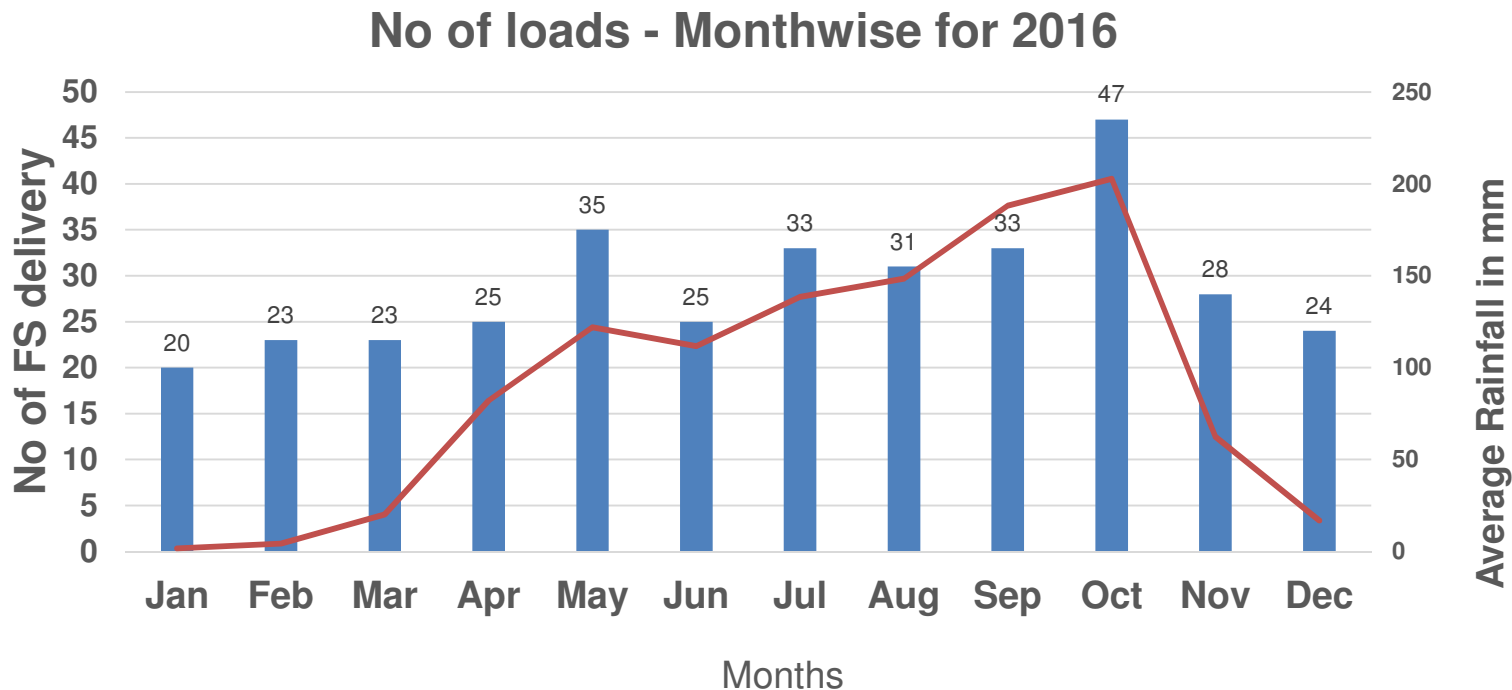- commercial: 1
- Institutions: 1

Source
Households- Individual, group of households (230 samples)
Commercial- Hotels, Restaurant
Institutions- Hostels, school
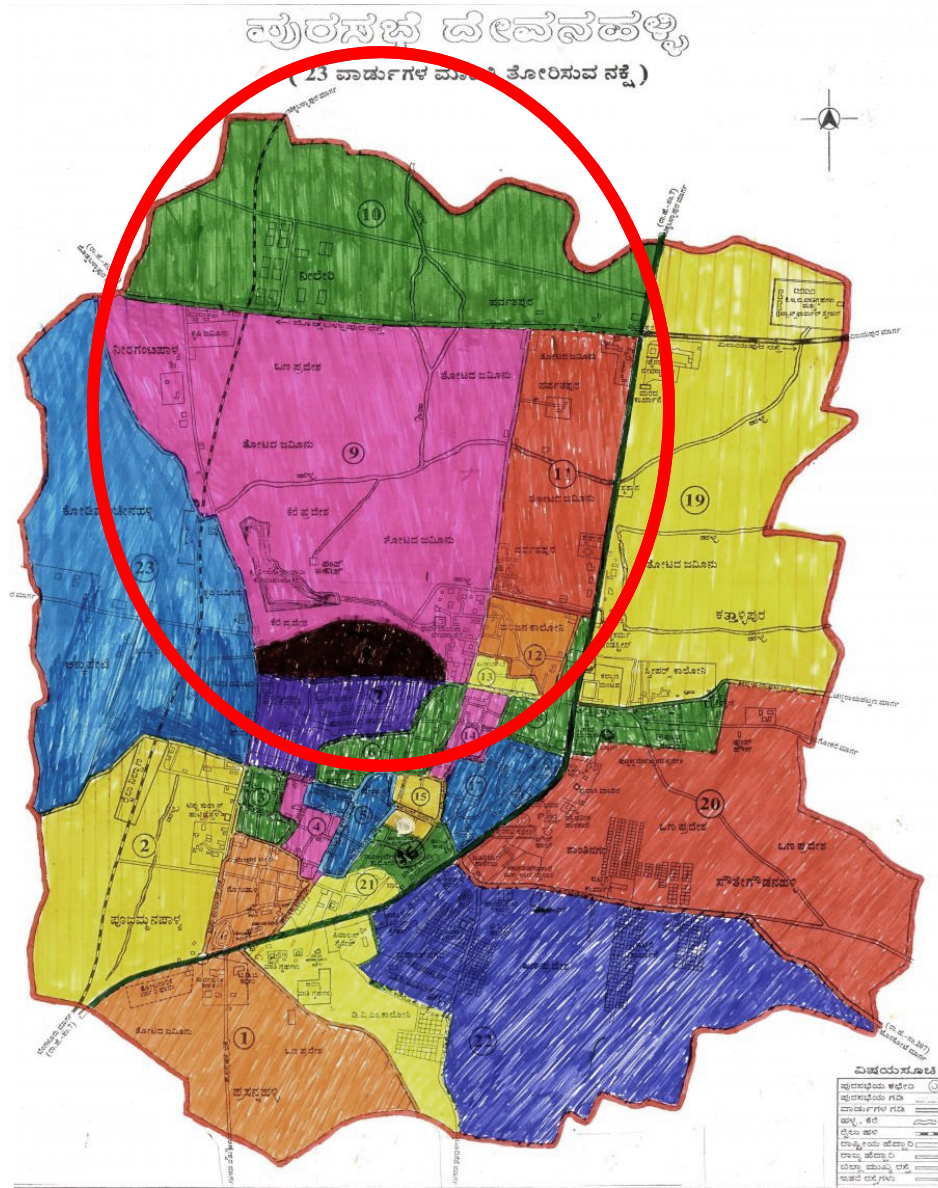
Seasonal variation of FS load to FSTP

No of loads - Monthwise for 2016

Key observations:
1. Feed to the plant is increased during the rainfall months

1 FS delivery= Avr.2000L, Capacity of plant- 6000L/d
**Total FS Quantity(340 Samples)- 700m³**

Source: https://www.worldweatheronline.com/devanhalli-weather-averages/karnataka/in.aspx

Key observations:
1. Majority of loads from surrounding of lake area

Results- Sample analysis

Parameters	Average	Maximum	Minimum	Standard Deviation	Median
pH	7.4	9.4	6.4		
COD, mg/l	59,745	1,90,300	7,450	42,839	50,825
TS, mg/l	42,395	1,24,375	868	30,568	31,605
VS, mg/l	15,223	86,390	265	17,565	21,005
NH_3-N, mg/l	1,323	10,800	100	1,422	1,000
PO_4, mg/l	1,001	8,240	100	1,525	640

As per Strauss, 1997, the faecal sludge samples analyzed fall under the category of Type "A" high strength (highly concentrated)

FSM4

COD & Solids
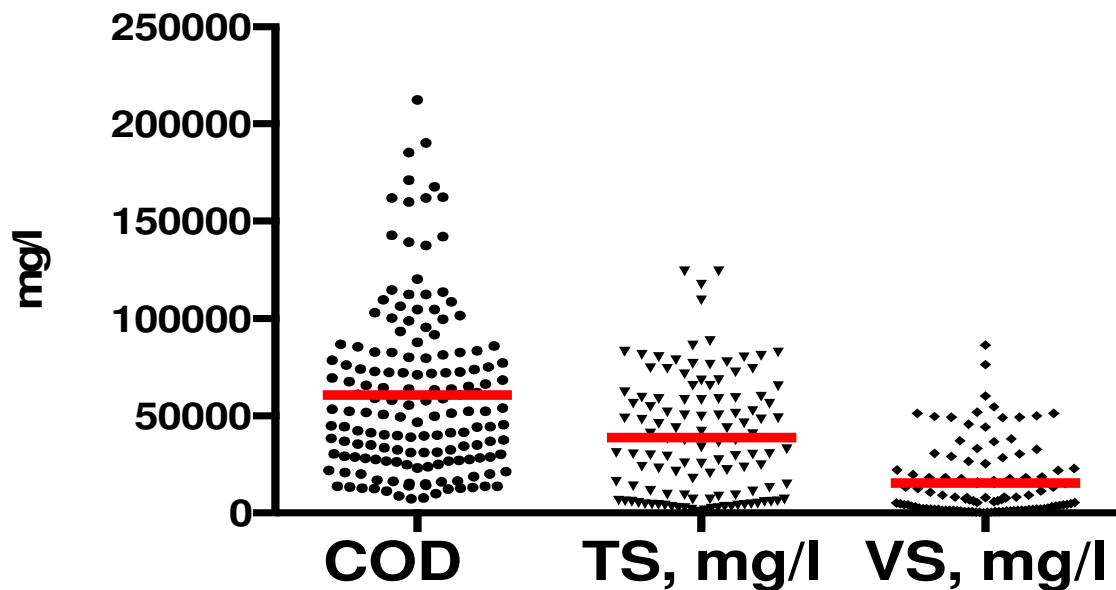
Key results- COD
Avearge-59745mg/l
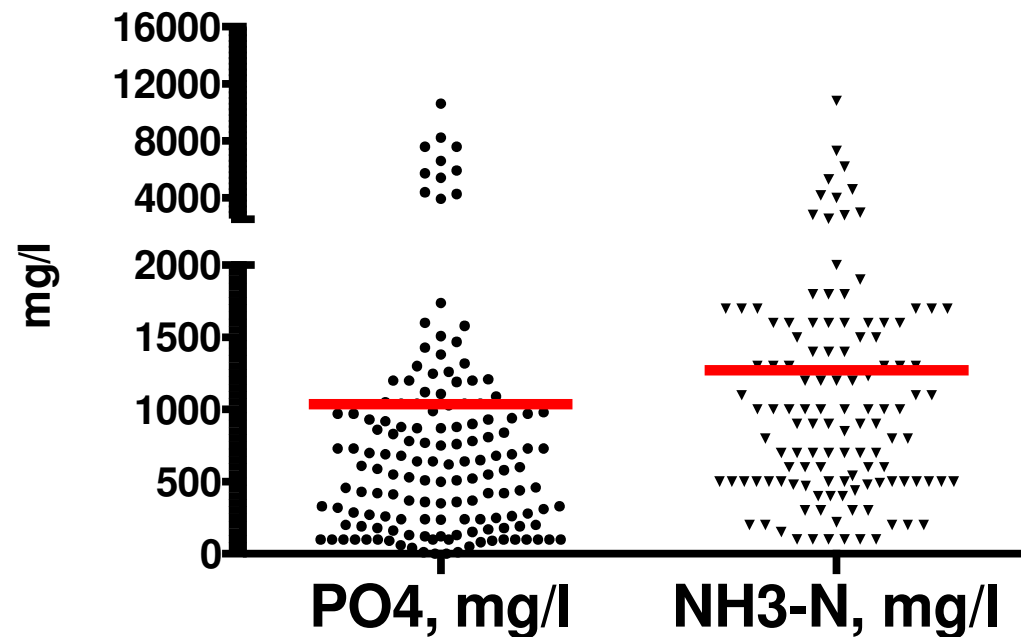
Key results- Total solids
Average -42395 mg/l

Key results- Volatile Solids
Avearge- 15223 mg/l

As per Strauss, 1997, the faecal sludge samples analyzed fall under the category of Type "A" high strength (highly concentrated)

Nutrients

Key results- PO$_4$
Avearge-1001mg/l

Key results- NH$_3$-N
Average -1323 mg/l

As per Strauss, 1997, the faecal sludge samples analyzed fall under the category of Type "A" high strength (highly concentrated)
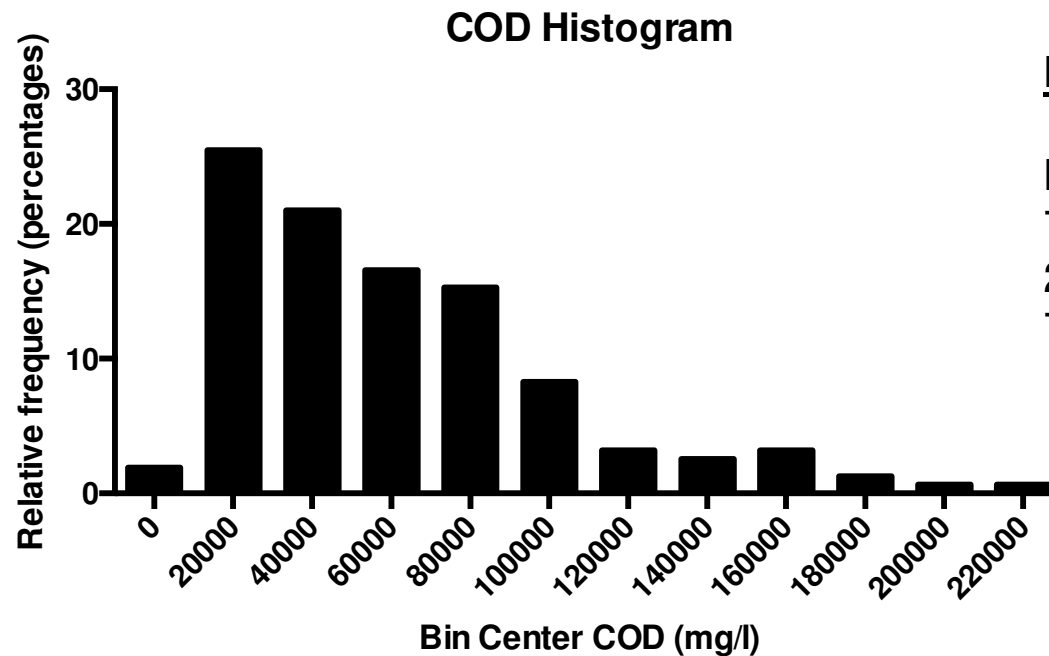
COD Values

COD Histogram

Key results
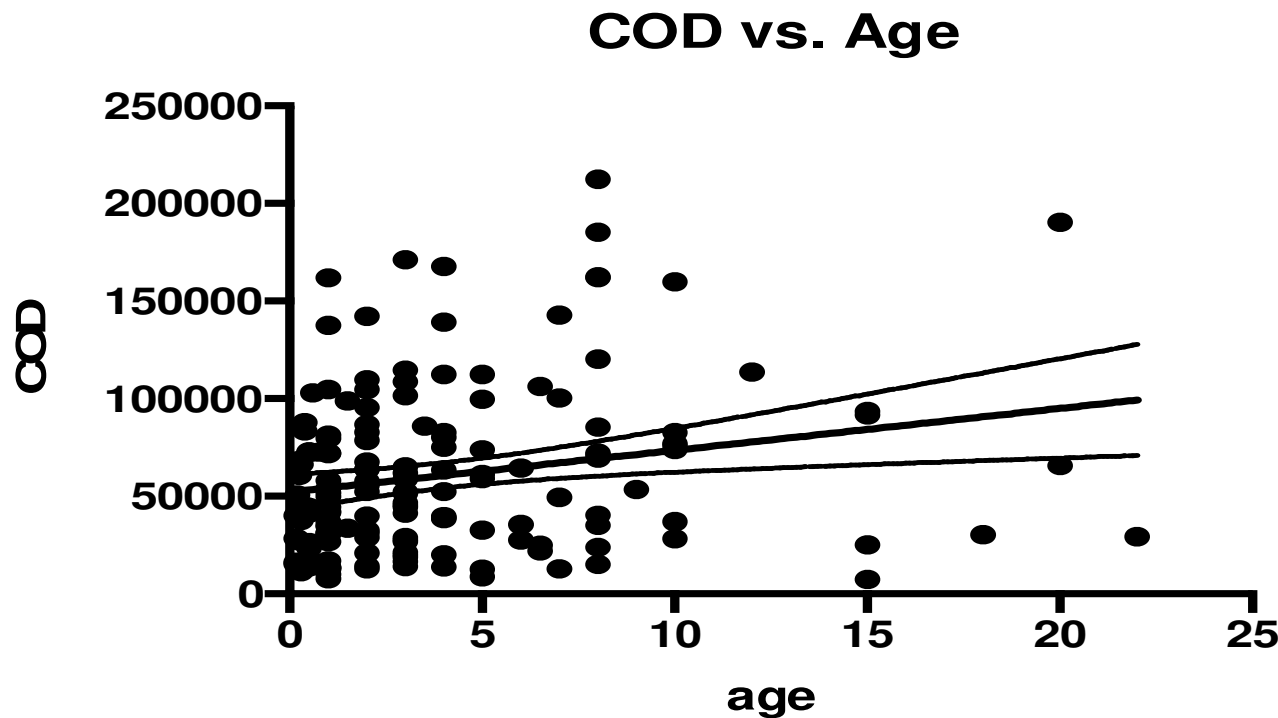
Mean- 60000 mg/l
78% of COD values between 20-80000mg/l
25% samples are < 28000 mg/l
75% of samples are <82000 mg/l

Key results:
1. 75% of samples are < 82000 mg/l

COD Values Vs Age

COD vs. Age

Correlation between Sludge age and COD:
Positive relation $r = 0.21$ and $r^2 = 0.04$

Key results:
1. The statistical analysis shows a positive correlation between COD and age

Outcomes

- This study again proves the highly variable nature of faecal sludge (Refer Slide 13;SD for COD ±42,839, TS ±30,568, VS±17,565, NH_3-N±1422, PO_4±1,525)

- Variations in characteristics were observed in relation to age of sludge (positive correlation between COD and age), type of sources like commercial, household, institutes

- The FS delivery to FSTP increases during rainy season (No of deliveries/month increases from 23 to 47 loads)

Further Studies

- Further analysis for biodegradability, pathogen and heavy metal content of FS samples

- Correlation between different aspects to FS characteristics
  - Seasonal variation and FS characteristics
  - Type of containment and FS characteristics
  - Impact of additives to FS characteristics
  - Determination of Calorific values of FS

- More samples to be analyzed for different sources for better understanding of FS characteristics

Key take away

- Implication of FS analysis results
    - Designers

        Can we use these data for other cities of same tropical conditions, what are quality checks ??

        What are the values to be considered for design of FSTP??

    - Policy makers
        - What are the technologies and discharge/reuse standards to be recommended ??
        - What measures to be taken to handle the FS (frequent desludging)??