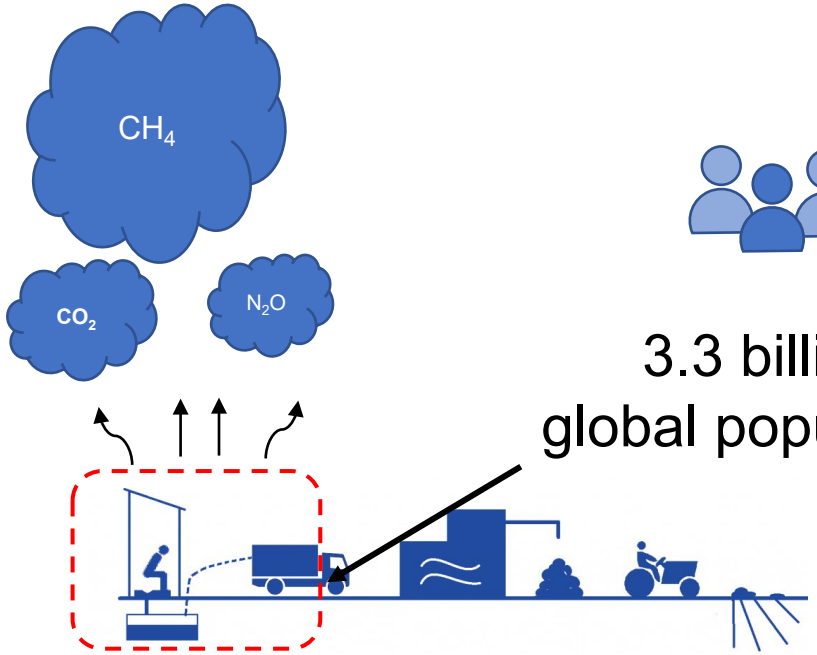
MEASURING GREENHOUSE GAS EMISSIONS FROM ONSITE SANITATION SYSTEMS IN NEPAL

Prativa Poudel, Subodh Sharma, Anish Ghimire, Guy Howard, Barbara Evans, Miller Alonso Camargo-Valero, Manish Baidya, Sarana Tuladhar

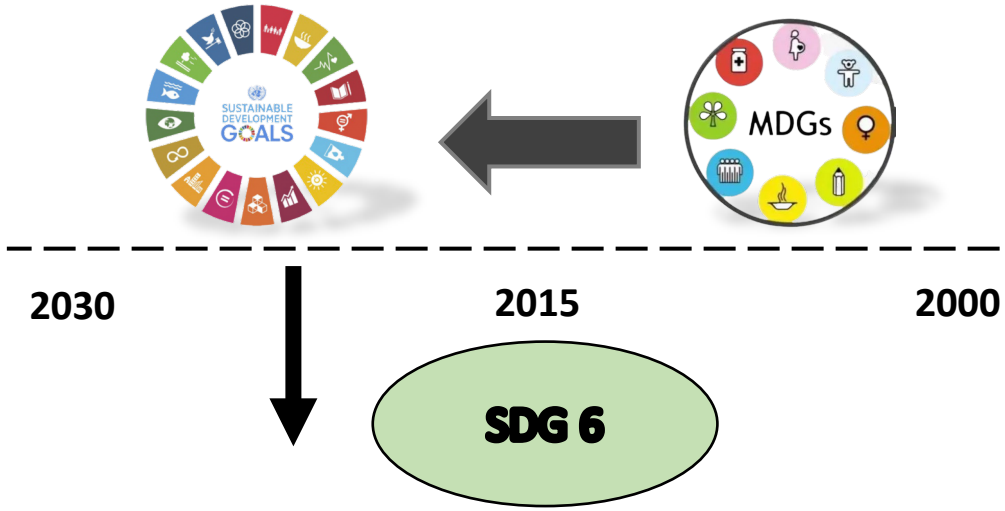
Kathmandu University

Nepal

INTRODUCTION



3.3 billion global population[1]



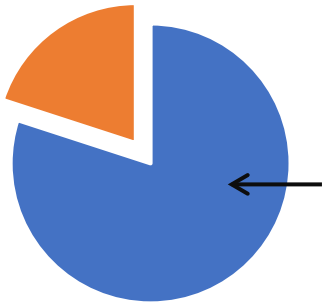
- **Increasing priority** to OSS- Low and middle-income countries (LMICs)

- Onsite sanitation system (OSS) has been identified as the **source of greenhouse gas (GHGs) emissions** [2,3,4,5].

- **About 4.7 %** of methane emissions are shared by onsite sanitation systems[6].

- Very few documentation focused on countries with a **high number of septic systems** [5,7,8,9].

CONTD…



- **83% of the total population of Nepal: OSS[10].**
- **With the majority being pit latrines, holding tanks, and septic tanks.**

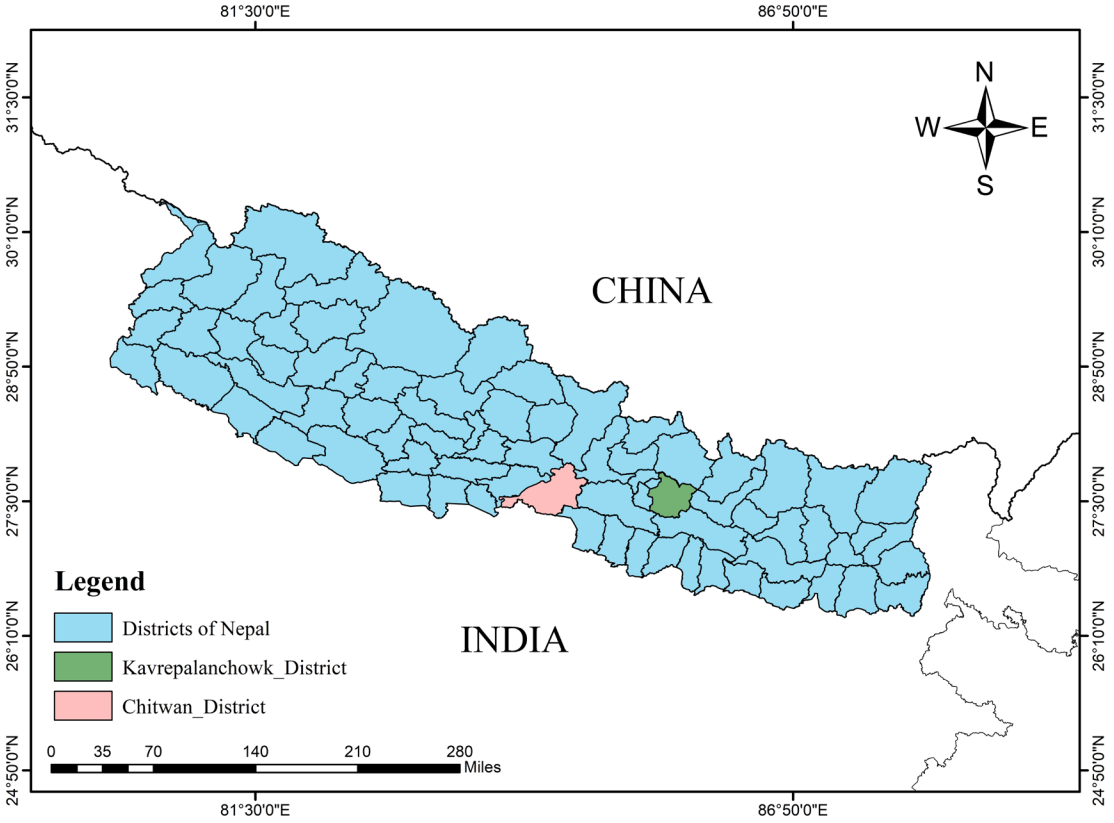
- Emissions from these containments are unknown
- The first study to quantify greenhouse gases emission from containments in Nepal.

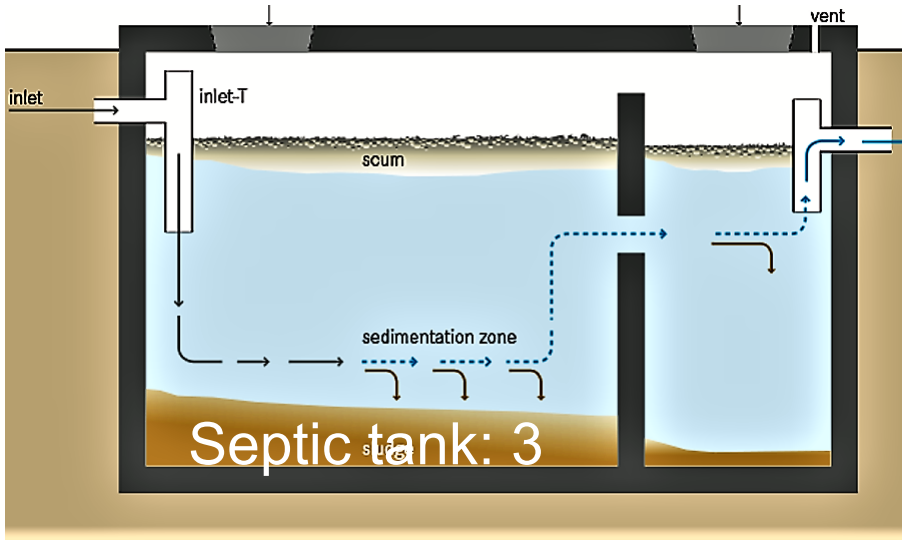
Aim of the study:

- To measure GHGs emissions from different containment types and their relationship to faecal sludge characteristics.

CO_2
CH_4
N_2O

STUDY AREA

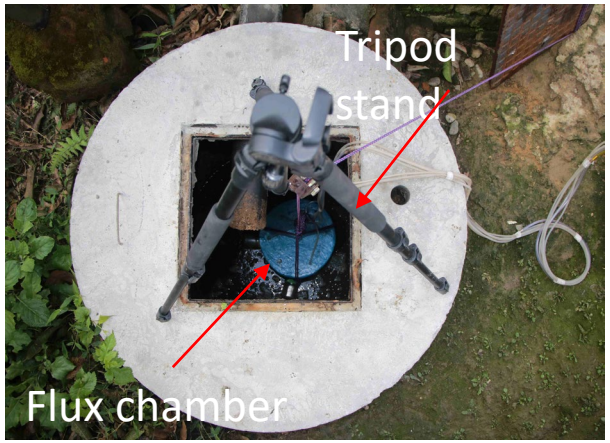


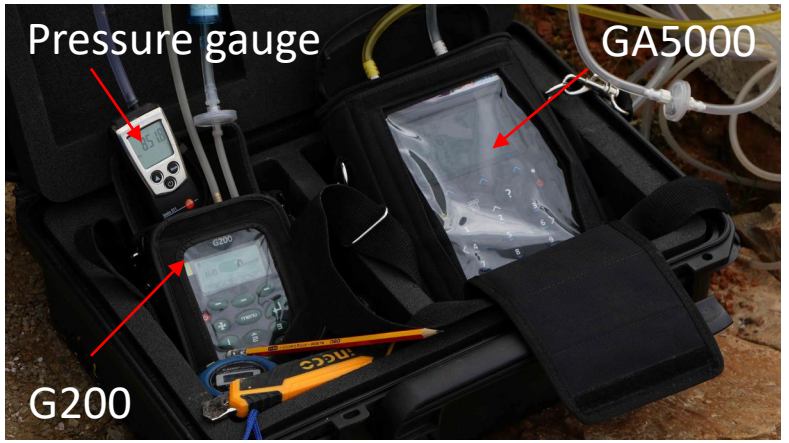


Secondary chambers of holding tank:2

- Gas sampling: December 2021-November 2022
- Sludge sampling: December 2021-May 2022

METHODS AND MATERIALS





Modified static flux chamber

- 12-inches diameter
- Glass fiber material

Gas analyzers GA5000: CH_4, CO_2 & G200: N_2O

Composite sample collection

- **Calibration and validation: Aquatic Ecology Centre, Kathmandu University**

- **Faecal sludge characterization: APHA 23rd edition**
  - pH, Temperature, Electrical Conductivity(EC), Total Dissolved Solids(TDS), Moisture Content, Total Solids(TS), Volatile Solids(VS),Chemical Oxygen Demand(COD), Ammonia(NH_3), Total Kjeldhal Nitrogen(TKN)

CALCULATION AND DATA ANALYSIS

1. Convert

% to mg m^{-3}

2. Plot

conc. in mg m^{-3} vs time

3. Calculate

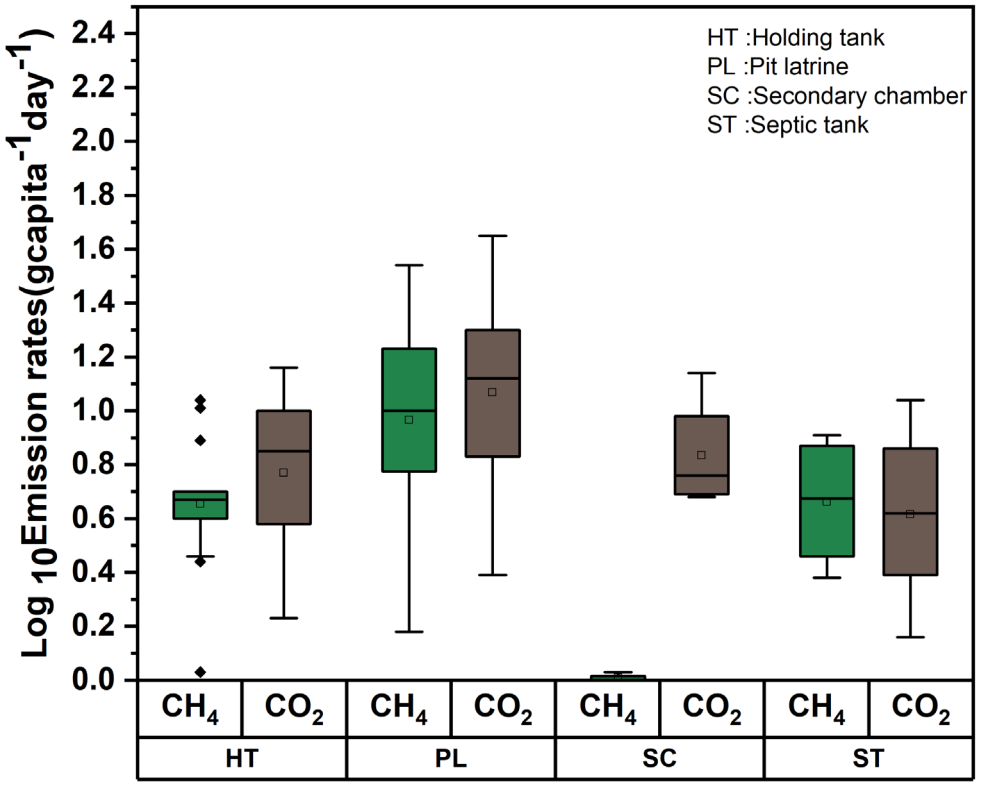
$$ER = \frac{m * 1440 * 10^{-3} * Vfc * A_{comp}}{(A_{fc}) * n}$$

1440 : minutes in a day
V_{fc} : volume of FC(m^3)
A_{comp}: area of the compartment(m^2)
A_{fc} : area of the chamber(m^2)

- ER obtained is in **g $capita^{-1}$ day^{-1}**
- All the variables were **log-transformed** to attempt the normal distribution.

RESULTS

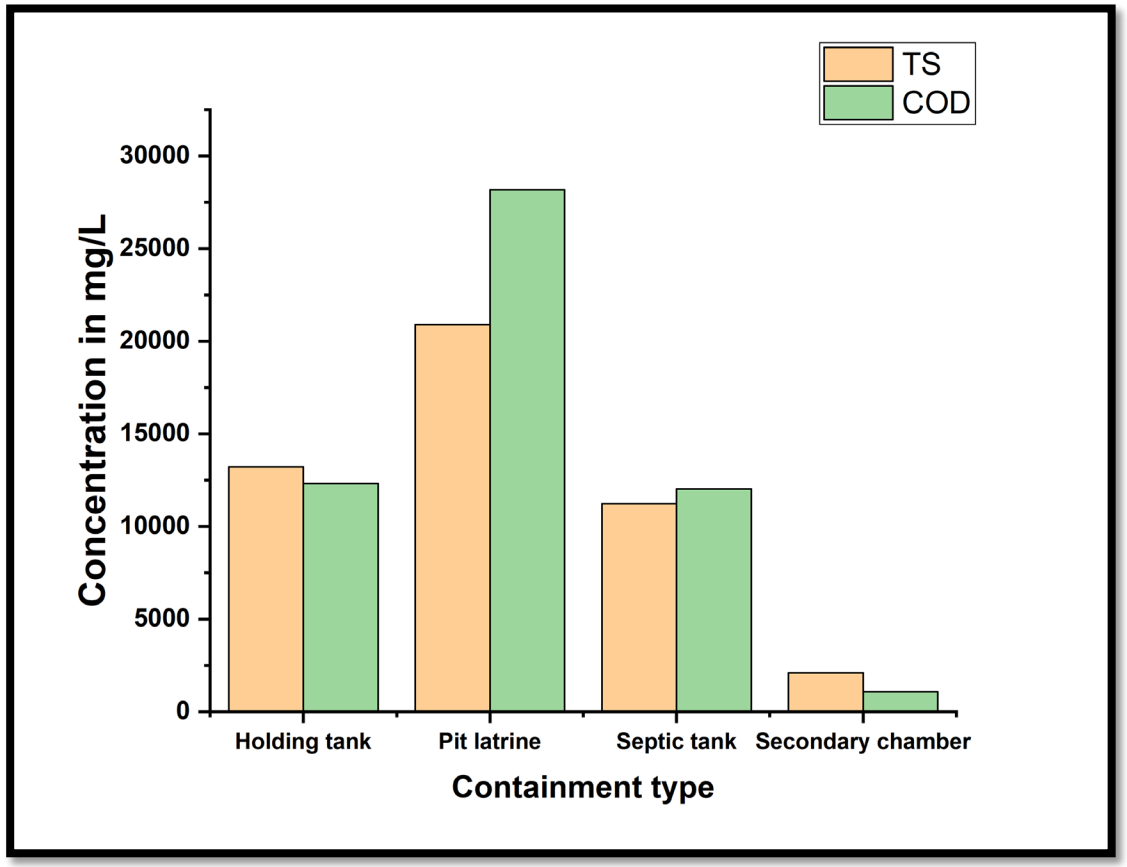
Containment type	Mean CH_4ER (g capita^{-1} day^{-1})	Mean CO_2ER (g capita^{-1} day^{-1})
Holding tanks	4.25±1.74	6.08±2.0
Pit latrines	7.51±2.40	12.81±2.14
Septic tanks	4.31±1.78	3.07±2.04
Secondary chamber	0.15±1.45	6.59±2.00

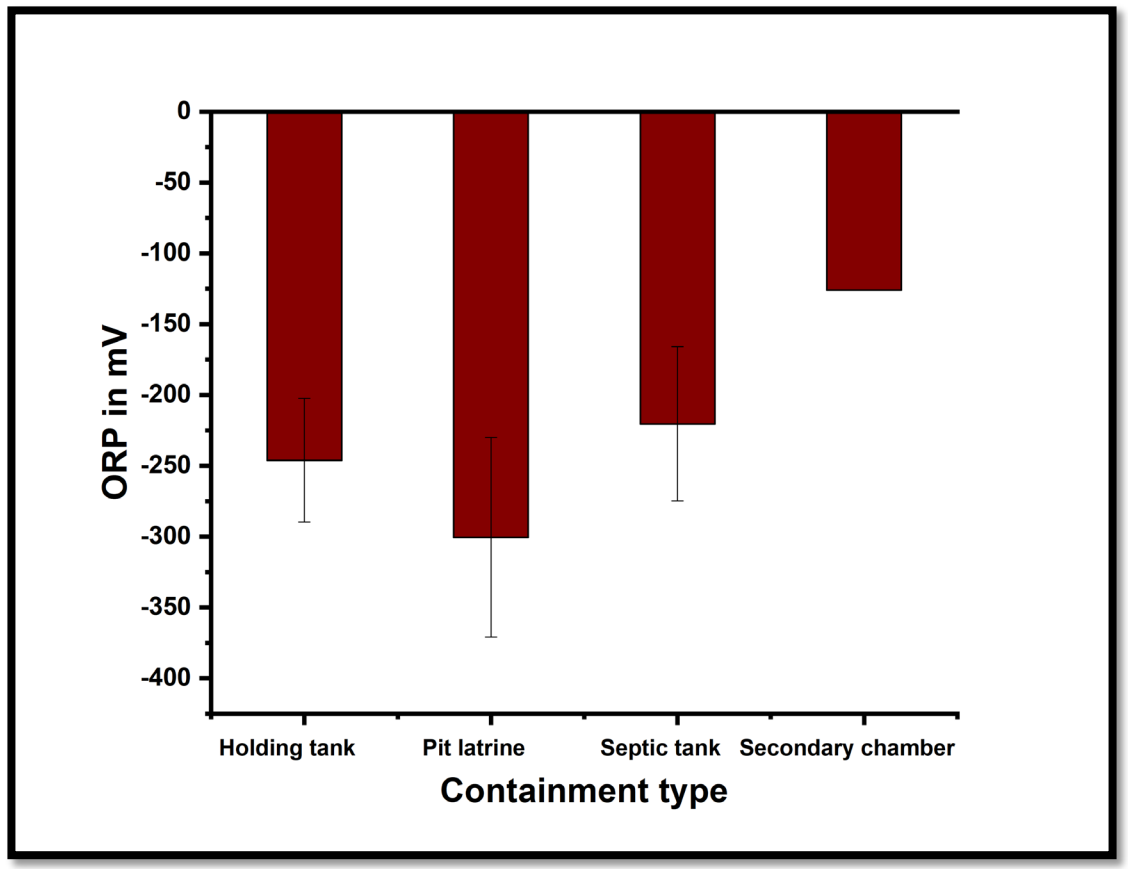


- N_2O was not detected by the instrument.
- **One-way ANOVA test** shows that the CH_4 and CO_2 emissions significantly vary between various containment types (*p* value<0.05).

Methane emission rate=CH_4ER
Carbon dioxide emission rate= CO_2ER

CONTD

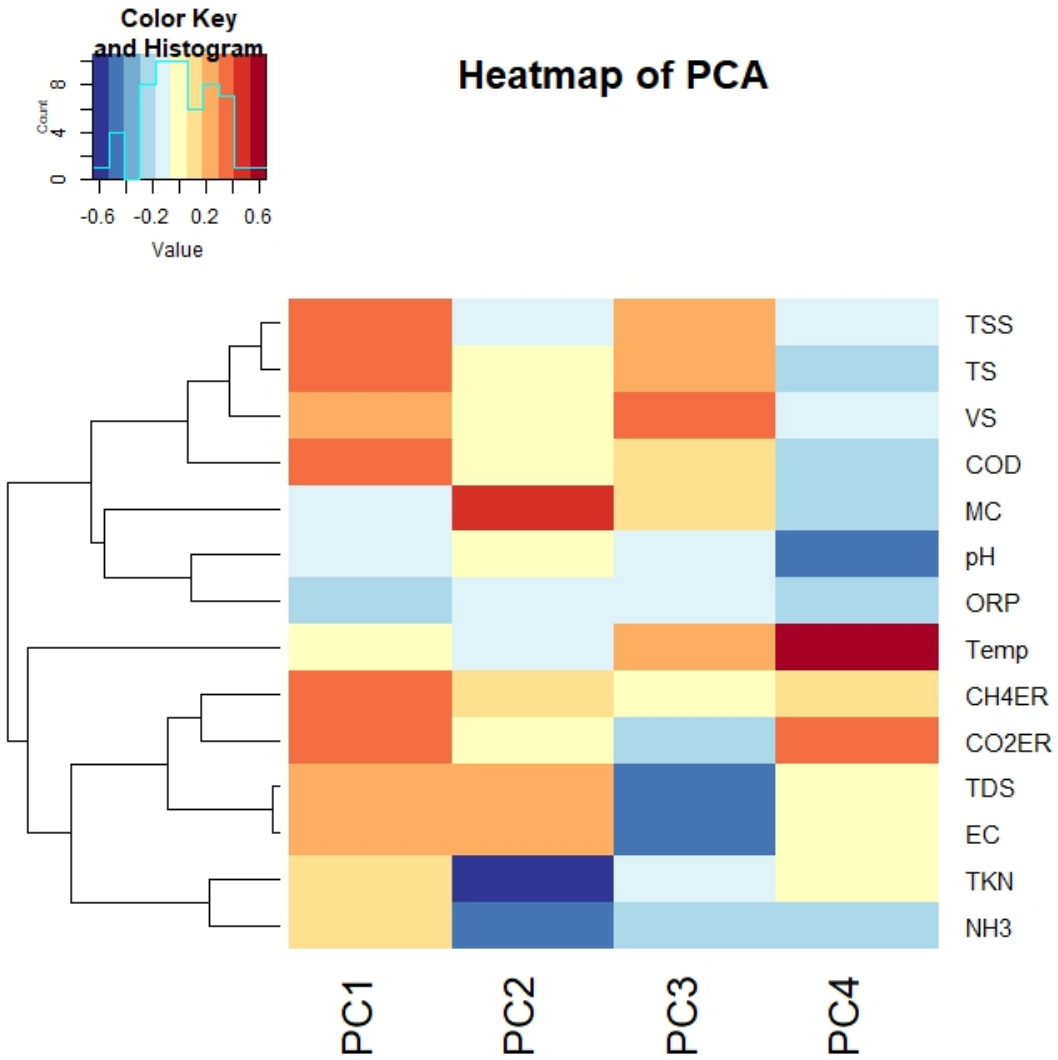




- **Variation in FS characteristics** was observed between the containment types.
- Pit latrines were observed to have **higher TS, COD, and highly negative ORP.**
- Highly negative ORP and higher COD - More anaerobic conditions favoring the emissions

PEARSON CORRELATION AND PRINCIPAL COMPONENT ANALYSIS(PCA)

- A **positive correlation** between
  - ➢ CH_4ER and TS, VS, EC, TDS& COD (*p-value*<0.01)
  - ➢ CO_2ER and COD, EC, TDS *(p-value*<0.01)
- A **negative correlation** between
  - ➢ CH_4ER, CO_2ER, and ORP (*p-value* <0.01)
- **No correlation** between GHGs and pH, Temperature, MC, NH_3, and TKN.



Variance explained: 37.5 % 13.9% 12.5% 9.4%

CONCLUSIONS

- Methane and carbon dioxide emissions from **pit latrines** are significantly more than holding tanks, septic tanks, and secondary chambers

- This gives an **overview for understanding** the emissions occurring from various containment types existing in Nepal

- **Detailed studies on containment type** and management practices are important to give any kind of policy recommendation.

- Seasonal variations in FS characteristics need to be explored for a **better picture** of GHG emissions.

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Prativa Poudel

Ph.D. Scholar

Kathmandu University

9779849926578

Prativapoudel1@gmail.com

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