

LIFE CYCLE (LC) FOR FARM MANURE AND GREENHOUSE GAS EMISSIONS AT EGERTON UNIVERSITY, KENYA

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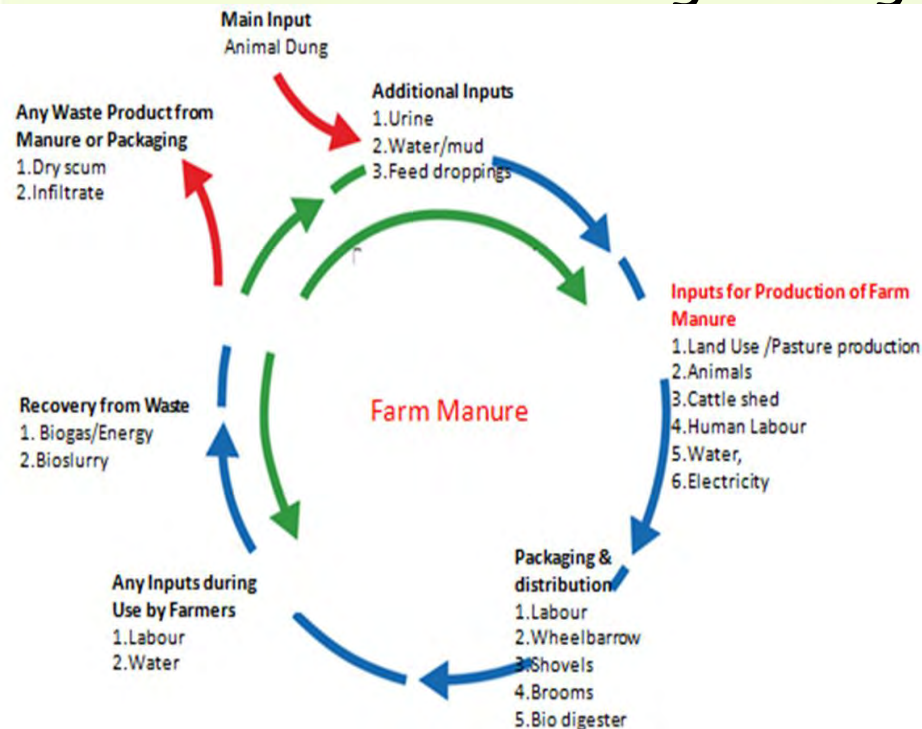


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INTRODUCTION

- Poor Farm manure LC accounts for about 31% of Greenhouse gases (GHGs) emissions mainly:
 - Methane (CH_4),
 - Nitrous oxide (N_2O) and
 - Ammonia (NH_3) (UNECE, 2016; UNFCCC, 2016)
- Study aimed at mapped & quantified GHGs hotspots at Egerton University for sound farm manure management and hence climate change mitigation



MATERIALS AND METHODS

- Study sites were Tatton (Teaching) and Ngongoneri (Commercial) Farms of Egerton University
- Quantification of emissions from manure

- Methane (E_t),
$$E_t = (F_e P_d) 10^{-6}$$

- where

E_t = Total emissions (Gg/year)

F_e = Emissions factor (kg/head/year) based on the climate local data

P_d = Dairy cattle population (head)

- Ammonia (E),
$$E = A[TAN]H^* r^{-1}$$

- where,

E = Emissions (kg NH_3 /cow day)

A = Fouled surface area per cow ($\text{m}^2 \text{ cow}^{-1}$)

TAN = Total ammoniacal nitrogen (kg m^{-3} as NH_3)

H^* = Effective Henry's Law Constant (dimensionless)

r = Mass transfer resistance (day m^{-1})



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Carbon (iv) oxide (CO₂) emissions

- The amount of CO₂ emitted from the lagoons was estimated based on equation 3

$$CO_2 = 10^{-6} \times Q_{WW} \times OD \times Eff_{OD} \times CF_{CO_2} \times [(1 - MCF_{WW} \times BG_{CH_4})(1 - \lambda)] \quad (3)$$

- where,

CO₂ = CO₂ emission rate (Mg CO₂/hr)

CH₄ = emission rate (Mg CH₄/hr)

Q_{ww} = Wastewater influent flow rate (m³/hr)

OD = Oxygen demand of influent wastewater to the biological treatment unit

Eff_{OD} = Oxygen demand removal efficiency of the biological treatment unit

CF_{CO₂} = Conversion factor = 1.375 g CO₂/g O₂ demand

MCF_{WW} = methane correction factor = 0.2

BG_{CH₄} = Fraction of carbon = 0.65



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RESULTS AND DISCUSSIONS

•Manure Hotspots and QGIS Map

1. Animal open lots, holding yards,
2. Milking parlours,
3. Oxidation Ponds (lagoons)
4. Biogas plant (digester)

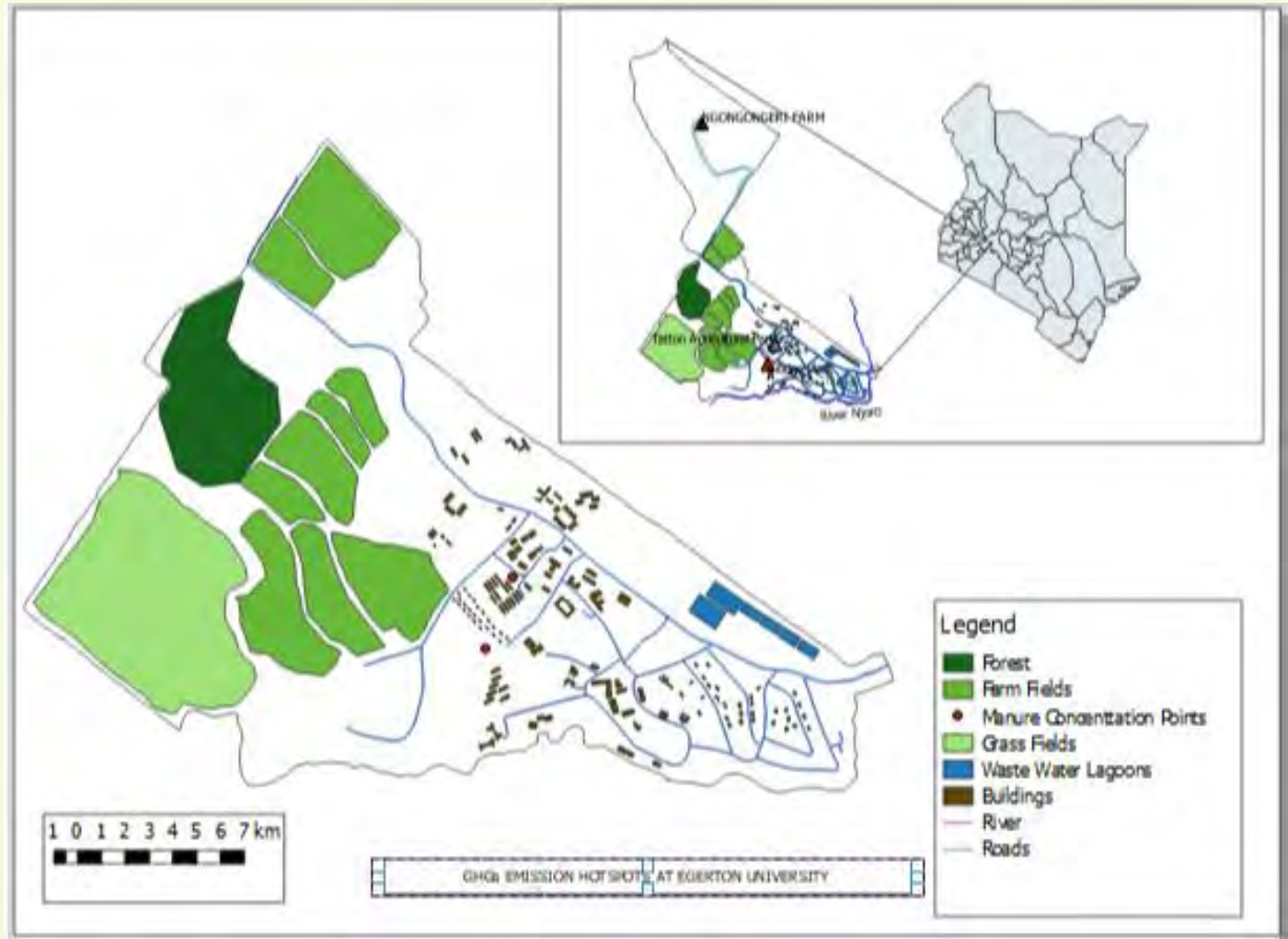


Figure 1 GHGs emissions hotspots at Egerton University, Kenya



Table 1 Open field GHG emissions per year in Tatton farm

Sub-group	Population	CH ₄ (kg)	NH ₃ (kg)	CO ₂ (kg)	N ₂ O (kg)	Total (kg)
Cows	250	44712.5	11862.5	2564125.0	912.5	2621612.5
Sheep	150	1916.3	508.4	109891.1	39.1	112354.8
Goat	100	887.8	235.5	50910.0	18.6	112354.8
Total	500	47516.5	12606.4	2724926.1	970.2	2786019.2

Table 2 Open field GHG emissions per year in Ngongongeri farm

Sub-group	Population	CH ₄ (kg)	NH ₃ (kg)	CO ₂ (kg)	N ₂ O (kg)	Total (kg)
Cows	400	71540	18980	2564125	1460	2656105
Sheep	200	2555	677.9	146521.4	39.10714	149793.4
Goat	150	1331.6	353.3	50909.9	27.90085	52622.8
Total	750	75426.6	20011.2	2761556.4	1527.008	2858521



Table 3 Emissions from pig and poultry housing at Tatton farm

Sub-group	Population	CH ₄ (kg)	NH ₃ (kg)	CO ₂ (kg)	N ₂ O (kg)	Total (kg)
Pigs	200	71540	18980	4102600	1460	4194580
Poultry	2000	9490	2517.755	69204	34310	115521.8
Total	2200	81030	21497.76	4171804	35770	4310102

- CH₄ emissions from pig bio-slurry during storage and field application were 78 g/m³ and 185 g/m³, and 27 g/m³ and 0.9 g/m³ for CO₂, respectively
- The GHG emissions from the biogas plant (bio-digester) which mainly uses cow dung substrate were 7300, 1936.7 418632.7 and 149 m³/year for CH₄, NH₃, CO₂ and N₂O, respectively



CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- Cattle holding yards gave the greatest GHGs emissions (5,277.7 tonnes/yr) followed by pigs (4,194.6 t/yr), sheep (2,62.1 t/yr), poultry (115.5 t/yr) then goats (0.2 t/yr)
- Total GHGs emissions from the pig bio-slurry and bio-digester were 290.9 g/m³ and 428018.4 m³/year, respectively

Recommendations

- Applicable solutions to reduce emissions such as sound farm manure management and conversion systems and technologies should be provided
- Emissions from donkeys, fish, impala etc at Egerton university should be evaluated



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THANK YOU!

