Activities & Research

at the Mazingira Centre at ILRI in Kenya

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Mazingira Centre

https://mazingira.ilri.org/

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Mazingira Centre - Mandate

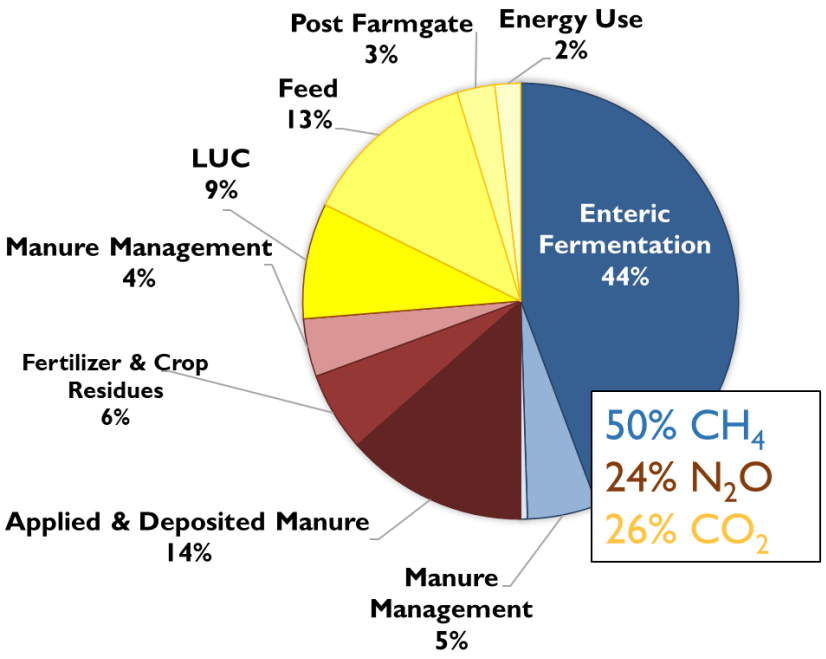
- Generate environmental baseline data of livestock production systems
- Test interventions to reduce environmental impact of livestock
- Serve as center for capacity building & hub for scientific exchange in sub-Saharan Africa

Mazingira Centre - Vision

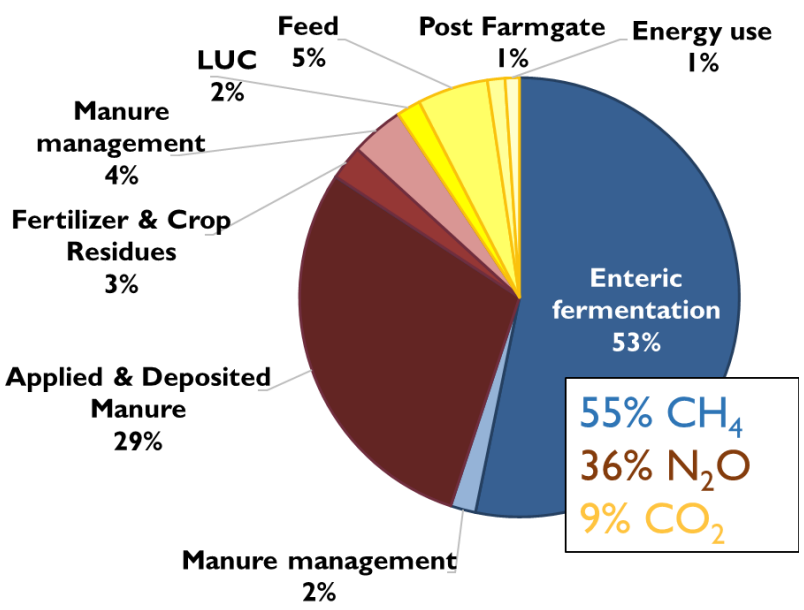
- To test and develop **Mitigation & Adaptation** strategies that increase livestock production while decreasing GHG emissions, resource use, and environmental degradation

GHG Emissions From Livestock Value Chain

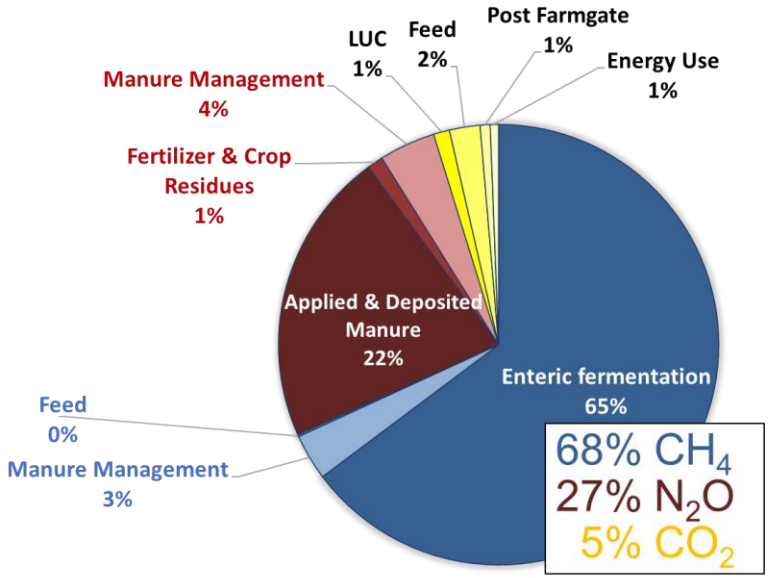
Global



Africa



Sub-Saharan Africa



Source: Gleam, 2020

Research Facilities

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Controlled Laboratory Experiments

Kapiti ILRI FARM, Research Station & Conservancy Field Laboratory

Mazingira Centre Facilities

- Animal GHG emission measurement facilities
- Manure, soil, and water GHG emission measurement facilities & equipment
- Landscape GHG and environmental measurement capacities
- Laboratories
  - GC Lab
  - Animal nutrition lab
  - Soil and Manure Lab

Animal GHG Emission Measurement Facilities

3 Large Ruminant Chambers

3 Small Ruminant Chambers

Mobile Lab & Animal Chamber
(yet to be deployed)

SF6
(under development)

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Manure GHG Emission Measurement Facilities

Chambers for manure heap measurements (9 with 100 kg capacity, 30 with 250 kg capacity)

2 Fixed-dome biodigesters

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Lab Manure GHG Emission Measurement Equipment

175 Anaerobic digestion/biogas batch bottles

150 in-vitro manure incubation jars

4 Continuously Stirred Tank Reactors (CSTR)
(to be set up in 2023)

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Field manure, soil, and water GHG emission measurement equipment

18 automatic soil GHG chambers + Picarro laser analyzer (soon to be deployed with mobile field lab)

>300 manual chambers for field GHG measurements (with GC or Laser/IRGA)

3 floating chambers for water GHG measurements

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Landscape GHG and Field Measurement Equipment

2 Eddy Covariance Flux Towers (CO_2, H_2O, CH_4)

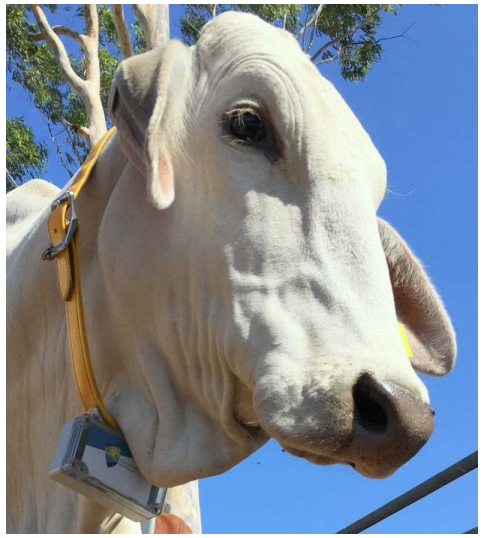
1 FLoX box (Plant fluorescence → photosynthesis)

1 Lysimeter (evapotranspiration → drought stress)

16 Weather stations (TAHMO weather network)

1 Root scanner in Eddy tower footprint (root growth dynamics)

Landscape GHG and Field Measurement Equipment



20 GPS collars for cattle & small ruminants

10 Camera traps (livestock/wildlife counting & plant phenology)

1 DJI Drone

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GHG Measurement Lab

6 Gas Chromatographs
(N_2O, CH_4, CO_2)
(SF_6 will be added)

3 Picarro Laser Analyzers
(N_2O, CH_4, CO_2, H_2O, NH_3)

Simultaneous measurements of methane and nitrous oxide in air

1 Los Gatos Research (LGR) Analyzer (CH_4 and N_2O)

LI-850 CO_2/H_2O Gas Analyzer

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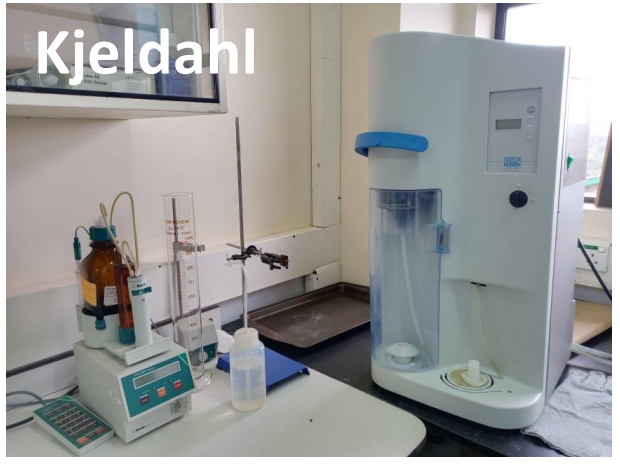
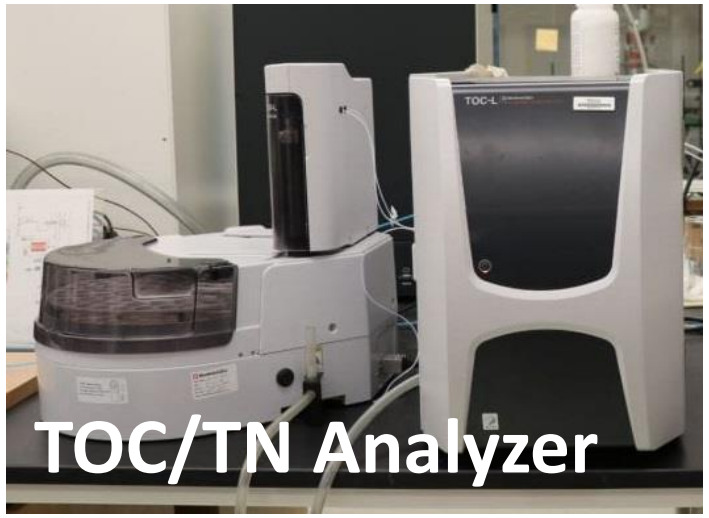
Animal Nutrition Lab

- Dry matter (DM)
- Ash
- Crude fiber (CF)
- Neutral detergent fiber (NDF)
- Acid detergent fiber (ADF)
- Acid detergent lignin (ADL)
- Crude Protein (CP)
- Total carbon and nitrogen (CN)
- Gross energy content (GE)
- LACTOSCAN milk analyzer



Soil & Manure Lab

- Dry matter (DM)
- Ash
- Volatile solid (VS)
- pH
- Soil texture
- Bulk density
- Total carbon and nitrogen (CN)
- Nutrients (ammonium, nitrate, Olsen P, total P)
- Microbial Biomass C and N
- Total organic carbon (TOC), dissolved organic carbon (DOC) and total nitrogen (TN) in aqueous samples (e.g. manure leachate, urine and water samples)
- Soil physics (pF pressure curves)



2 Ways To Estimate Enteric CH_4 Emissions

Direct

***In-vivo* measurements using**

Chambers or SF6

Animal measurements

Indirect

Basis for GHG Inventories & intervention modelling

GHG emissions = Animal population * Emission factor

Emissions factor is estimated based on activity data

IPCC
INTERGOVERNMENTAL PANEL ON climate change

GHG equations developed from data of direct emissions measurements in the Global North

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Livestock Emission Data From African Systems

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Stock Take







Direct & indirect GHG emissions estimates for enteric CH_4 emissions from African Livestock[1]

- Few studies on direct and indirect
- Very little data on small ruminants

Measurement	Number of studies	% of total studies
Cattle	14	70%
Direct	6	30%
Indirect	8	40%
Small Ruminants	6	30%
Direct	2	10%
Indirect	4	20%
Total	20	

Complete study:

Poster #93 Graham et al.

[1]Source: Graham et al., unpublished..

In-vivo Enteric CH_4 Emission Measurements at Mazingira Centre

- Severe below-maintenance feed intake increases methane yield from enteric fermentation in cattle (Goopy *et al.*, 2020)
- Weight gain and enteric methane production of cattle fee on tropical grasses (Napier, Rhodes, *Brachiaria*) (Korir et al. accepted in Animal production Science)
- Performance and enteric methane emission of tropical cattle supplemented with either concentrates or tannin-rich leguminous forage (**Poster #136 by Korir *et al.***)
- Impact of Haemonchus contortus infection of Red Maasai and Dorper lambs on enteric methane emissions (**Poster #176 by Mwangi *et al.***)
- Effect of gastro-intestinal tract parasites and tannins in sheep (trial on-going)

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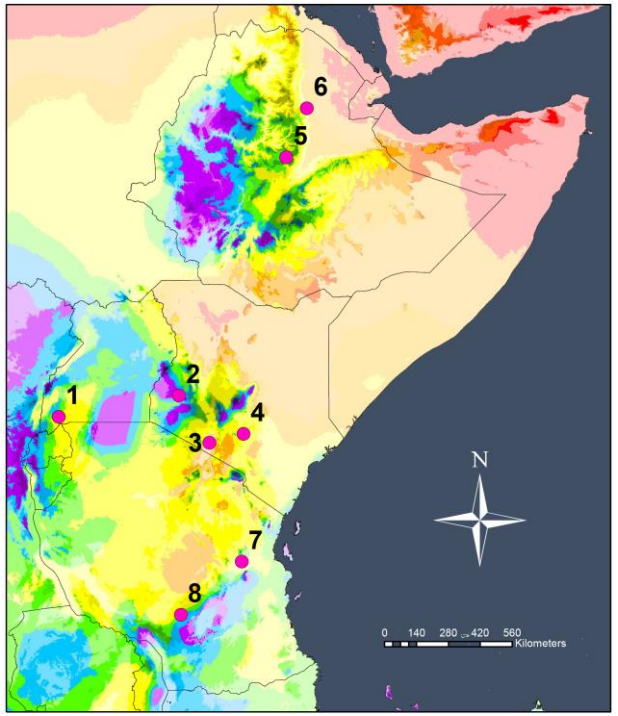
Indirect GHG Estimations by Mazingira

- Activity data collection via household surveys
  - Calculation of enteric and manure GHG emissions based on IPCC 2006 methodology
    - Protocol for activity data collection for Tier 2 EF generation for enteric CH_4 and manure CH_4 and N_2O



Research Sites
(Cattle & Small Ruminants)
- Burkina Faso
- Kenya
- Ethiopia
- Tanzania
- Uganda

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Publications by Mazingira using indirect GHG Estimations

- Farm-level emission intensities of smallholder cattle (*Bos indicus*; *B. indicus–B. taurus crosses*) production systems in highlands and semi-arid regions (Ndung'u et al., 2022)
- Data describing cattle performance and feed characteristics to calculate enteric methane emissions in smallholder livestock systems in Bomet County, Kenya (Ndung'u et al., 2021)
- Calculation of new enteric methane emission factors for small ruminants in western Kenya highlights the heterogeneity of smallholder production systems (Goopy et al., 2021)
- Improved region-specific emission factors for enteric methane emissions from cattle in smallholder mixed crop: Livestock systems of Nandi County, Kenya (Ndung'u et al., 2020)
- A new approach for improving emission factors for enteric methane emissions of cattle in smallholder systems of East Africa - Results for Nyando, Western Kenya, (Goopy et al., 2018)
- Improved Emission Factors and Intensities for African Livestock Systems for GHG Accounting and Mitigation – Case studies in Kenya (KE) **(Poster #178 *Ndung'u et al.*)**

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Thank you very much for your attention!

Better lives through livestock

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