Enteric Methane Emission Factors for Cattle in Pastoral Systems: A Case Study in Kenya

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Introduction

- Livestock production in Kenya contributes about 60 % to national GHG emissions, primarily CH_4 from enteric fermentation.
- Accurate estimation of CH_4 emissions is crucial for environmental management and national policy development as well as international reporting under UNFCCC.
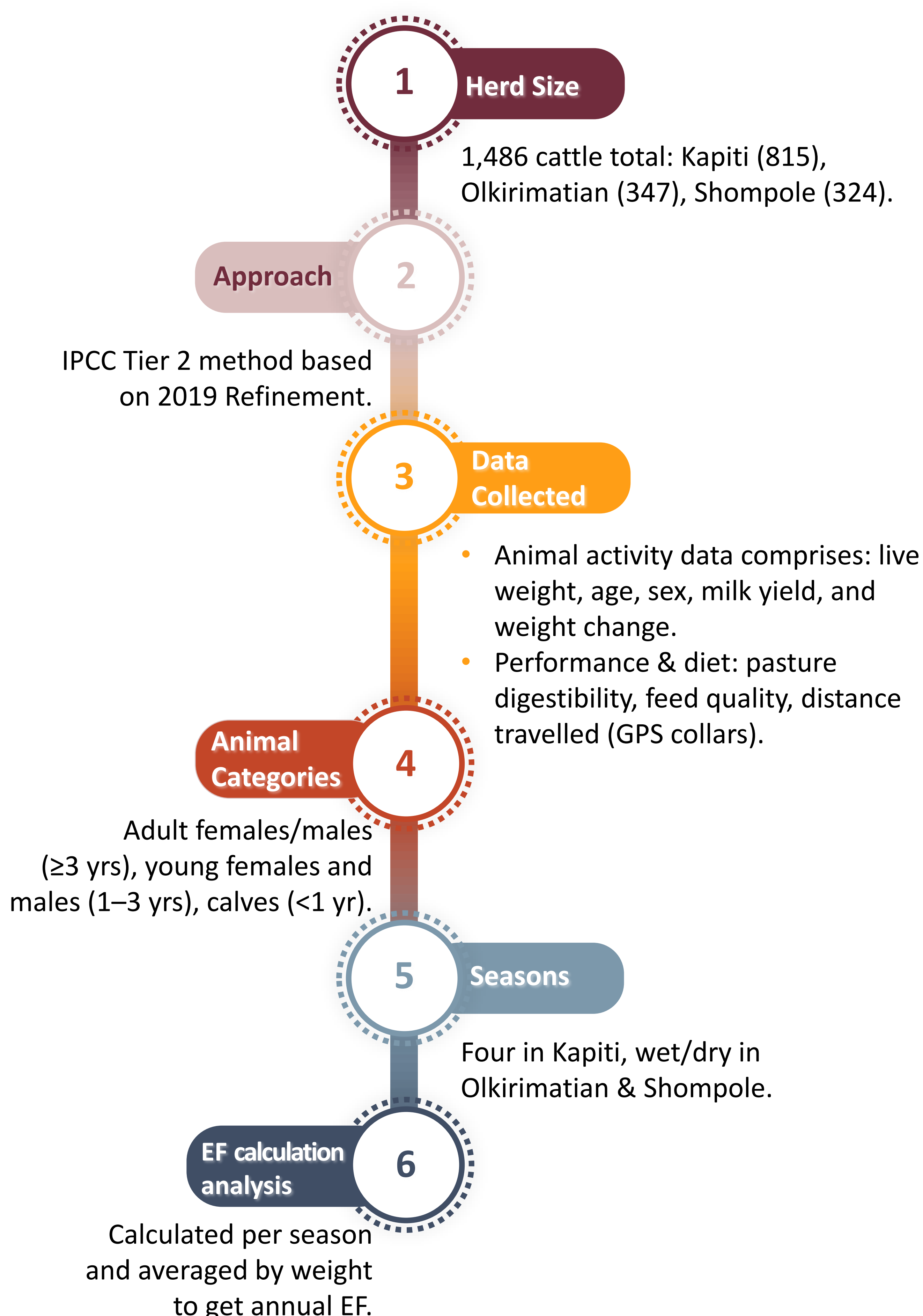
Objective:

To develop precise, system-specific methane emission factors (EFs) for rangeland cattle using the IPCC Tier 2 methodology.

Materials & Methods

- Study conducted in Kapiti research station, Olkirimatian, and Shompole group ranches, representing South Central rangelands in Kenya.
- Animal activity data were collected.
- Animal data were distinguished by animal category.
- Data collection covered four seasons in Kapiti and one wet and one dry season in Olkirimatian and Shompole.
- Tier 2 EF_S were calculated for each season and averaged by weight to get the annual Efs.
- Analysis of variance (ANOVA) was used to compare EF among the three sites.

1 — Herd Size

1,486 cattle total: Kapiti (815), Olkirimatian (347), Shompole (324).

2 — Approach

IPCC Tier 2 method based on 2019 Refinement.

3 — Data Collected

- Animal activity data comprises: live weight, age, sex, milk yield, and weight change.
- Performance & diet: pasture digestibility, feed quality, distance travelled (GPS collars).

4 — Animal Categories

Adult females/males (≥3 yrs), young females and males (1–3 yrs), calves (<1 yr).

5 — Seasons

Four in Kapiti, wet/dry in Olkirimatian & Shompole.

6 — EF calculation analysis

Calculated per season and averaged by weight to get annual EF.

Results & Discussion

Table 1. Tier 2 Emission factors (mean ± SE, kg CH_4 /head/year) for different categories of cattle in the three study locations.

Cattle category/location	Emission factors (kg CH_4/head/year)			
	Kapiti	Olkirimatian	Shompole	IPCC 2019 Tier 1
Adult females	90.4[a] ± 1.4	66.3[b] ± 1.5	54.5[c] ± 1.2	74
Lactating	101.0[a] ± 1.4	66.5[b] ± 1.5	63.0[b] ± 3.1	
Non-lactating	68.5[a] ± 1.4	53.4[b] ± 5.3	51.1[b] ± 1.1	
Adult males	82.9[a] ± 1.6	70.8[b] ± 2.7	75.4[ab] ± 3.0	79
Young females	54.9[a] ± 0.8	48.5[ab] ± 2.2	41.1[b] ± 1.1	46
Young males	56.3[a] ± 0.9	43.0[b] ± 1.5	36.4[b] ± 1.5	46
Calves	39.5[a] ± 0.6	25.5[b] ± 1.0	22.0[b] ± 0.5	31

NB: Rows with different superscripts differ significantly.

- Kapiti had the highest enteric methane emissions, influenced by greater live weight and milk yield.
- Considerable differences between Tier 2 findings and IPCC Tier 1 defaults -> Tier 1 leads to under-or over-estimation of emissions.
- Rangeland systems show large within-country variability.

Conclusion & Implications

- **Use of generic, regional EF for Africa** masks essential differences across systems and breeds.
- **Locally tailored emission factors** are critical for effective climate policy and mitigation in Kenyan livestock systems
- **National inventories** must use system- and breed-specific EFs for accuracy.

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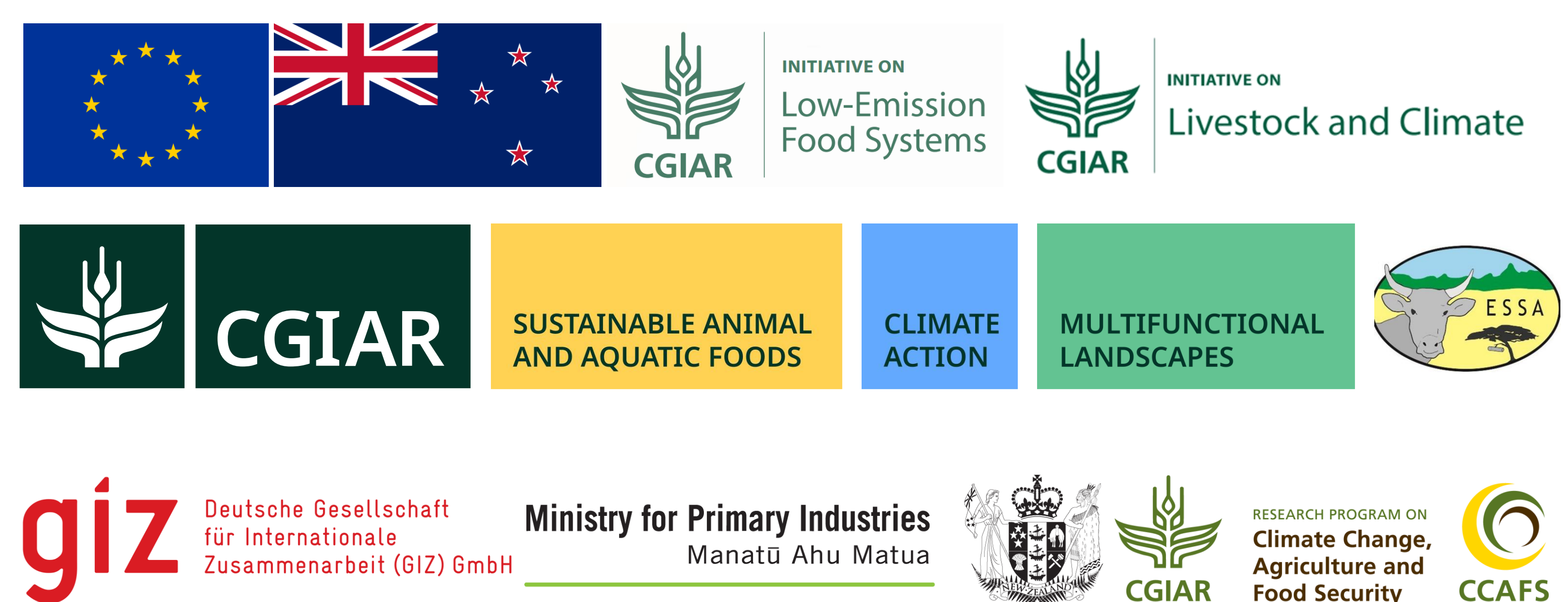
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