Exploring the role of seasonal variation in livestock feed composition on diet quality and methane emissions in Kenyan livestock

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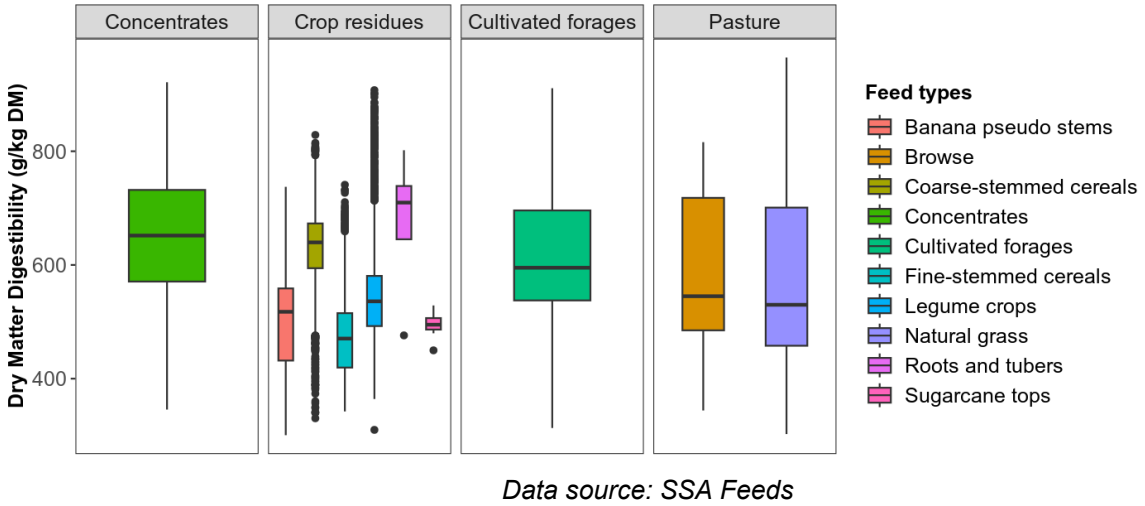
Livestock Sector and Greenhouse Gas Emissions

- Responsible for 11-17% of total global greenhouse gas emissions.
- Emissions primarily from enteric fermentation and manure decomposition.
- Diet is a key determinant of production and GHG emissions from the livestock sector.

Variation in the Quality of Livestock Feed Items

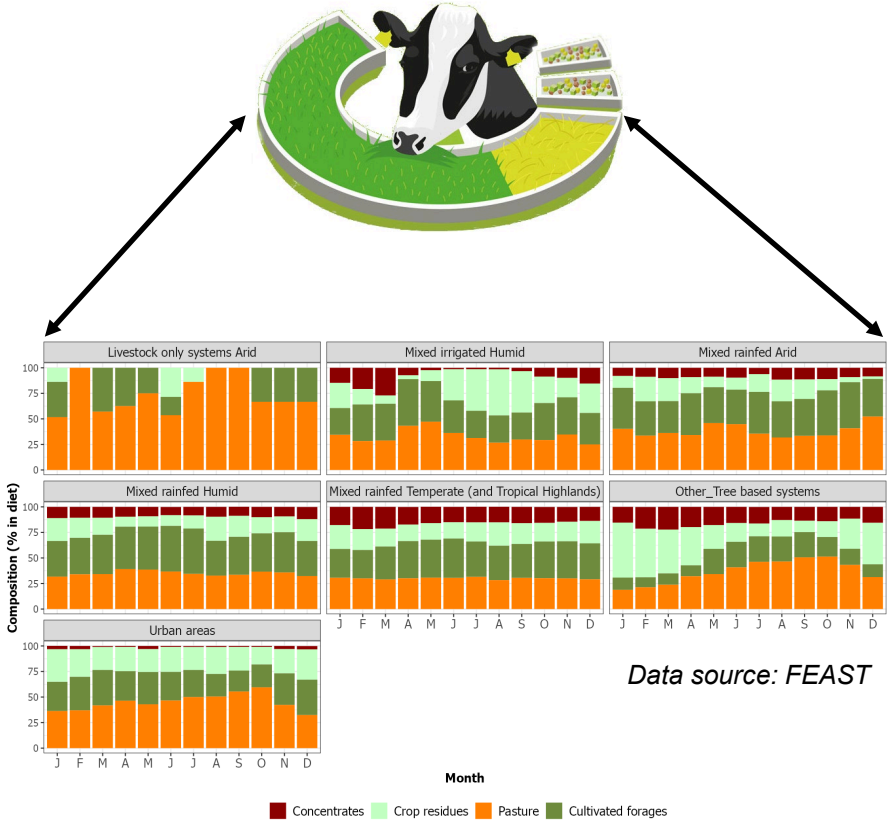
- Nutritive value of feed items varies widely.
- Higher variation exists across geographical zones and seasons.
- Types of crop residues fed to livestock are determined by the crops grown in a specific region.



Data source: SSA Feeds

Role of Feed Composition in Diet Quality and Emissions

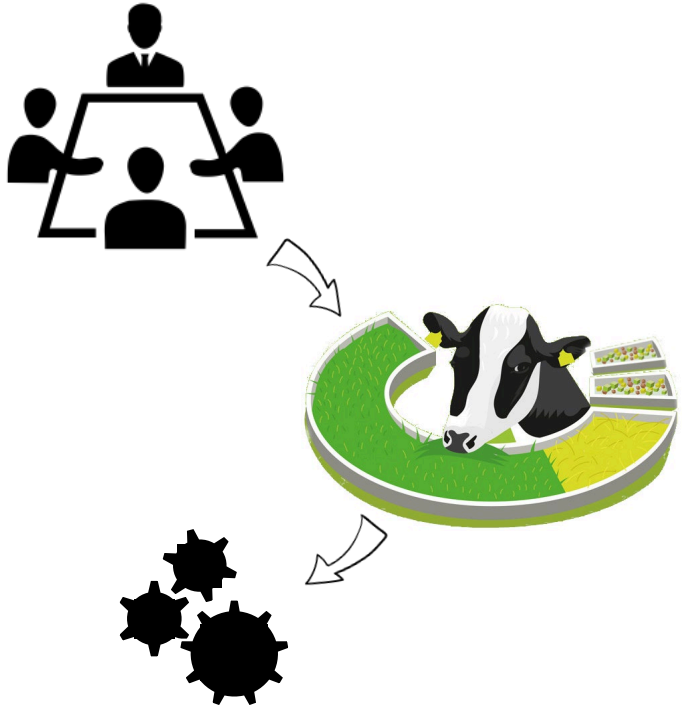
- Quality of livestock diet is intricately shaped by feed composition.
- Diet of better quality is linked to lower GHG emissions.
- Feed composition varies both spatially and temporally.
- Year-round feed composition fluctuations alter diet quality and emissions.



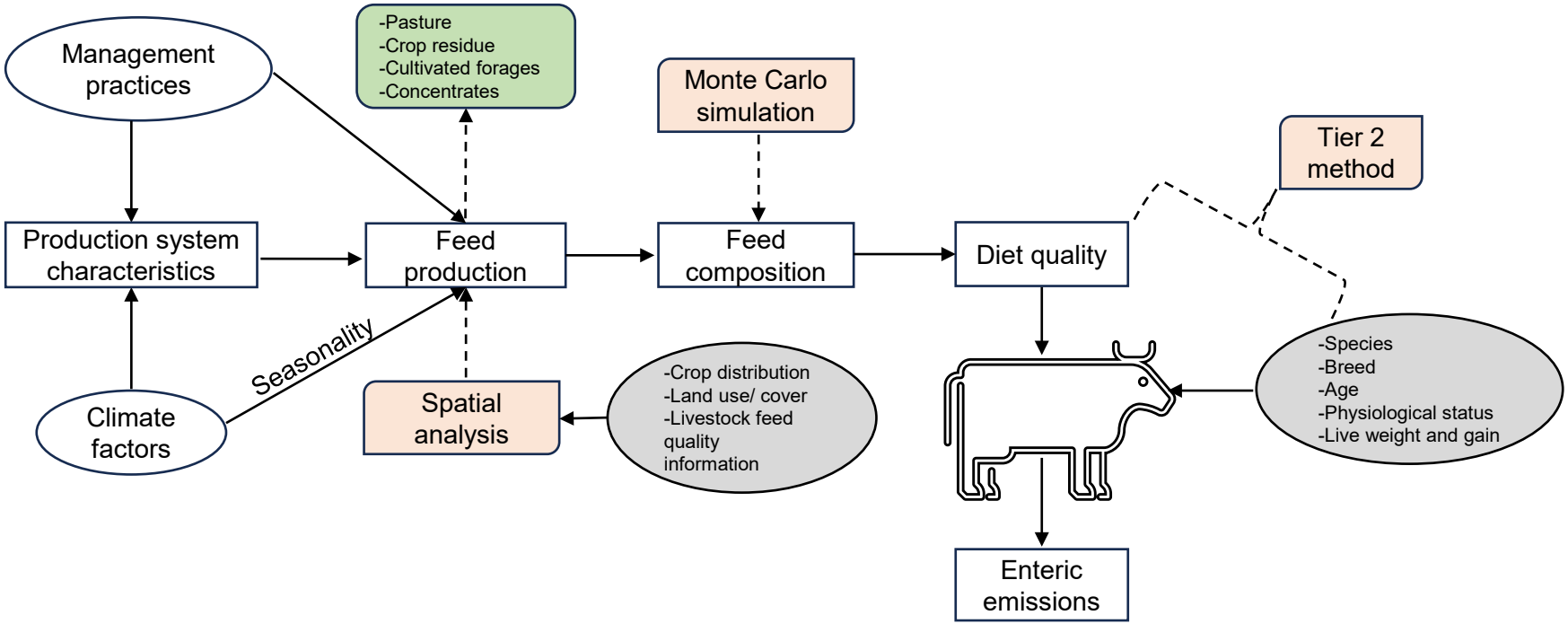
Data source: FEAST

Current Livestock Emission Estimates using Global Models

- Livestock diet data is based on expert opinion.
- Diet composition data is available as a stable annual distribution.
- Models unable to account for seasonality in diet composition.
- Ground measurement has been done in limited locations.

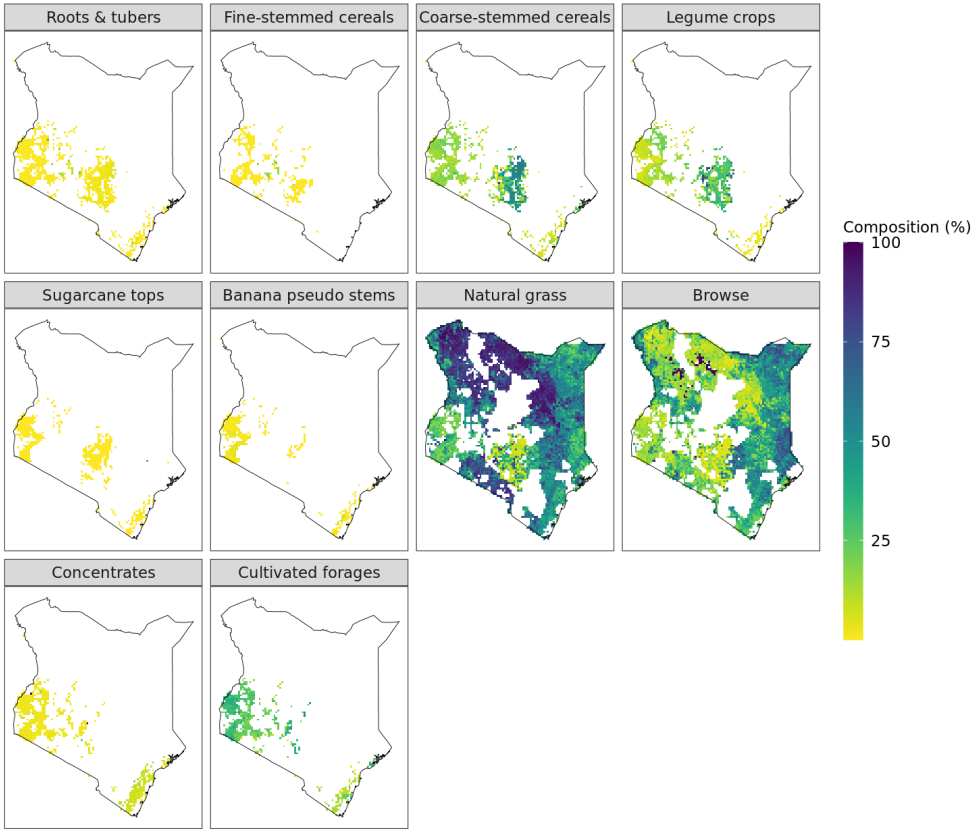


Modelling Implications of Diet Changes on Methane Emissions



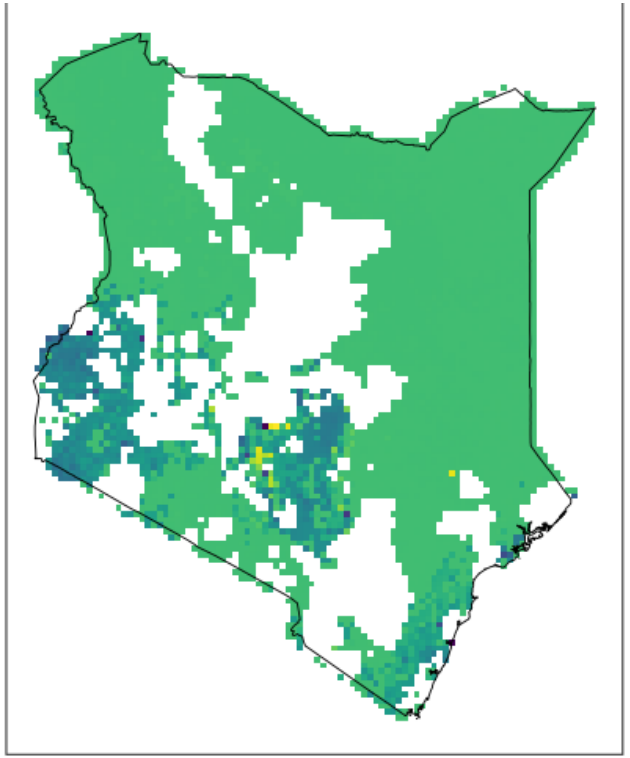
Assumption: Animal diet is based on feed production at a pixel.

Results: Livestock Diet Composition



- Livestock diets vary across the landscape.
- Coarse stemmed cereals and legume crops are prominent in the central highlands.
- Western Kenya has a diverse mix of feed resources including cultivated forages
- Arid and semi-arid areas are dominated by pasture.

Results: Livestock Diet Quality



- Diet quality varies across livestock systems (Mean=**581.3 g/Kg DM**, IPCC default value = **550 g/Kg DM**).
- Greater variability in mixed (crop and livestock) systems

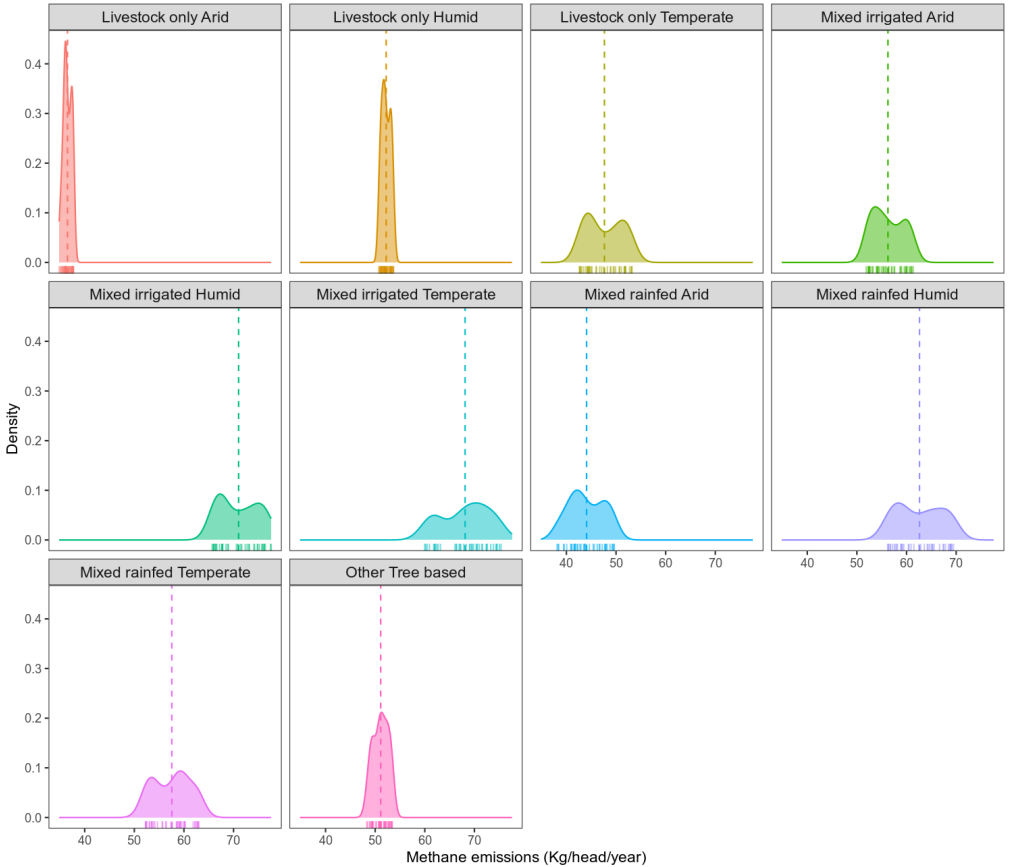
Results: Methane Emissions

- Notable variation exist between and within production systems.
- Highest dry matter intake in the mixed systems.

Production system	Agro-ecological zone	Live weight (Kg)	Metabolizable energy requirement (MJ/head/day)	Dry matter intake (Kg)	Methane production (Kg/head/year)
Livestock only	Arid	182.8	42.6	4.8	36.6
	Humid	254.6	60.9	6.9	52.0
	Temperate	261.2	59.5	6.7	50.9
Mixed rainfed	Arid	203.1	49.9	5.6	42.4
	Humid	282.9	71.8	8.0	60.1
	Temperate	290.2	67.3	7.5	56.4
Mixed irrigated	Arid	213.3	61.9	7.2	54.6
	Humid	297.1	79.4	8.9	67.5
	Temperate	304.7	74.9	8.4	63.8
Other	Tree based	270.0	59.3	6.7	50.8

*Temperate includes tropical highlands

Results: Sensitivity of Methane Emissions to Changes in Diet Composition



- Notable variation exist between and within production systems.
- Livestock only and tree-based systems have relatively low variability.

Does the Seasonal Variation in Diet Quality Matter?

- It does matter when comparing it to an annual value.
- Highest variation exist in mixed systems.
- Substantial spread of estimated methane emissions.

Production system	Agro-ecological zone	Variance (kg/head/year^2)	Standard deviation	p-value
Livestock only	Arid	0.6	0.8	0.727
	Humid	0.8	0.9	0.181
	Temperate	23.1	4.8	0.000***
Mixed rainfed	Arid	14.4	3.8	0.005**
	Humid	26.3	5.1	0.001***
	Temperate	14.2	3.8	0.049*
Mixed irrigated	Arid	12.0	3.5	0.002**
	Humid	27.4	5.2	0.000***
	Temperate	41.2	6.4	0.000***
Other	Tree based	2.3	1.5	0.240

*Temperate includes tropical highlands

Implications and Conclusion

- Diet composition varies by location and is climate-influenced.
- Seasonal fluctuations in feed availability alter diet composition.
- Livestock diet impacts methane emissions, especially with changing feed composition.
- These seasonal changes need to be incorporated in livestock emission assessment models.

Questions?

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