The effects of climate on decomposition of cattle, sheep and goat manure in Kenyan tropical pastures

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Introduction

Decomposition:
The physical & chemical breakdown of dead organic matter

- C cycling:

More than half of net primary production (NPP) is returned to the soil (David et al. 2004)

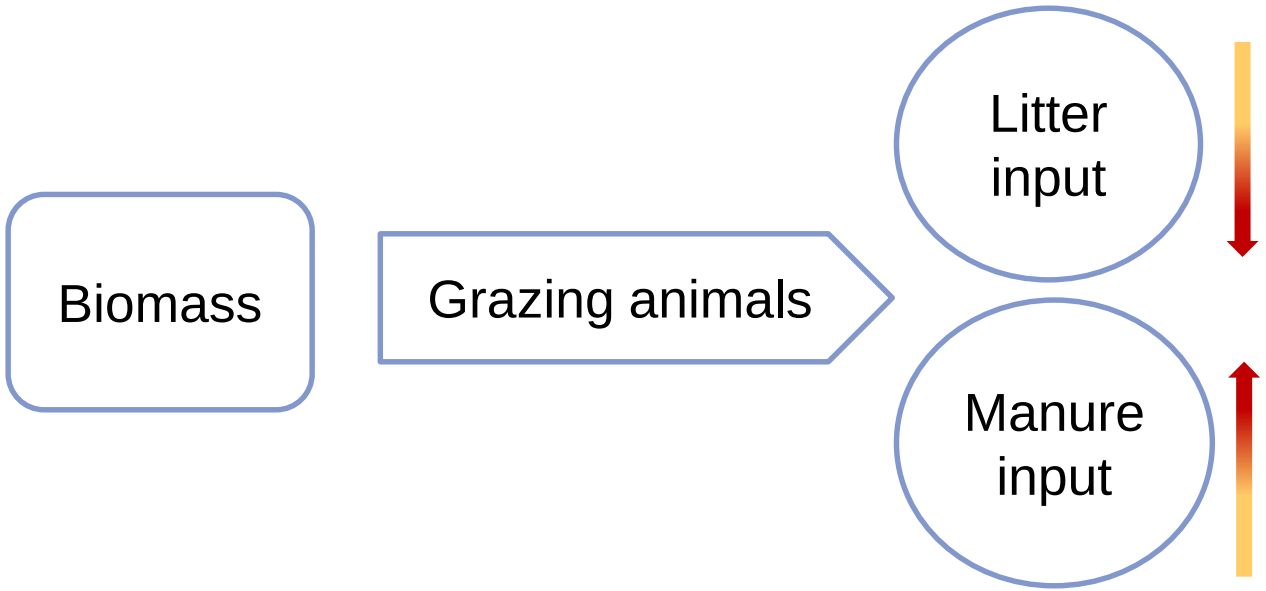
It also results in CO_2 emissions to the atmosphere of about 60 Pg C yr^{-1} (Houghton 2007)

- N cycling:

Internal recycling of nitrogen (N) from litter decomposition is also the primary source of N for most ecosystems (Parton et al. 2007; Chapin et al. 2012)

Grazing system

Grazing animals consume large amounts of biomass that often reduce litter inputs to soil (Güsewell et al. 2005; Tanentzap and Coomes 2012)



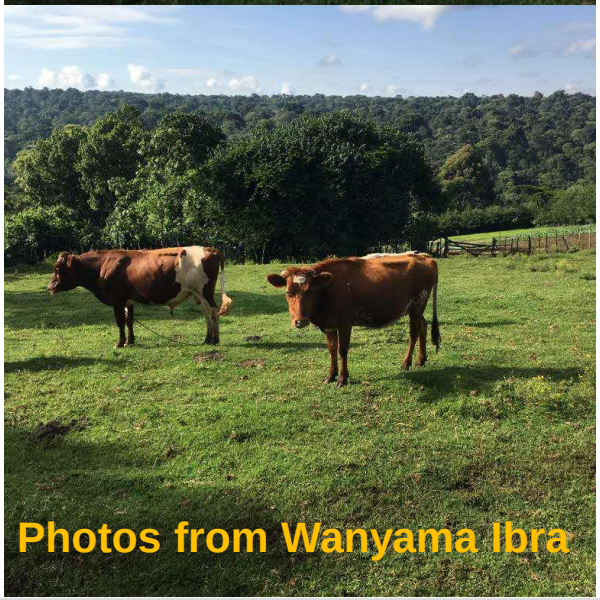
Manure is important for C&N cycle in grazing system

Smallholder mixed-crop and pastoral livestock systems

- Average farm size 0.5-2 h
- Pasture-fed
- Daily grazing
- No fertilization

Manure still exist for months to years.

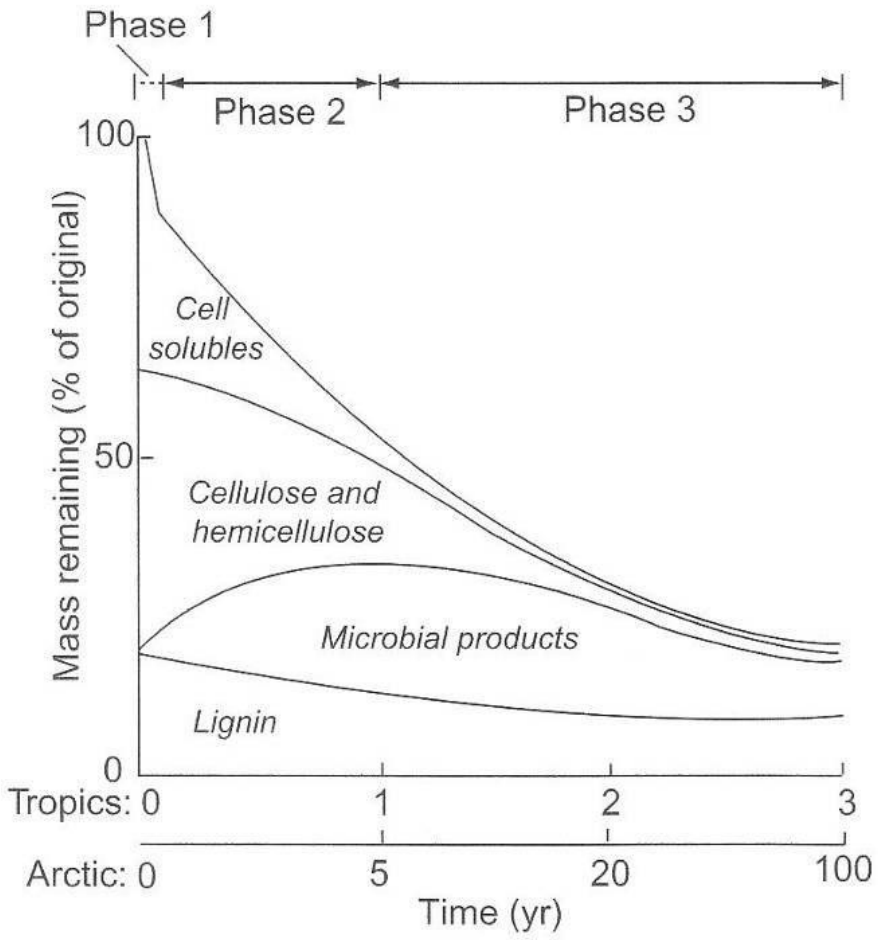
Manure decomposition?

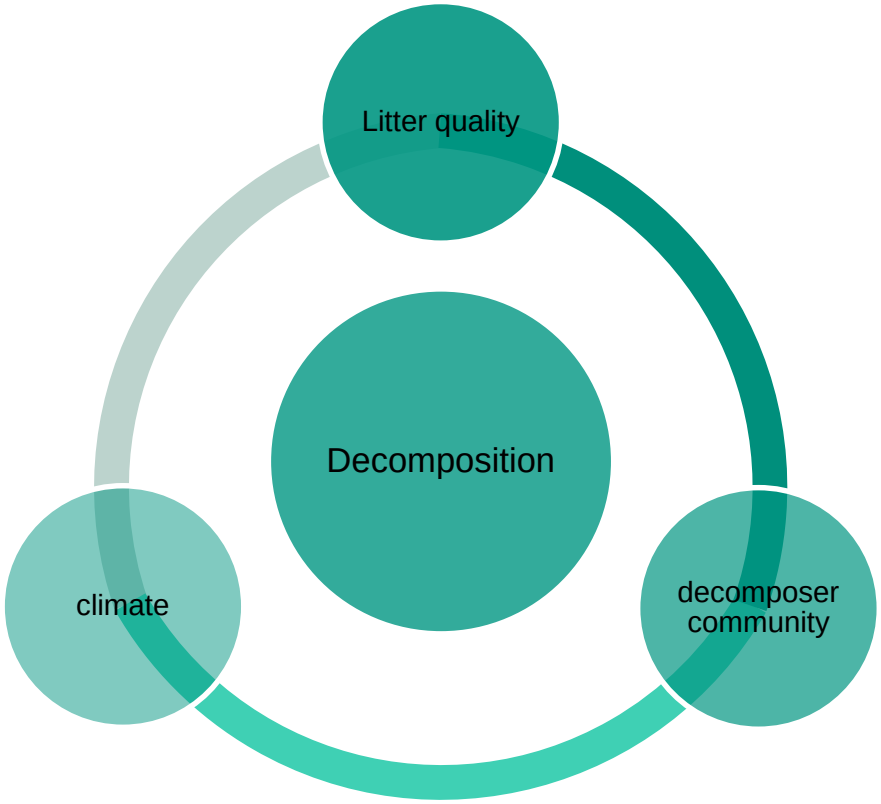


Photos from Wanyama Ibra

Litter decomposition pattern

Exponential decay: $k = \ln(M_t/M_0)\ (-1/t)$





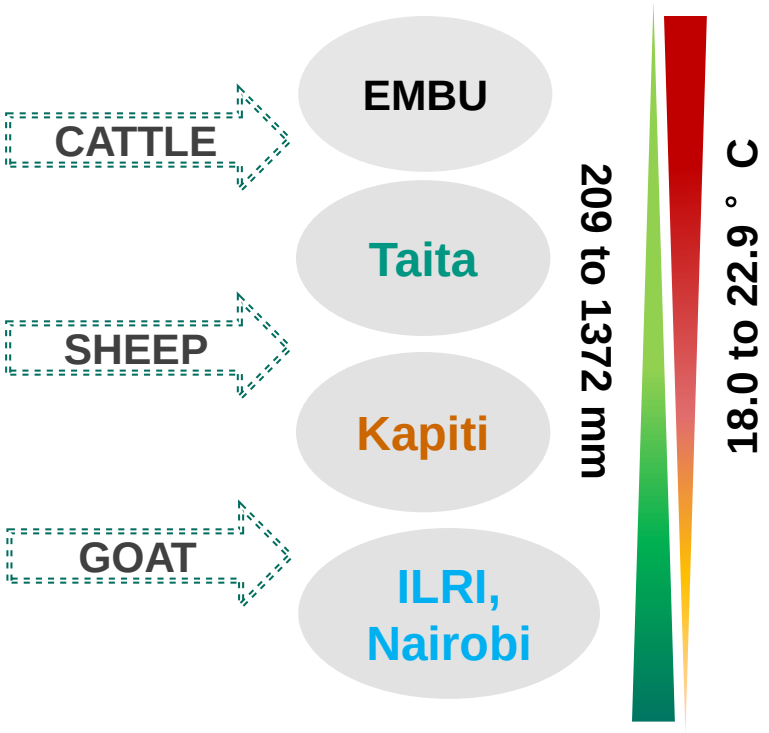
Objectives

1) measure changes in manure dry matter, C and N concentrations over time after manure deposition;
2) determine if manure type (i.e. animal species) affects manure decomposition rates; and
3) determine how climate affects manure decomposition.

Hypothesis:

1) manure decomposition would also follow exponential decay;
2) manure decomposition rates would be faster for manure with lower initial C/N ratios and higher initial N concentrations; and
3) manure would decompose faster under wetter and warmer climatic conditions.

Experimental design



Manure bags: 69 bags for each manure type at each site
Sampling weekly, biweekly or monthly over 378 d

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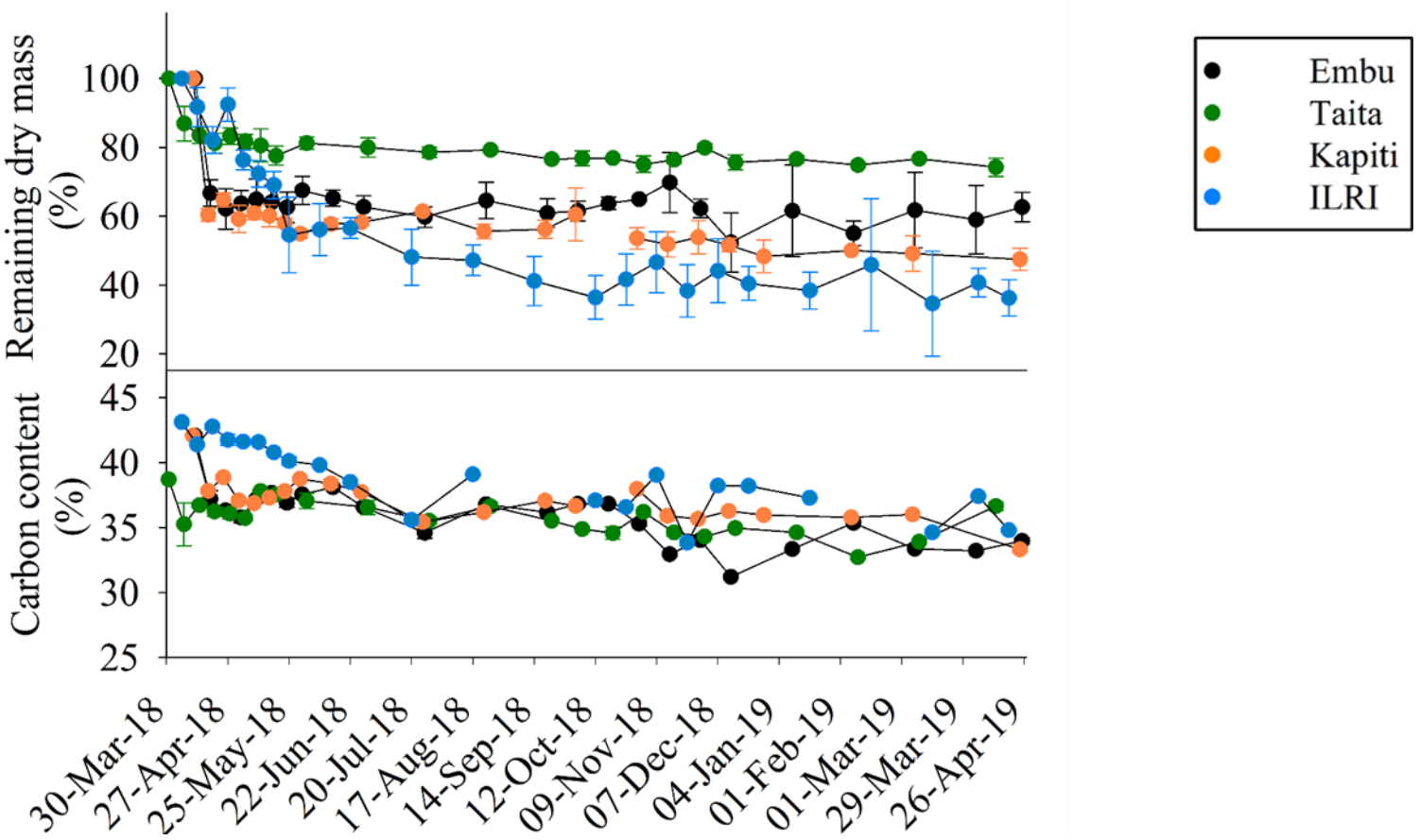
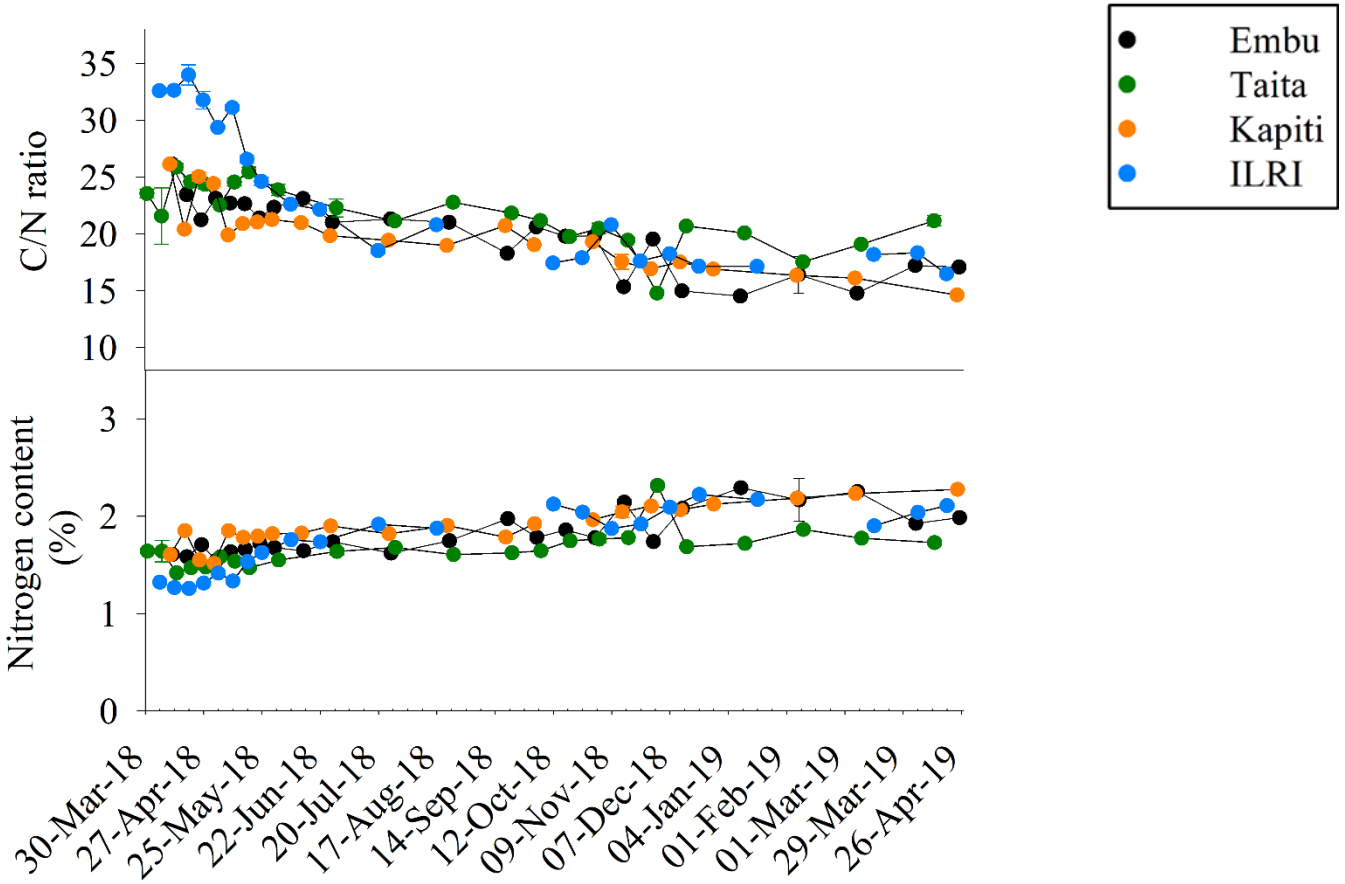
Temporal dynamic of dry matter loss



→ Dry matter decreased exponentially

Temporal dynamic of changes in C/N ratios and N concentrations

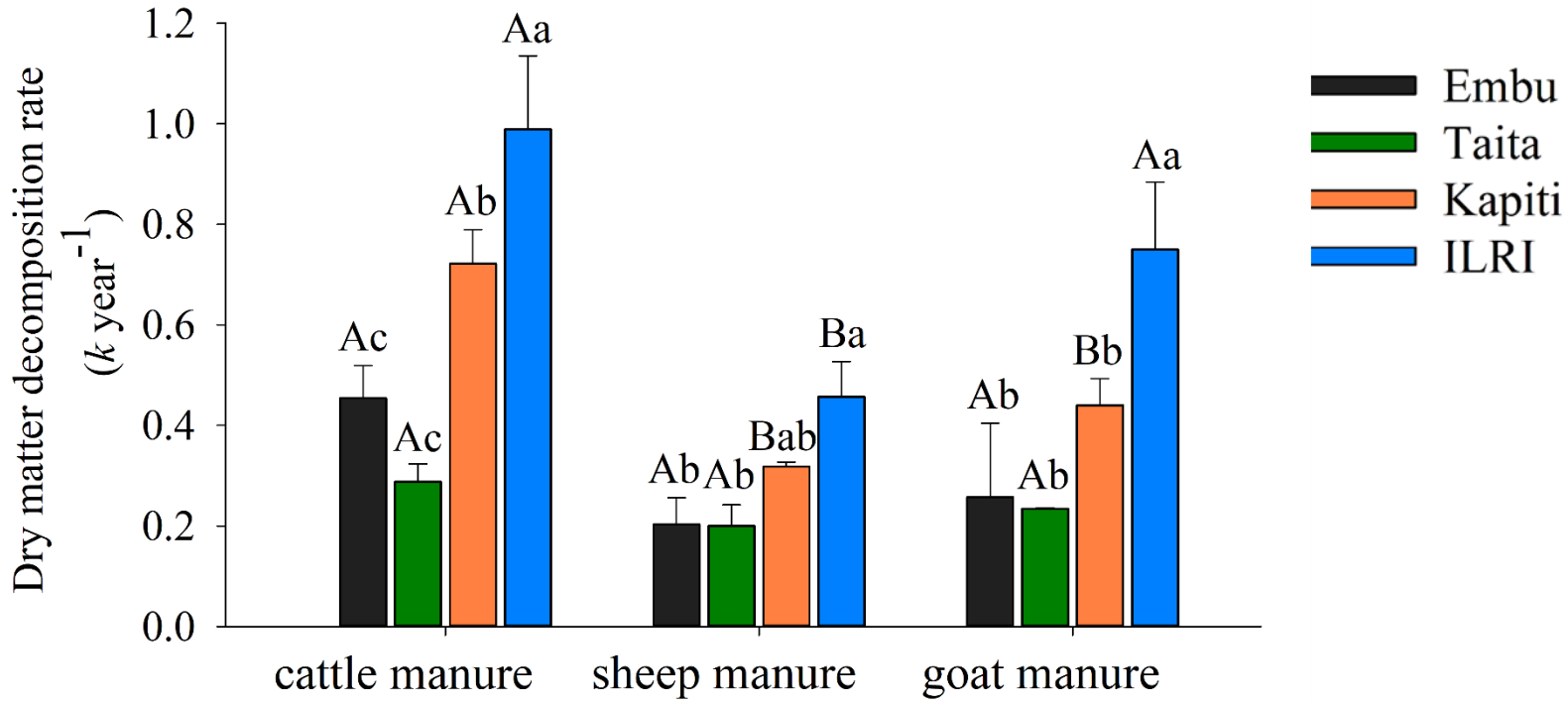


→ N mineralization < C mineralization

→ **decreasing** C/N ratios

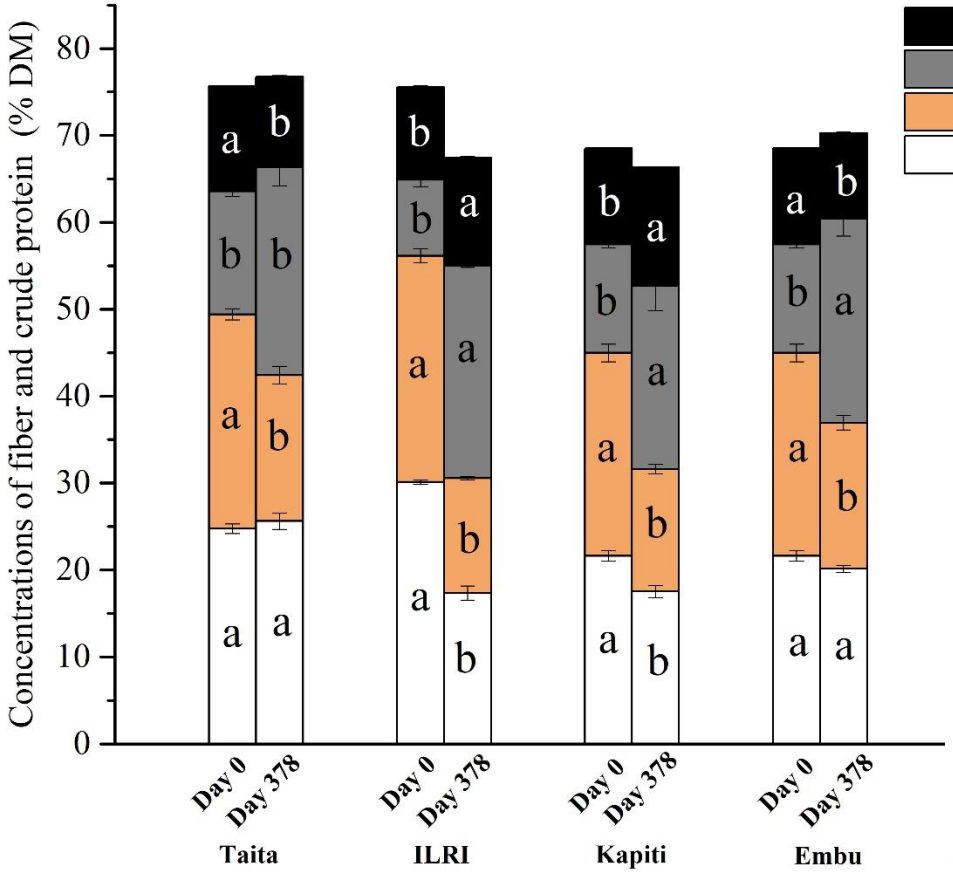
Dry matter decomposition rates

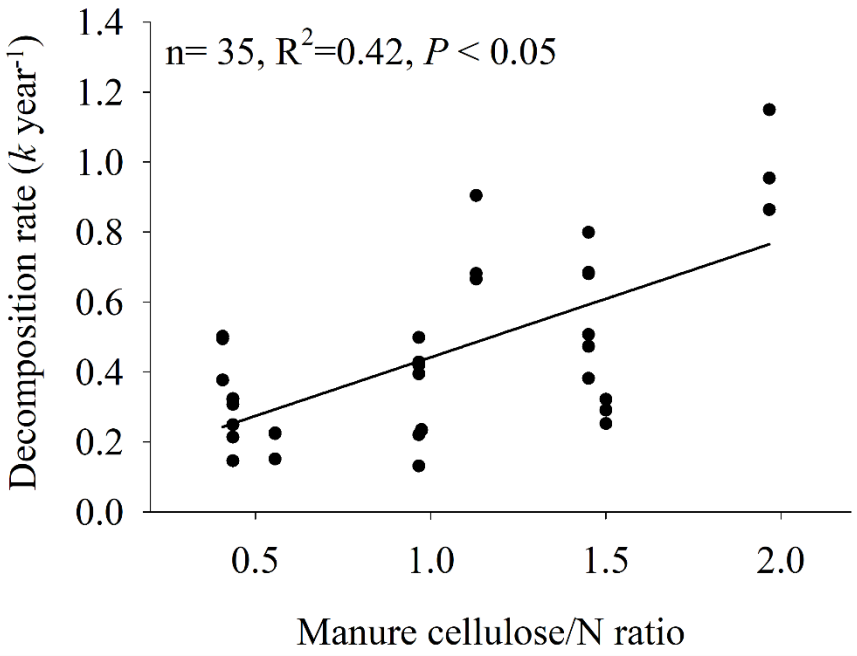
$$k = ln(M_t/M_0)(-1/t)$$



→ Both manure type and climate influenced manure decomposition rates

Changes in chemical characteristics during decomposition

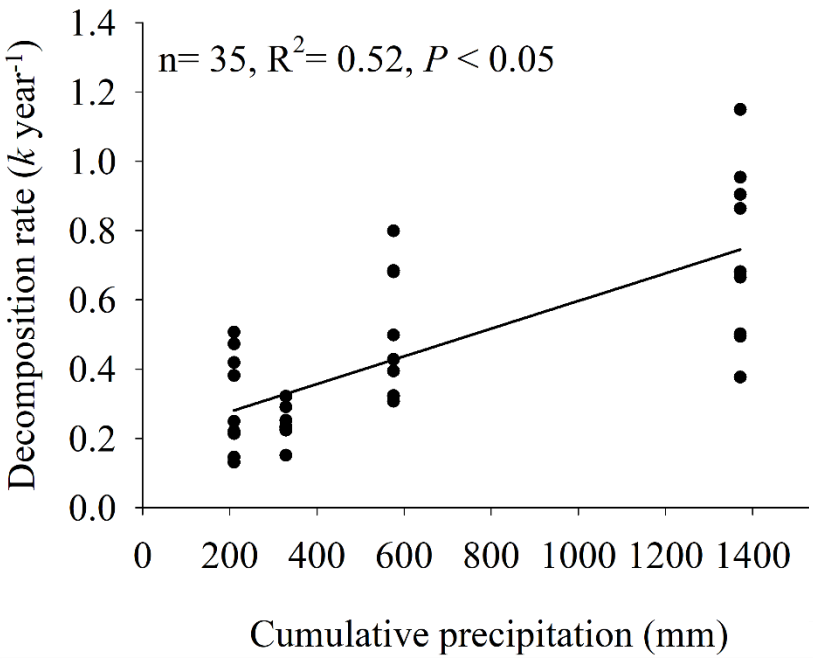


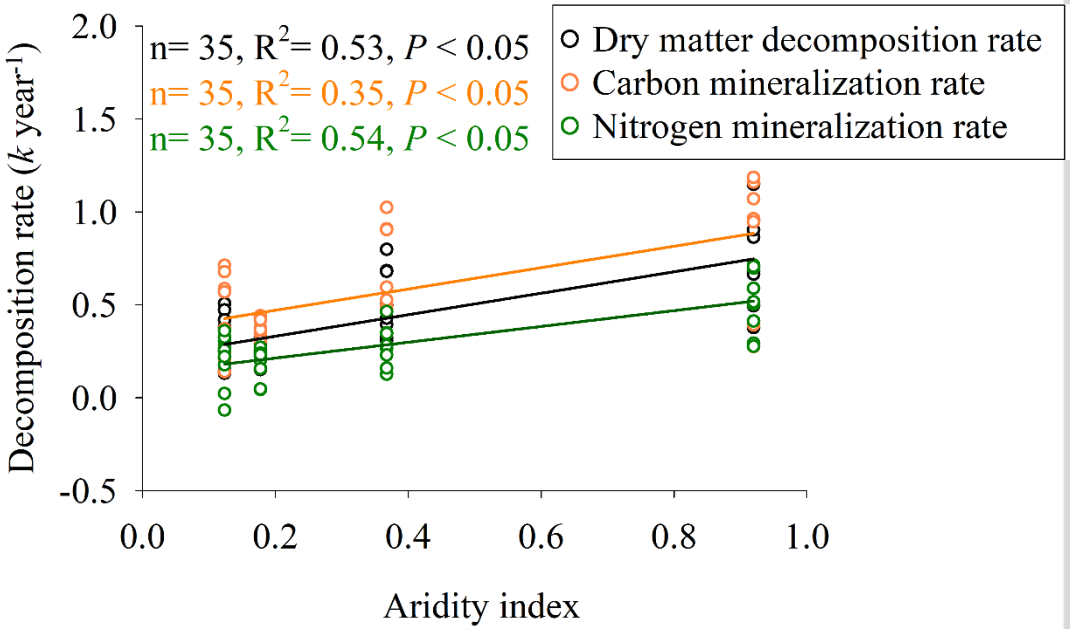


→ Cattle manure has highest cellulose and cellulose decomposes fastest

→ Decomposition rate increases with increasing cellulose/ N ratio

Effects of climate factors





→ Rainfall amount limits manure decomposition under tropical climate.

Thank for your attention