Integral assessment of productive and environmental parameters of a forage-based silvopastoral system

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Introduction

Diversification of pastures and the incorporation of key plant functional groups (legumes) generally improve nutrient cycling and often lead to increased carbon sequestration in the soil. Furthermore, the inclusion of trees in the pastures improve soil properties while creating a microclimate more suitable for cattle, as well as for soil biological activity.

Improved pastures with environmental benefits alongside with good management have vast potential to support region and country-level strategies to address relevant challenges related to the livestock sector in Latin America and the Caribbean (LAC) (Rao et al, 2015).

The LivestockPlus project seeks to apply the concept of sustainable intensification of livestock systems in two countries of the LAC region such as Costa Rica and Colombia, to provide technical support, generate critical information and guidelines necessary for identifying options while contributing to planning and policies for scaling up of NAMAs.

Objective

To evaluate productive and environmental parameters associated with the integration of forage legumes and grasses in tropical pasture systems.

Methodology

Experimental design:
Randomized complete blocks with 3 replications.

Treatments:

T1: Grass alone (GA) (*Brachiaria* hybrid cv Cayman or *Brachiaria brizantha* cv Toledo).

Figure 1. Experimental layout. Green bars indicate the strips of the shrub legume (Leucaena).

T2: GA + Herbaceous legume (*Cannavalia brasiliensis*)

T3: GA + Herbaceous legume (*C. brasiliensis*) + Shrub legume (*Leucaena diversifolia*; 2,000 plants of *Leucaena*/ha)

Grazing management: Rotational. The total area of each block of 0.33 ha was divided into nine sub-plots (0.036 ha each) with an occupation time of three days. Each plot was grazed by four animals for 27 days.

Variables measured:

- Animal productivity (weight gain per unit of area and time)

- Methane (CH_4) emissions (Polythunnel technique)

- Abundance of soil macrofauna in Caymangrass experiment

REFERENCES: Rao IM; Peters M; Castro A; Schultze-Kraft R; White D; Fisher M; ... Rudel T. 2015. LivestockPlus: the sustainable intensification of forage-based agricultural systems to improve livelihoods and ecosystem services in the tropics. Tropical Grasslands-Forrajes Tropicales. 3:59-82. doi: https://doi.org/10.17138/tgft(3)59-82

Results

The inclusion of legumes in the pastures favored animal productivity by increasing weight gain 3.1 and 3.4 times with the herbaceous and shrub legume respectively using Cayman as the grass component, whereas 2.5 and 1.4 fold increment was observed in Toledo for the same set of legumes.
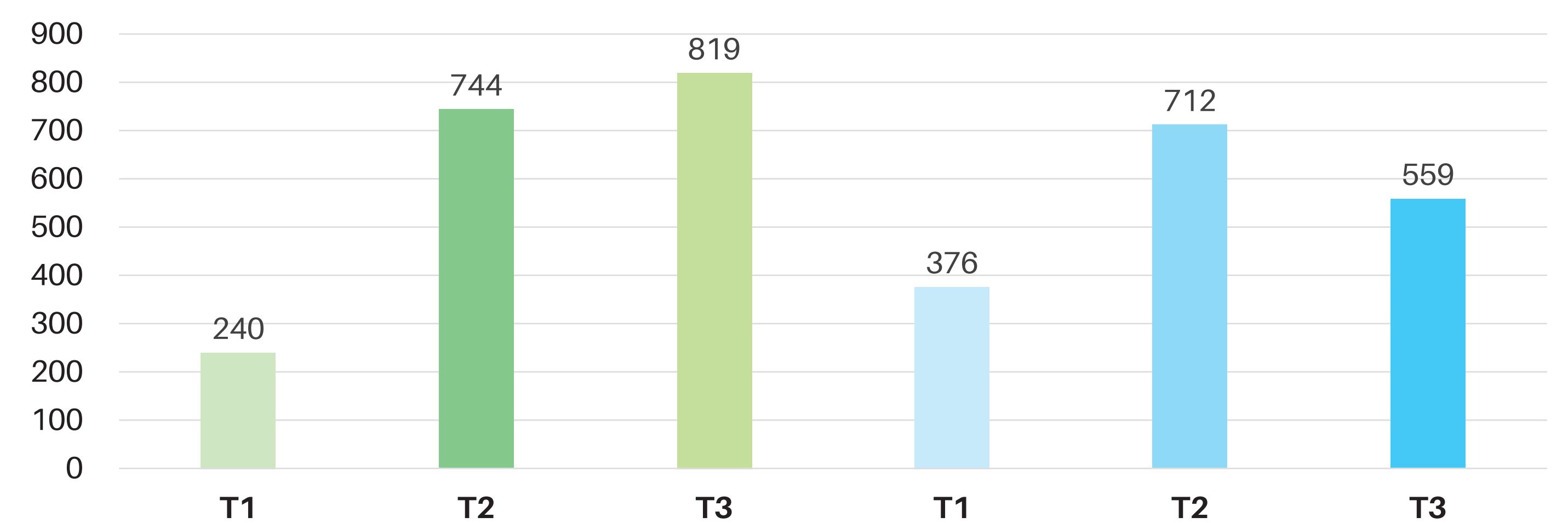

Figure 2. Live weight gain (kg/ha/year) recorded of cattle grazing improved forages. Green bars represent the Caymangrass experiment while Blue bars represent the results of Toledograss plots.

Treatments including legumes showed 33.8% less CH_4 emissions compared to grass alone treatments due to higher dry matter intake and better nutrient use efficiency.
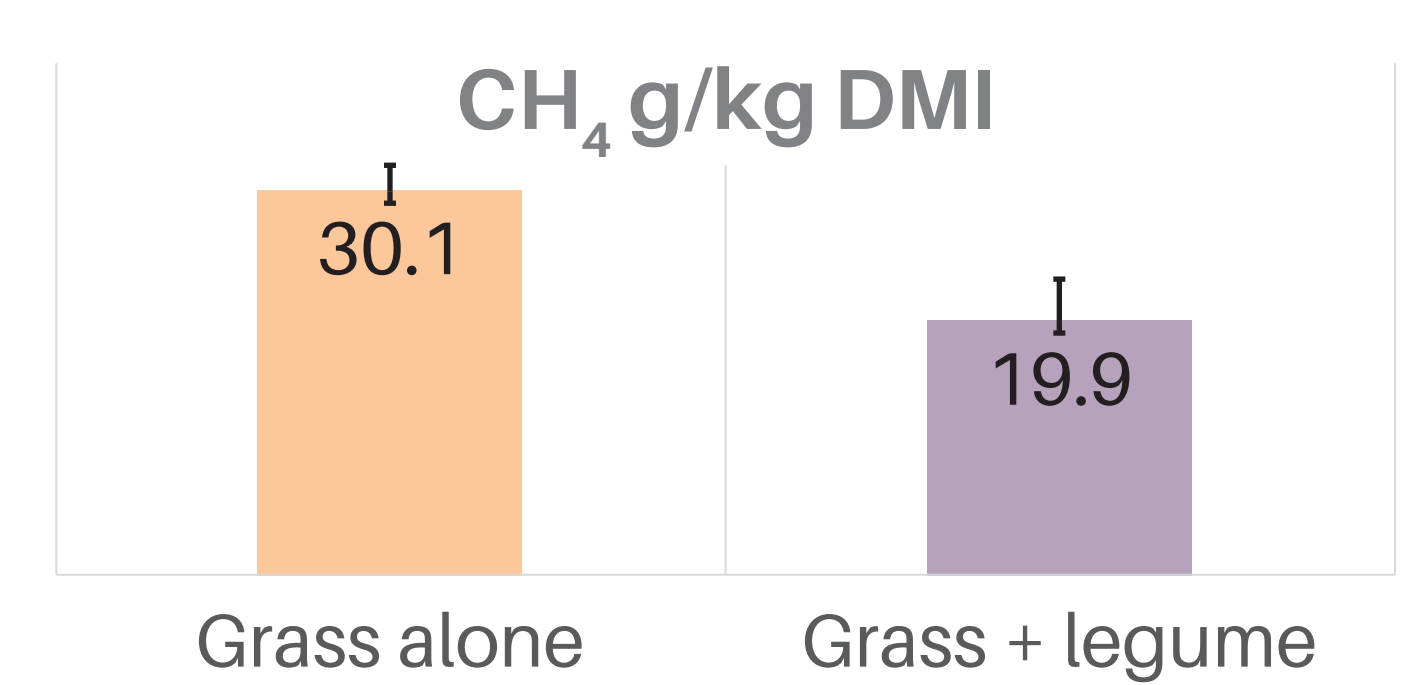

Figure 3. Cumulative emissions of methane per dry matter intake over a 24h period (n=4).

The inclusion of legumes likely stimulated plant biomass production, serving as shelter and direct food storage to soil macrofauna, which was up to five times more abundant in T2 and T3 treatments compared to T1.
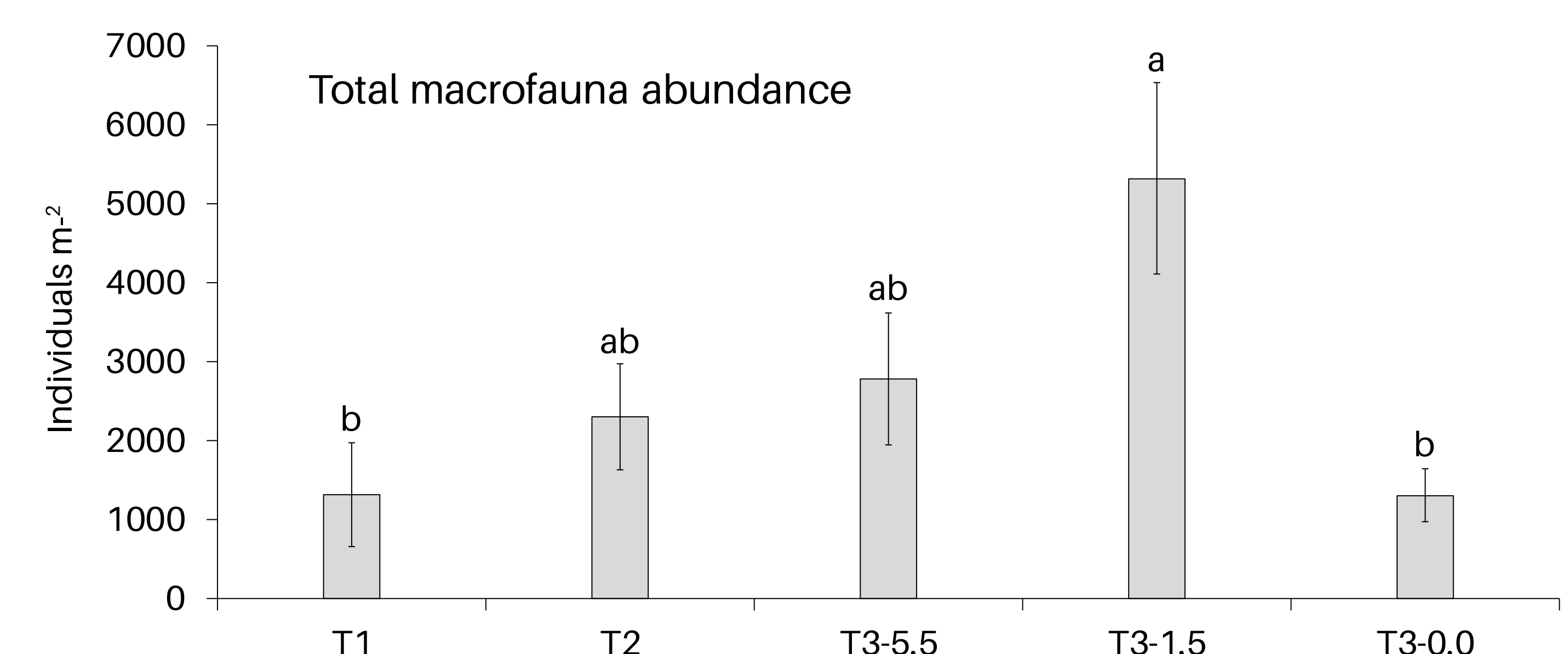

Figure 4. Total abundance of soil macrofauna in T1, T2 and at the tree different distances from the *Leucaena* doble-row in T3. Bars represent the Standard Error (n=12)

Conclusions

The diversification of pastures, through the development of mix arrangements of grasses and forage legumes at different strata provided multiple benefits at the productive and environmental level, improving animal weight gain and increasing abundance of soil macrofauna while reducing emissions of methane due to enteric fermentation.

The LivestockPlus project generated critical information for the achievement of low emission development by identifying and evaluating best-fit mitigation options for the tropics. Moreover, these strategies can be scaled up using NAMAS and other policies through other countries in the LAC region.

Poster presented at: TROPENTAG 2019