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Effects of Management Practices on Carbon Allocation in the semi-arid Savannahs of the Borana Zone, Ethiopia

Lena Rathjen[a] , Jan Pfister[a] , Folkard Asch[a]

[a]University of Hohenheim, Department of Plant Production and Agroecology in the Tropics and Subtropics, Stuttgart, Germany

Research Site near Madhecho, Borana Zone during the dry Season in August 2011

Introduction

Grassland systems covering a large proportion of the earth´s terrestrial area are expected to have a high potential for carbon sequestration if appropriate management would be applied.

The Borana pastoral area in southern Ethiopia (elevation: ~ 1500 m asl) is characterized by semi-arid climate with highly variable, bimodal rainfall (MAP: 300 - 900 mm, MAT: 20 °C).

Traditionally, the Borana people were pastoralists, driving their herds between varying grazing grounds in the dry and rainy season. Through institutional changes, increasing population density and the spread of cropping area, these systems are nowadays in transition to semi-sedentary systems.

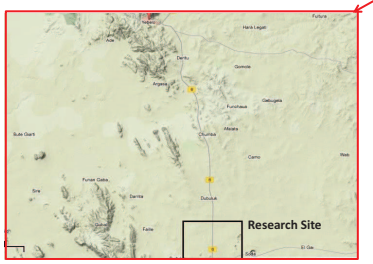
The establishment of grazing enclosures (*Kallo and Obru*) is one of the tools of the Borana people to cope with recurrent droughts and fodder scarcity by preserving fodder for weak animals and calves during the dry season.

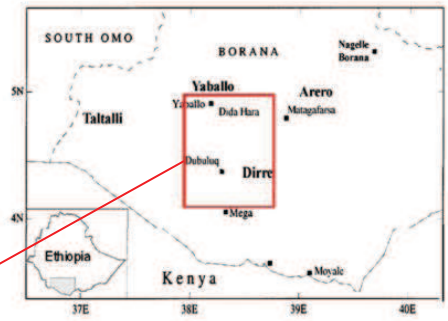
Objectives

- **Characterize the two existing grazing management types (open-grazed vs. enclosure) according to aboveground biomass accumulation, soil organic carbon stocks (SOC), species composition, soil cover and stocking density**

Material and Methods

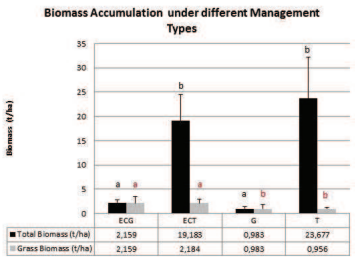
Experimental Design			Methods		
Vegetation Type	**Management Type**	**Plots (30 x 30 m)**	**Soil Sampling**	**Plant Sampling**	**Statistical Analysis**
Grassland	open- grazed (G)	5	• Auger samples • 4 depths (0-100 cm) • 10 repetitions	• Plant sampling in 3 diagonal 1 m² subplots	• One-way-ANOVA in SAS 9.3 • T-test at $p < 0.05$
	Enclosures (EC-G)	5			
Tree Savannah	open-grazed (T)	5	• Bulk Density • SOM • SOC • Carbonates • pH • texture	• DM biomass • C/N (%) total Analysis • Soil cover (%) • Species composition	
	Enclosure (EC-T)	5			

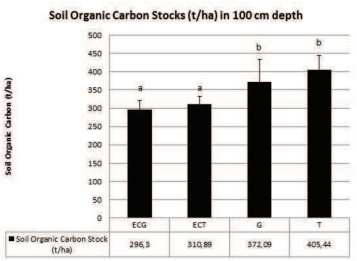


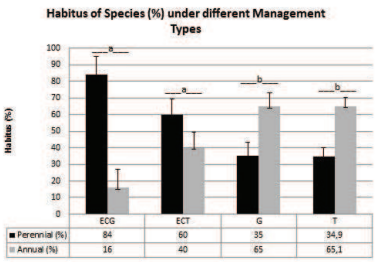


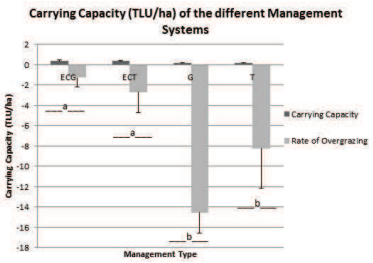
Research Site between Dubuluk in the North, Soda in the East and Mega in the South.
The Site selected is 10x10 km² in size.
Top left: Cattle during rainy season in a *Pennisetum spp.* grassland with scattered acacia trees (open-grazed area)

Results and Discussion









Means followed by the same letter are not significantly different at P<0.05. Bars show the standard error over the repetitions. Colours in the first graph indicate the signifcances for Grass and Total Biomass. Some data was not normally distributed and had to be log-transformed. ECG= Enclosure in Grassland; ECT= Enclosure in Tree-Savannah; T= Open- grazed Tree-Savannah; G= Open-grazed Grassland

- **Total biomass accumulation** was significantly higher in tree than in grass savannahs; **Grass biomass** was dependent on grazing management
- Soil organic carbon stocks were significantly higher under open grazing than in enclosures
- Species composition differed significantly between enclosures and open- grazed areas. More perennials grew in enclosures. Species palatability and soil cover were higher too (data not shown)
- Both grazing systems showed overgrazing, although enclosures could carry significantly more animals (TLU/ha) and were less overgrazed

Conclusions

- **In open-grazed systems more organic carbon is stored than in enclosures**
- **More seasonal biomass is accumulated in enclosures**
- **Questions arise concerning sustainability, overgrazing (see graph 4), land degradation, reduced soil cover (data not shown) and species alteration (see graph 3)**

Contact: lena.rathjen@gmx.net; jan_pfister@uni-hohenheim.de

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