Estimation of Carbon sequestration potential under different vegetation types in the Borana rangelands, Ethiopia

Jan Pfister*[1], Folkard Asch[1], Mohammed Said[2], Marcus Giese[1]

[1] University of Hohenheim, Garbenstraße 13, 70599 Stuttgart, Germany
[2] International Livestock Research Institute, Livestock System and Environment, Nairobi, Kenya

* Jan_Pfister@uni-hohenheim.de

Introduction

The Borana rangelands in southern Ethiopia used to be among the most productive pastoral areas in East Africa. Intensive grazing and land-use change has resulted in declining rangeland conditions and encroachment of woody-species. Payment for environmental services (PES) based on carbon sequestration could offer additional livelihood options. However, basic information on above- and below-ground biomass (AGB, BGB) and carbon pools and their seasonal dynamics is missing.

Objectives

Assessing the biophysical potential for carbon sequestration by

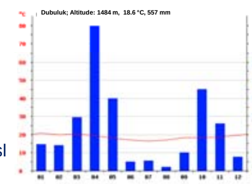
A) estimating above- and belowground biomass and carbon stocks related to four main vegetation types (VT) and

B) evaluating seasonal dynamics of herbaceous and root biomass

Conclusion and Outlook

- **Differences between vegetation types are based on above-ground (woody) biomass stocks**
- **Root biomass does not reflect seasonal AGB dynamics and showed no difference between vegetation types**
- **Total above-ground biomass stocks of main vegetation types in the Borana rangelands are not related to SOC pools.**
- **More data will be used to study seasonal dynamics; integration with social and grazing data will start discussions on possible PES schemes**

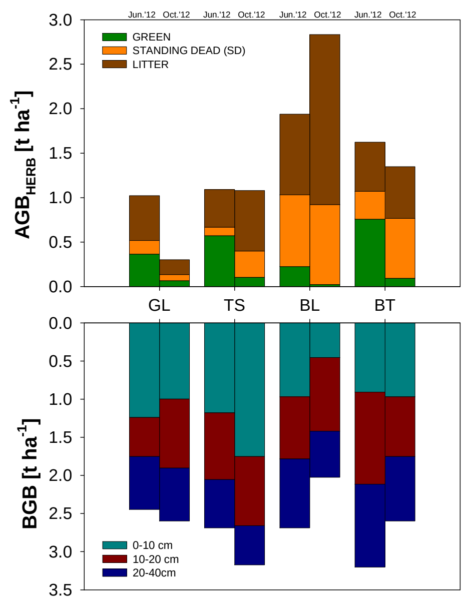
- Climate: semi-arid
- bimodal rainfall
- MAP: 400-600 mm
- MAT: 19-24 °C
- Elevation: 1500 m asl



Results

Parameter ± SE [t ha^{-1}]		Grassland GL	Tree savanna TS	Bush land BL	Bush and Tree savanna BT
Soil Organic Carbon 0-100 cm (SOC_{TOT})		**368.5** ± 53.7	**381.0** ± 29.5	**326.6** ± 31.0	**363.9** ± 29.1
Woody Biomass (AGB_{WOODY}) ‡		**0.0** ± 0.0 a	**22.2** ± 5.0 c	**7.1** ± 2.6 ab	**15.0** ± 4.3 bc
Herbaceous Biomass (AGB_{HERB})	JUNE '12	**1.0** ± 0.2	**1.1** ± 0.1	**1.9** ± 0.5	**1.6** ± 0.5
	OCT '12	**0.3** ± 0.0	**1.1** ± 0.2	**2.8** ± 0.7	**1.3** ± 0.4
Root Biomass 0-40 cm (BGB_{TOT})	JUN '12	**2.4** ± 0.4	**2.7** ± 0.4	**2.7** ± 0.4	**3.2** ± 0.4
	OCT '12	**2.6** ± 0.2	**3.2** ± 0.5	**2.0** ± 0.2	**2.6** ± 0.2

Means with different letters are significantly different (Tukey's HSD test)
‡ Calculation of woody biomass according to Hasen-Yusuf et al. 2013



A) Quantification of biomass and comparison of VTs

- sign. differences for **woody biomass**: TS, BT > BL > GL
- no sign. effect for all other biomass pools and SOC
- Trend (but no sign. effect) of **herbeceous biomass**: BL > BT > TS > GL (for both sampling dates)

B) Seasonal change (JUNE '12 vs. OCT '12):

JUNE '12: end of rainy season, expected biomass maximum
OCT '12: end of dry season, expected biomass minimum

- sign. decrease of **green biomass**
- Increase (not sign.) of **standing dead biomass** and **litter**
- No change in **below-ground biomass**

Materials and Methods

- **AGB_{HERB}:** destructive sampling (clippping) of 3 subplots per plot
- **AGB_{WOODY}:** all species per plot were measured, biomass was calculated from allometric equations
- **BGB:** sampled using Split-tube auger, 3 depths, composite sample
- **SOC:** sampling of 10 auger per plot, 4 depths, soil organic matter (SOM) determination by Loss-on-Ignition method (muffle furnace)
- **Bulk density:** standardized metal cylinder, 5 cylinder per plot, 2 depths

BMZ Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

This study was conducted within the framework of the BMZ funded project
"Livelihood diversifying potential of livestock based carbon sequestration options in pastoral and agro-pastoral systems in Africa",
a joint project of ILRI, ICRAF (Kenya), Hawassa University (Ethiopia), INERA (Burkina Faso), DITSL, Hohenheim University (Germany)

Tropentag 2013, Hohenheim

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE