Tropentag, September 16-18, 2015, Berlin, Germany

"Management of land use systems for enhanced food security: conflicts, controversies and resolutions"

Effects of Clipping and Irrigation on Grass Carbon Allocation: Implications for Rangeland Management and Food Security

Samuel Tuffa Kawo[1], Anna C. Treydte[1], Dana Hoag[2]

[1] *University of Hohenheim, Inst. of Plant Production and Agroecology in the Tropics and Subtropics, Germany*

[2] *Colorado State University, Agricultural and Resource Economics, United States*

Abstract

Predicting whether rangeland grasses have the potential to mitigate increasing atmospheric CO_2 requires understanding how individual grass responds to major rangeland stressors, herbivory and drought. Yet, achieving such understanding has been hampered by the difficulty of quantifying grass below-ground C pools, and little experimental research has been conducted on this aspect.

We estimated above and belowground carbon production in two native grassland species (*Chloris gayana* and *Cenchrus ciliaris*) in mature stands, along with a corresponding pot and plot experiment using seedlings of the same two species in Borana rangelands, southern Ethiopia. We simulated grazing by clipping at different frequencies, and also simulated climate change in the pot and plot experiments by increasing precipitation by 5 % and also decreasing precipitation by 30 %.

Results of our study indicated that when we applied clipping as a single factor, aboveground grass organic carbon (agOC) was significantly higher in the unclipped compared to clipped grass tufts in both *Chloris gayana* ($p = 0.0001$) and *Cenchrus ciliaris* ($p < 0.0001$); on the other hand, below-ground grass organic carbon (bgOC) was significantly higher ($p = 0.0303$) in clipped tufts than in unclipped ones. When we applied two factors combined (clipping frequency and irrigation amount), both factors significantly influenced agOC and we found higher agOC and bgOC in clipped than in unclipped treatments; limited irrigation (30 % decrease of average annual rainfall), however, resulted in significantly lower agOC and bgOC. Interactions between the two factors were observed only in the pot experiment of *C. gayana* affecting bgOC.

Our study indicated that both grazing frequency and rainfall amount significantly influenced grass C allocation potentials. This implies that unless appropriate grazing management is in place, the potential of grasses to sequester C and store it in biomass and soil will be greatly limited by existing herbivore pressure and high variability of rainfall amount in the course of climate change; soil C sequestration is a versatile strategy as it restores degraded soils, enhances land productivity (improve food security), improves biodiversity and mitigates climate change.

Keywords: Carbon, carbon dioxide, climate change, clipping, food security, grazing, herbivory, irrigation, rainfall amount

Contact Address: Samuel Tuffa Kawo, University of Hohenheim, Agroecology in the Tropics and Subtropics, 70593 Stuttgart, Germany, e-mail: satukada@gmail.com