

Sustainable rangeland management: how grazing management and woody cover can alter herbaceous species richness, forage quantity, and carbon stocks in semi-arid rangelands of Ethiopia

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Abstract

Semi-arid savanna rangelands are currently under threat by overgrazing, which, in the absence of fire, can lead to dense woody cover and often results in the suppression of herbaceous plants. On the other hand, woodland expansion might result in a large increase in Carbon (C) storage in the grassland ecosystem, an important aspect for climate change mitigation potentials. Particularly the influence of grazing intensities on the belowground herbaceous root biomass, where large amounts of C can be stored, has never been tested systematically. We compared the effect of enclosures under varying woody cover in pastoral grazing systems of southern Ethiopia. Caged plots and transects were established to assess species composition, dry matter and above-and below-ground C stocks of herbaceous plants, as well as those of the total ecosystem under the different treatments. Herbaceous species richness and aboveground dry matter yield declined whereas woody above-and belowground C storage was higher with increasing woody cover. Herbaceous plants dry matter yield was significantly higher in enclosures compared to open grazing lands but was dependent on woody plant density and cover. Herbaceous species composition did not significantly vary across grazing management while root biomass and total soil organic C positively responded to higher grazing intensity. Older enclosures did not pronounce differences in herbaceous species composition and dry matter yield, compared to younger ones, which highlights the importance of rotational grazing practices. We conclude that high woody cover suppresses herbaceous species richness, dry matter yield but both herbaceous and woody plant productivity and C-sequestration potential can strongly be enhanced by managing grazing herbivores and selective wood thinning. While enclosures represent important management tools rotational grazing and seasonal land use should be fostered to restore herbaceous vegetation and its C stocks.

Key words: Borana rangeland, bush encroachment, carbon sequestration, grazing management