

Herbaceous Vegetation Response on Continuous Grazing around Wami Sokoine Charco Dam

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Abstract

This paper provides basic information on the effects of grazing around the charcoal damat Wami Sokoine grazing lands in Mvomero district. Livestock grazing have enormous effect on vegetation composition and structure of grasslands. Different grazing regimes have different ecological outcomes in different ecosystems. The present study determined the effect of grazing close to watering point on herbaceous vegetation composition and structure. Data collected includes species composition and distribution, canopy cover percentage, height and root structure of herbaceous species. Results indicated negative impacts grazing close to the watering point on species composition and structure. Grazing pressure and trampling thought to be the cause of few species with the lowest mean of height, root depth and branching in area close to the watering point. More studies are required to understand dynamics of herbaceous species around watering points in grazing areas at different seasons of the year.

Keywords: *Herbaceous vegetation, grazing, WamiSokoine, watering point*

Introduction

Grazing land is an ecosystem of its own with three main elements influencing each other, the herbaceous vegetation, watering points and grazing animals. Water availability in grazing land apart from its importance as nutritional part for animals; determine rangeland health through favouring grazing distribution (Fraser, 2007). According to Jackson *et al.* (1997), the effect of watering points around riparian areas through which moisture available for vegetation was shown by evergreen vegetation around these areas. Different grazing regimes have different ecological outcomes in different ecosystems. For example, animals grazing around watering point are likely to influence the composition and structure of herbaceous species in a positive or negative manner. Liet *al.* (2011) explain that an optimal grazing tends to increase decomposition of microorganisms in the soil through hooves trampling and manure addition, which favours growth of herbaceous vegetation through rapid re-growth of above and below ground structures. On other hand several studies including Gandiwa *et al.* (2012), Goodall (2006), and Beukes and Ellis (2003) have demonstrated

the impacts of increased grazing and trampling resulting into nutrient depletion, soil compaction, poor plant growth, root structure modification and declined diversity of herbaceous species. Moreover, Greenwood and McKenzie (2001) report on the soil compaction by animal trampling that increases with soil moisture when the top soil layer is at field capacity or wetter condition, to result in weakened and declined non-woody species with domination of weeds in vicinity to watering points. Stern *et al.* (2002) reported the decrease of species composition with an increase in grazing intensity as a serious problem in various grazing areas. This study was conducted during wet season to evaluate effects of grazing close to the watering point on herbaceous vegetation composition and structure.

Material and Methods

Study area

Wami Sokoine grazing land is located in Mvomero district, Morogoro region, eastern Tanzania between latitudes 6°00' and 8°00' south of equator and longitudes 36°00' and 38° east of Greenwich. The area experiences two climatic seasons namely dry season from June to October, with

about 10 mm of rainfall as well as the wet season (around April each year) when the average precipitation is about 189 mm. The average annual temperature is about 25.4°C (District data). Wami Sokoine is a lowland area dominated with high fertile loam clay soil and hard soil pans around the water resource (Fig. 1). Vegetation is mainly grasses and scattered shrubs. Herbaceous species mainly found in this area included *urochloa species*, *bothriochloa species*, *brachiaria species*, *dactyloctenium species*, *Tephrosia species* and *Cyperus species*.



Fig 1. Wami Sokoine grazing land and the charcoal dam

Source: Google sat. image

Sampling procedure and data collection

Selected sample plots were in grazing area with uniform soil characteristics of colour and texture. The study used a complete randomized design (CRD) with a single factor (distance from watering point) and three replicates of 300 meters transect line each. Three levels in each transect were established, very close to the watering point (0 m to 100 m), at intermediate closeness (100 to 200 m) and at the remote distance (200 to 300 m) from the direction of watering point. Sampling units systematically selected after every 10 meters using 0.5 m x 0.5 m quadrant frame for data collection in each distance level. For each sampling unit data collected, include basal cover estimation through interception method, herbaceous species counting and identification, and height measurement. The number of species counted gave way to calculate species abundance and species diversity using Shannon Wiener Index. Moreover, in a sampling frame, herbaceous species were uprooted to measure rooting depth and count number of root branching.

Statistical analysis

Data were analysed using the general linear model (GLM) procedures found in the Statistical Analysis System (SAS), version 9.2. Decisions were made using Duncan multiple test after analysis of variance (ANOVA) and the goal was to attest whether there were significant differences in parameters along transect lines from watering point.

Results and Discussion

Effect of grazing close to the watering point on herbaceous composition

Attributes of species composition including abundance of herbaceous species, diversity of herbaceous species and cover of herbaceous species are presented in Table 1. Herbaceous species diversity increase as one moves away from the watering point up to 200 meters then decreases on far distance from the water source ($p = 0.0303$). The lowest species diversity observed at distance closest to the watering point than in the remote distance, while an intermediate distance observed to have high species diversity. Overgrazing and trampling affected species diversity on areas closer to the watering point at a distance

of 100 meters, hypothesized to be a result of daily animal crowding to get access to water, causing continuous grazing pressure on most of the palatable species leading to their disappearance. The argument is in line with Mohamed et al. (2010) who reported that grazing affects the ecological balance as animals make a consumption choice that favours non-consumed plants and decreases the appreciated ones. On the contrary, Feoli et al. (2002) reported that grazing activity influences the vegetation physiognomy more than its composition. Availability of enough moisture to support vegetation growth while minimum grazing pressure exerted on the vegetation as animals dispersion increases at the intermediate distance can be associated with the increase in species diversity. The decrease in species diversity at the distance of 300 meters was due to decreased soil moisture content that would support vegetation growth. However herbaceous species abundance and cover did not show significant difference ($p= 0.0558$ and 0.1333 respectively) at varying distance from the watering.

Table 1: Effect of grazing close to the watering point on species abundance, diversity and cover

Dependent Variable	Distance From Watering Point	Mean \pm Se (Cm)	CV	P-Value
Species Abundance	Closest distance	14.67 ^A \pm 1.08	10.59	0.0558
	Intermediate distance	18.00 ^A \pm 1.08		
	Remote distance	18.33 ^A \pm 1.08		
Species Diversity	Closest distance	1.03 ^B \pm 0.16	2.00	0.0303
	Intermediate distance	1.27 ^A \pm 0.16		
	Remote distance	1.04 ^B \pm 0.16		
Cover of herbaceous species	Closest distance	296 ^A \pm 67.07	19.23	0.1333
	Intermediate distance	379 ^A \pm 67.07		
	Remote distance	641 ^A \pm 67.07		
	Remote distance	67.07		

** Means of the same letter are not significance different at 0.05 confidence level.*

Effect of grazing close to the watering point on herbaceous vegetation structure

Assessment of above and below ground structure of herbaceous species was represented by species height, number of root branches and rooting depth. Overall, there was a significant effect of grazing closer to the watering point with a p-value of 0.0001 on herbaceous species (Table 2). Decrease in herbaceous height above the ground, decrease in rooting depth and decrease in the mean number of root branches at the closest distance from watering point (within 100 meters from watering point) was observed. This can be attributed to over-grazing, over-consumption, and trampling effects toward herbaceous species due to crowding of animals around watering points these in turn results into damage of species, poor nutrient translocation, and poor development of both above and below the ground structures of herbaceous species. Our results concur with the observation of Kidane (2005), Pringle and Landsberge (2004) and Brits *et al.* (2002). These authors at different times and places argued that, gradients of utilization pressure develops around water points, with the greatest impact on soils and vegetation near the water point.

Table 2: The effect of grazing close to the watering point on herbaceous structure

Dependent Variable	Distance from watering point	Mean±SE(CM)	CV	P-Value
Height of herbaceous vegetation	Closest distance	17.67 ^C ± 2.77	6.45	0.0001
	Intermediate distance	53.33 ^B ± 2.77		
	Remote distance	118.33 ^A ± 2.77		
Rooting depth	Closest distance	13.05 ^B ± 0.48	25.98	0.0001
	Intermediate distance	16.51 ^A ± 0.48		
	Remote distance	17.63 ^A ± 0.48		
Root branching	Closest distance	12.65 ^B ± 0.57	34.44	0.0001
	Intermediate distance	14.31 ^A ± 0.57		
	Remote distance	15.22 ^A ± 0.570		

** Means of the same letter are not significance different at 0.05 confidence level.*

Conclusion and Recommendations

Changes in herbaceous abundance, herbaceous cover, height, rooting depth and number of root branching closest

to the watering point (within 100 meters) revealed that, an ecological process taking place around watering points subjected to grazing pressure is detrimental on the vegetation. Moreover, uncontrollable effects of grazing closer to the watering point can result into loss of herbaceous species, formation of bare land, soil erosion and gradual loss of grazing land capabilities to provide its services for both vegetation and animals. This study provides an opportunity to be aware of ecological processes occurring in grazing areas such as the effect of an interaction between watering points, herbaceous species and grazing animals around watering points. Additionally, studies should be done to understand the dynamics of herbaceous species around watering points in grazing areas at different seasons of the year.

It is therefore recommended that several mechanisms be implemented to ensure that grazing activities are not detrimental toward herbaceous species around watering points. Such mechanisms may include (i) proper distribution of watering points within grazing lands which is relevant to the stocking rate, (ii) proper utilization of

watering points by setting water troughs, buffer zonation and specific entrance to the watering point so that animals will not concentrate and degrade vegetation around watering points, and (iii) to establish new species around watering points, especially planting non-desirable species which will discourage concentration of animals around watering points.

References

- Beukes, P.C. and Ellis, F. (2002). Soil and vegetation changes across a succulent karoo grazing gradient. *African Journal of Range and Forage Science* 20:11–19.
<https://doi.org/10.2989/10220110309485793>.
- Brits, J., van Rooyen, M.W. and van Rooyen, N. (2002). Ecological impact of large herbivores on the woody vegetation at selected watering points on the eastern basaltic soils in the Kruger National Park. *African Journal of Ecology* 40(1): 53–60.
- Feoli, E., Vuerich, L.G., Zerihun, W. (2002). Evaluation of environmental degradation in northern Ethiopia using GIS to integrate vegetation, geomorphological, erosion and socio-economic factors. *Agric.Ecosyst. Environ* 91:313–325.
[https://doi.org/10.1016/S0167-8809\(01\)00236-5](https://doi.org/10.1016/S0167-8809(01)00236-5).

- Fraser, D.A. (2007). Rangeland health field guide book. National Library of Canada Cataloguing. <http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Mr117.htm>.
- Gandiwa, E., Tupulu, N., Zisadza-Gandiwa, P. and Muvengwi, J. (2012). Structure and composition of woody vegetation around permanent artificial and ephemeral-natural water points in northern Gonarezhou National Park, Zimbabwe. *Tropical Ecology* 53:169–177.
- Goodall, D.W. (1952). Some considerations in the use of point quadrants for the analysis of vegetation. *Australian Journal of Biological Sciences* 5:1–41.
- Greenwood, K.L. and McKenzie, B.M. (2001). Grazing Effects on Soil Physical Properties and The Consequences For Pastures: a review. *Australian Journal of Experimental Agriculture* 41:231–250.
- Jackson, R.B., Mooney, H.A. and Schulze, E.D. (1997). A global budget for fine root biomass, surface area, and nutrient contents. *Proceedings of the National Academy of Sciences*.
- Kidane, G. (2005). Rangeland Potential, Quality and Restoration Strategies in North-East Ethiopia: A case study conducted in the Southern Afar Region. Doctoral thesis, University of Stellenbosch, Agronomy Department, South Africa. 243 pp.

- Mohamed T., Farah, B.S., Azaiez, O.B. and Mohamed, N. (2010). Acceptability of plant species along grazing gradient around watering points in Tunisian arid zone. *Functional ecology of plants*.
- Li, W., Huang, H., Zhang, Z. and Wu, G. (2011). Effects of grazing on the soil properties and C and N storage in relation to biomass allocation in an alpine meadow. *Journal of Soil Science and Plant Nutrition* 11:27-39.
- Pringle, H. and Landsberg, J. (2004). Predicting the distribution of livestock grazing pressure in rangelands. *Australia Ecology* 29(1):31–39.
- Stern, M., Quesada, M., Stoner, K.E. (2002). Changes in composition and structure of a tropical dry forest following intermittent cattle grazing. *International Journal of Tropical Biology* 50:1021–1034.