The Influence of High Density Grazing and Conventional, Rotational Grazing on Soil And Vegetation Parameters in the Semi-Arid and Mesic Grasslands of South Africa

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Keywords: high-density grazing; vegetation, soil, forage quality, *Themeda triandra*

Abstract. In South Africa, multi-camp rotational grazing using 'conservative stocking rates' have been the conventional approach to livestock grazing management systems. However, as of late, the high-desnity approach (used interchangeably – depending on the situation – with regenerative grazing, mob grazing, short duration, high pressure grazing, rapid rotation, time controlled, ultra-high density, holistic grazing and holistic resource management) has been adopted by numerous farmers. This approach is considered to be an adaptable one, incorporating the 'herd effect' concept, whereby large numbers of animals occupy an area for short periods of time, and allowed an extended rest period. It claims to improve rangeland productivity by improving both vegetation and soil condition, and, in turn, enhancing animal productivity. However, scientifically sound information regarding these claims, as well as the influences of this strategy opposed to the conventional rotational systems in South Africa is somewhat lacking. The aim of our research is to explore the different facets of regenerative grazing, practiced by various livestock farmers in natural veld in the semi-arid and mesic grasslands of South Africa. These facets include different soil (physical and chemical parameters), vegetation (composition, dry matter production, necromass, cover and quality (i.e. crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and organic matter (OM)), animal and human (decision-making and financials) interactions and dynamics, in comparison to conventional, rotational grazing. Due to preliminary trials, only the forage quality parameters will be discussed. These parameters have been shown to differ between the two different grazing management strategies on a farm scale, however, not on a spatial scale. This project has the potential to produce scientific and objective information on the functionality of different grazing systems in the grasslands of South Africa, and it can, too, assist livestock farmers in understanding the rationale behind high pressure grazing.

Introduction

Recently, the concept of regenerative grazing has gained popular interest amongst livestock farmers in South Africa. Used interchangeably with high density (referred to from here onwards), high intensity, holistic and time rapid grazing to name a few, incorporates the rotation concept of conventional, rotational grazing. It is regarded as an adaptive and goal driven approach and is achieved through the rotation of generally a one herd of livestock of high stocking densities (usually double/triple, some quadruple the area norm) being rotated between relatively small camps (which can range from a few m x m to approximately 15 ha). This results in shorter periods of occupation, usually lasting between 1-3 days, followed by a long rest period. High grazing densities have been proposed to increase the trampling and incorporation of organic material into the soil ('herd effect' and 'animal impact'), thereby increasing soil nutrient cycling, basal ground cover and animal production (Heitschmidt and Walker, 1983; Xu et al., 2018). In broader aspects, it is a concept that puts focus on the improvement and revitalizing of soil health, which in turn, has a claimed marked positive influence on plant and animal dynamics. In addition, it claims that fixing our soils have positive feedback on the abovementioned parameters, but also assists in a wide range of environmental issues, which includes desertification, the carbon cycle, the water cycle and mitigating climate change.

These are however broad generalizations of high-density grazing and are based on insufficient supporting scientific evidence. In addition, evidence as a tool for rangeland restoration of degraded lands or as a

sustainable method of grazing management of rangeland in a good condition is generally lacking. In addition, due to the no-formula and adaptive approach of this grazing method, no clear definitions exist regarding the different approaches of the concept. This results in much confusion in the approach of investigating the concept.

The aim of the study is, thus, to test the general claims of the benefits of high density grazing by investigating its impact on soil and vegetation parameters. The aim of the study will be achieved through the following objectives: (1) To determine the influence high density grazing and conventional rotational grazing on rangeland health in terms of plant composition, plant production, plant litter, forage quality and rangeland condition, and (2) To determine the influence of high density and conventional rotational grazing on soil health in terms of soil exchangeable cations, soil organic matter, soil moisture and soil pH. However, due to extent of the project, only the influence of the two grazing management strategies on *Themeda triandra,* a key forage species common in South Africa will be discussed in this paper.

Methods

Preliminary trials were conducted on five farm pairs (a pair consists of one high density and one neighbouring conventional, rotational farm), in the Grassland and Savanna Biomes in South Africa. All sampling was conducted from August 2021 – March 2022 on all identified high density (HDG) and adjacent conventional, rotational farms (CRG). Transects were be placed after each camp has been evaluated, and a site (representative of the camp) was identified. As seen in Figure 2 below, all sampling was conducted on three 100 m line transects, placed parallel to the fence and adjacent to one another.

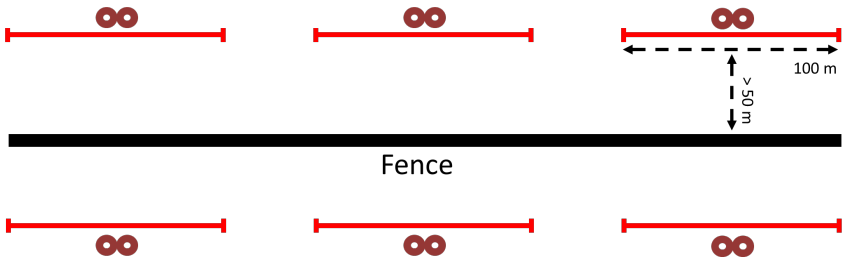

Figure 1: Schematic representation of transect layout on each farm

Each transect was divided into two 50 m subplots. Within the proximity of the 50 m subplots, ten quadrants (0.5 x 0.5 m) were thrown at random and only *T. triandra* was sampled using the harvest method and and brown paper bags for storing. Weights of the samples were noted, and material was dried in an oven at 60° C until constant weight. At constant weight, the samples were reweighed and milled through a 1 mm sieve. The milled samples were sent to the Department of Animal Science laboratory at the University of the Free State for chemical analyses. All samples were tested as per AOAC (2000) for organic matter (OM), crude protein (CP), acid detergent fibre (ADF), acid detergent lignin (ADL) and neutral detergent fibre (NDF).

Preliminary results and discussion

Table 1: Chemical composition of *Themeda triandra* under two management grazing systems (high density grazing (HDG) and conventional, rotational grazing (CRG)) in the Free State, North-West and Eastern Cape Provinces of South Africa

		Free State		North-West	Eastern Cape		
Quality parameters (%)	Grazing management strategy	1	2	3	4	5	*Overall means*
OM	HDG	90,96 ± 0,39	91,93 ± 0,59	89,42 ± 0,31	89,71 ± 0,14	90,99 ± 0,30	*90.54*
	CRG	91,11 ± 0,38	91,00 ± 0,54	89,82 ± 0,32	90,06 ± 0,15	90,22 ± 0,30	*90.07*
	p	0.787	0.246	0.376	0.086	**0.07**	*0.735*

Ash	HDG	8.97 ± 0.52	7.95 ± 0.75	10.59 ± 0.34	10.29 ± 0.15	9.01 ± 0.30	*9.36*
	CRG	8.79 ± 0.48	8.96 ± 0.77	10.18 ± 0.33	9.93 ± 0.15	9.78 ± 0.32	*9.53*
	p	0.797	**0.04**	0.394	0.311	0.919	*0.741*
CP	HDG	4.72 ± 0.14	4.26 ± 0.08	5.10 ± 0.15	4.48 ± 0.10	4.43 ± 0.11	*4.60*
	CRG	4.47 ± 0.13	4.62 ± 0.08	4.51 ± 0.13	4.32 ± 0.10	4.12 ± 0.10	*4.40*
	p	0.182	**0.002**	**0.002**	0.255	**0.039**	*0.219*
NDF	HDG	68.72 ± 0.25	68.94 ± 0.40	69.86 ± 0.53	70.27 ± 0.22	69.80 ± 0.24	*69.52*
	CRG	69.21 ± 0.24	68.96 ± 0.38	70.11 ± 0.53	69.96 ± 0.22	69.16 ± 0.24	*69.48*
	p	0.159	0.977	0.735	0.325	0.057	*0.910*
ADF	HDG	40.62 ± 0.27	40.29 ± 0.32	39.65 ± 0.41	38.76 ± 0.19	38.23 ± 0.18	*39.51*
	CRG	40.33 ± 0.26	39.74 ± 0.30	40.84 ± 0.42	38.58 ± 0.19	39.10 ± 0.19	*39.72*
	p	0.437	0.216	**0.045**	0.491	**0.001**	*0.702*
ADL	HDG	5.26 ± 0.07	5.00 ± 0.07	5.68 ± 0.17	6.47 ± 0.16	6.28 ± 0.17	*5.74*
	CRG	5.56 ± 0.08	5.30 ± 0.07	5.78 ± 0.17	6.70 ± 0.16	6.23 ± 0.14	*5.92*
	p	**0.004**	**0.003**	0.689	0.297	0.777	*0.602*

*Significant *p*-values indicated in bold

The preliminary results give a clear indication that forage parameters and influences thereof should be interpreted on a farm scale, and not a larger spatial scales (due to the influence of grazing management strategies on forage quality parameters between farm pairs, and not necessarily the influence of these said management strategies on forage parameters on a national/landscape scale). The differences in forage quality parameters between farm pairs can possibly be attributed to various factors, such as the time of sampling in relation to the last grazing event, type of livestock farmed with, the history of management, occupation and absence periods of livestock, soil type, climatic attriubutes, as well as the social influences, such as each farmers goals and objectives. Therefore, broad generalizations can not be made based on these preliminary results, and can be made more confidently once all soil and vegetation parameters have been quantified and thereafter considered holistically.

Conclusions and/or Implications

The exploration into the various claims of high density grazing is important to assessing and quantifying potential positive and/or negative impacts of high density grazing in natural grassland areas of South Africa. If the sustainability of increased stocking densities above those suggested by the normal stocking rates can be confirmed, it might have a major impact on livestock production in South Africa. The contrary, however, might emphasize that conservative stocking densities under more conventional grazing management practices is still a viable option, especially when considering the required high capital outlay and labour-intensive nature of short duration, high intensity grazing systems. The overall study has the potential to clarify some of the controversies around high density grazing for South African livestock farmers, as well as for rangeland scientists; scientifically quantify the potential impact of high density grazing on various soil and vegetation characteristics under different rainfall and soil type regime, and redefine short duration, high density grazing, and provide guidelines for the practical application of short duration grazing as a management tool for both commercial and communal farmers.

Acknowledgements

- National Research Foundation for funding

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