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Grazing intensity and its impact on plant performance at semi-arid zone of Sudan

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Abstract

Livestock grazing can affect the herbaceous composition by making changes to the vegetation coverage. Plant species contribute to the largest proportion of the fodder. Despite the profound benefits obtained, anthropogenic disturbances are hindering its development. The study was carried at Umkaddada locality, North Darfur State, for years 2017 and 2018 to investigate the effect of grazing intensity on plant density and species. A total of twenty random line transects in unprotected area were conducted, quadrats of 1×1 m2 size were laid down at 50 m intervals along every transect, and data were analyzed by t-test to compare data. The result showed the higher number of plants subjected to grazing was at level (III) with the percentage of 52.9% at the late of first season, and showed that there was 39.4% at level (I) at early of the second season. Also the result showed that the higher number of species not subjected to grazing was 100% at early of the first season, and the result showed there was 100% grazing at level (III) at the late of second season. The study concluded that grazing intensity of level (II) and more may have significant effect on plant growth.

Keywords: Grazing intensity; Grazing level; Herbaceous; Plant density

1. Introduction

Livestock grazing is a major determinant of soil and vegetation that can affect the structure and function of vegetation coverage in many ways, for which it is necessary to establish a grazing plan for the conservation of these ecosystems and their plant species useful for livestock [1]. It can also influence the nutrient flows and the performance of rangeland ecosystems. In most cases, livestock grazing leads to the abundance of plants that have a low rate of decomposition in the plant composition. This can be attributed to the fact that only those plants that contain deterrent texture such as lignin, kutins, and toxins are able to survive in the plant composition [2].

The most common vegetation pattern found in semi-arid areas are usually referred to as spotted or stippled and consists of dense vegetation clusters that are irregular in shape and surrounded by bare soil [3]. In Sudan, rangelands are varied from poor to rich according to the ecological zones. The high numbers of animals concentrate in a certain area could destroy the natural vegetation leads to overgrazing and hence deterioration of the pasture. Continuous overgrazing, through shrub removal and complete utilization of grasses and herbs, particularly before maturity, has resulted in an overall land degradation. Good management of rangeland resources requires many techniques of measurements and sampling used in range inventory and monitoring programs to determine the proper use of range resources. Because the inventory and monitoring are essential features of a range management process and plan, they can be as detailed as important to meet the objectives of the plan [4].

Degradation of lands due to uncontrolled and excessive use of communal grazing land and erratic rainfall in semi-arid areas have further reduced the availability of feed resources [5]. Restoration of plant species diversity is an important management strategy for rehabilitating landscapes, which have lost vegetation cover [6]. Maxwell (1991) stated that

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the main objectives of rangeland improvement is firstly to rehabilitate degraded rangeland, restore its use and prevent soil erosion, and secondly to improve plant productivity, herbage quality and provide conserved forage for supplementary feeding during seasons of poor fodder quality and growth [7]. The main problem associated with rangeland management is over-stocking leading to progressive reduction in biomass production and plant cover that lead, in the arid and semi-arid areas, to soil degradation [8].

2. Material and methods

2.1. Study area

The study was carried out at Umkaddada locality, which located in the eastern part of North Darfur State of western Sudan, 167 km from Alfashir - Capital of North Darfur State, between longitudes 26 - 27˚ E, and latitudes 13 - 14˚ N covering an area of about 15000 km^2 [9]. Total annual of rainfall in 2017 & 2018 was 146.1 and 254.3 mm respectively. There is pronounced different in temperature between winter and summer. In winter months the mean temperature ranges between 20 – 37.7 ℃, the minimum temperature is around 10 ℃, and the normal maximum reaches 31 ℃. In summer months the mean temperature ranges between 28.3 – 30.5 ℃, the minimum is 19 ℃, while the normal maximum temperature is 38 ℃ [10]. The study area is part of what is called sedentary zone, located between zones of camel-owning nomads to the north and cattle owners to the south. The area is dominantly inhabited by Barti tribes accustomed to a sedentary life and is more attached to their lands, representing indigenous pastoralism for livelihoods than other tribes of the region.

2.2. Sampling and data collection

The field work was carried out for two consecutive years 2017 and 2018. The samples were collected from Eastern part of Umkaddada town. A total of twenty random line transects of 100m length were conducted at each site, quadrats of 1×1 m^2 size were laid down at 50 m intervals along every transect, and data were analyzed by t-test to compare data. The following data were collected: plant density (plants/m^2) and species density. Plant density was calculated for each quadrate and recorded, then the total calculation was summed and divided by the number of quadrates to give one average plant density for one quadrat.

The degree of grazing intensity was determined using method similar to what was used by Saltaz *et al;* (1999) [11]. In each quadrat data was recorded, then the intensity of grazing was assessed as level I if it estimated 0% ->50%, level (II) within 50% ->75% grazed, level (III) within 75 % -100% grazed.

3. Results and discussion

3.1. Effect of grazing intensity on plant density

Table (1) show the higher number of plants subjected to grazing was at level (III) with the percentage of 52.9% at the late of first season, this result may be due to shortage of rain fall and this lead to increase in grazing intensity and decrease in vegetation cover. This agreed with [12] they stated that palatable species has been subjected to selective grazing by the huge number of animals in addition to erratic rainfall reduces the number and densities of the palatable species. Also this result is consistent with those of Tatian *et al;* (2014) they stated that an increase in grazing intensity is correlated with a decrease of crown percentage, a change in plant composition, and a cut in vegetation coverage [13]. Also Table (1) showed that there was 39.4% at level (I) at early of the second season, this may be attributed to more desirable plants at the study area and these plants were selected by animals, Rahma (2015) stated that most of the livestock owners preferred to stay near to the security areas, this situation would result in excessive grazing which can lead to negative impact on rangelands [14]. Intesive grazing and displaced people activities can be considered as first factors affecting the study area.

Table 1 Effect of grazing levels on plant density

	No grazing				Level I				Level II				Level III			
	Early		Late		Early		Late		Early		Late		Early		Late	
2017	14	41.2%	5	14.7%	6	17.6%	2	5.9%	7	20.6%	9	26.5%	7	20.6%	18	52.9%
2018	8	24.2%	4	12.1%	13	39.4%	8	24.2%	7	21.2%	11	33.3%	5	15.2%	10	30.3%

Level I (0% - 50% grazed), Level II (50 % - 75% grazed), Level III (75% - 100% grazed); Early = Flowering stage Late = Maturity stage

3.2. Effect of grazing intensity on plant species

The result in Table (2) showed that the percent of no grazing was 100% at early of the first season, this may be due to low palatable of *Eragrostis sp*.

Table 2 Effect of grazing levels on plant species at the first season

	No grazing				Level I				Level II				Level III			
	Early		Late		Early		Late		Early		Late		Early		Late	
1	9	47.4%	3	15.8%	2	10.5%	2	10.5%	3	15.8%	6	31.6%	5	26.3%	8	42.1%
2	2	40%	0	0%	2	40%	3	60%	0	0%	1	20%	1	20%	1	20%
3	8	100%	0	0%	0	0%	5	62.5%	0	0%	2	25%	0	0%	1	12.5%
4	1	50%	0	0%	0	0%	0	0%	0	0%	0	0%	1	50%	2	100%

Level I (0% - 50% grazed), Level II (50 % - 75% grazed), Level III (75% - 100% grazed); Early = Flowering stage Late = Maturity stage; 1 = *Aristida* sp 2 = *Cenchrus biflorus* 3 = *Eragrostis sp* 4 = *Dactyloctenium aegyptium*

Table 3 Effect of grazing levels on plant species at the second season

	No grazing				Level I				Level II				Level III			
	Early		Late		Early		Late		Early		Late		Early		Late	
1	11	85.7%	1	7.1%	0	0%	1	7.1%	2	14.3%	8	57.1%	1	7.1%	4	28.6%
2	1	14.3%	0	0%	4	57.1%	1	14.3%	0	0%	0	0%	2	28.6%	6	85.7%
3	7	77.8%	1	11.1%	0	0%	0	0%	2	22.2%	5	55.6%	0	0%	3	33.3%
4	0	0%	0	0%	2	66.7%	0	0%	0	0%	0	0%	1	33.3%	3	100%

Level I (0% - 50% grazed), Level II (50 % - 75% grazed), Level III (75% - 100% grazed); Early = Flowering stage Late = Maturity stage; 1 = *Aristida sp* 2 = *Cenchrus biflorus* 3 = *Eragrostis sp* 4 = *Zalya pentandra*

In Table (3) the result showed there was 100% grazing at level (III) at the late season, this result may be due to increase in number of animals or the system of animal grazing selection in diet. Also severe grazing pressures affect the range component which was reflected in reduced desirable species and high percentages of bare soil. Thomas *et al;* (1989) Stated that grazing pressure influences herbaceous composition [15]. The structure of plant communities is often changed by grazing since a number of examples where defoliation by grazing herbivores altered plant height and canopy cover, and changed species composition to include structurally different types of plants. Trampling may also change the structure of plant communities by breaking and beating down vegetation, this agreed with Huntly (1991) [16]. Proper grazing management can promote desirable vegetation and reduce invasive plant populations.

4. Conclusion

The study concluded that levels of grazing can be used as indicators for plant density and frequency as proved in the area of the study. Grazing intensity of level (II) and more may have significant effect on plant growth.

Recommendation

The study recommended that grazing level can be used as practical mean to assess utilization level as expressed by growth performance indicators.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest.

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