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ASSESSING GRAZING INTENSITY PLANT FREQUENCY IN KORDOFAN REGION

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Abstract

This study was conducted in Um "Nabag" (15km north of "Bara"), "Dilling" (160km south of "Elobeid") and "Eldemiokya" (30km east of "Elobeid"). The main objective of this study is to assess the effect of grazing on growth performance of natural rangelands in Kordofan region. The specific objectives: To assess the effect of grazing level on vegetation frequency. The results showed different levels of grazing intensity at different sites as indicated by plants frequency and biomass. Intensive grazing levels were found at Bara in the north, early and late in the rainy season but in Dilling it was not found in the late in the rainy season for both seasons (2008 and 2009) which indicated longer stay of herders in "Bara" area as a rainy season residences. Frequency of the species between non- grazed and grazed areas showed a decrease for the two seasons especially for preferred species at the different sites as in the case of *Eragrostis termula* and *Cenchrus biflorus* in (2008),Similar results were observed in (2009) with *Fimbirsty dichotomo* and *Cenchrus biflorus*. The study recommended that grazing level can be used as practical mean to assess utilization level as expressed by growth performance indicators including frequency. Level (II) is expected to result in negative impact on rangeland plants growth performance.

Key words: Grazing level, plant frequency, grazing density

Introduction

Sudan has a diverse agro-climatologically zones ranging from desert in the north to humid equatorial in the south, that contain vast and large natural rangelands suitable for grazing for all kinds of animals. The total area of rangelands in the country is estimated as 117.6 million hectares. Forage produced from natural pastures represent 86.6% of national animal feed requirements ARC (2006). To reach the optimum livestock production, it is imperative that balance should be made between the number of animals and the vegetation productivity. This balance does not exist in North Kordofan State for the time being, and the number of animals is by far exceeding what the land is offering. Therefore, with the prevailing systems of production, the negative impact on the land and the environment would be expected to continue. Since most of the animal wealth is concentrated in the hands of transhumant and nomads, it is difficult to alleviate the pressure on land by attempting to reduce the number of animals. These constraints may be reflected in severe deterioration in both quality and quantity of rangelands and consequently reduced livestock productivity. Therefore detailed evaluation of vegetation is necessary to describe the current status of rangelands in semi-desert and low rainfall savanna, comparing these measurements over time to detect the change that has happened to rangeland, using ground measurements and remote sensing techniques. Such monitoring would enable setting up strategies and measures aiming at alleviating constraints and improving productivity.

Material and methods

This study was conducted in three areas namely “Um Nabag" (13.51978°N, 30.36193E) in Bara locality, "Dilling" (11.85815°N, 29.71562°E) and "Eldemiokya" (13.28291°N, 30.47830°E) as these areas represented different geographical locations in relation to agro pastoralist movement and consequently represented different timing and intensity of use .

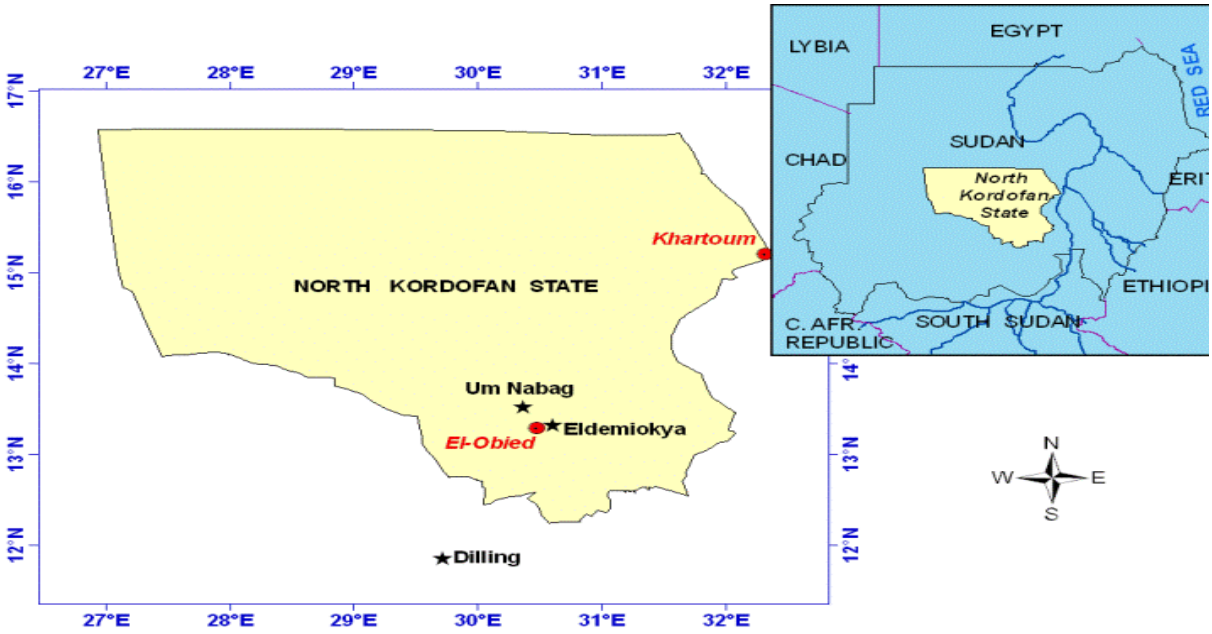

Figure 1: Location of North Kordofan State and study area

Sampling design: Three range sites were selected in each of the three geographical areas, within each site an area of 1km x 1km plot was marked based on Releve (Greig-Smith 1979 and Barbour and Burk et al 1987), each containing three smaller circular plots of a radius of 200 m, marked based on the minimum area, principle.

Research Methodology: Data and information used in this study included both primary and secondary data. Primary data covered measurements on rangelands at the two ecological zones. In Semi-Desert (SD) and Low Rainfall Savanna on Sand (LRFS) measurements included plant cover, frequency, biomass, root biomass of herbaceous plans. Sources of secondary data indicated published reports and studies covering variety of related topics to the study area.

Climatic data: Measurements of climate variables (air temperature, relative humidity, soil moisture and soil temperature) were performed by instruments supplied with sensors for each one of the above mentioned climatic factors. These instruments were installed in the three study areas by CARPOAFRICA project activities. All instruments were inter calibrated at location before and after each growing season collected.

In Um Nabag annual rainfall was estimated at 232 mm, minimum temperature 20°C, maximum temperatures 35°C and the average is 27°C (Table 1). On the other hand, annual rainfall on Eldemokya was estimated at 318 mm. Similar to Um Nabag, minimum temperature 20°C, maximum temperatures 35°C and the average is 27°C (Table 2): Finally,

in Dilling annual rainfall was estimated at 557 mm, minimum temperature 21°C, maximum temperatures 35.5°C and the average is 26°C as indicated in Table 3.

Table 1. Temperature and rainfall data of Um Nabag

Month	Mean Temp. [°C]	Max. Temp.[°C]	Min. Temp.[°C]	Precipitation [mm]
January	21.7	29.8	13.5	0
February	23.7	32.2	15.3	0
March	27.3	35.7	19.1	0
April	30.2	38.5	21.8	1
May	32	39.4	24.6	3
June	31	37.5	24.5	12
July	28.5	33.9	23.1	85
August	27.5	32.7	22.3	86
September	28.2	34.7	21.7	36
October	29.3	36.4	22.3	9
November	25.8	33.5	18.2	0
December	22.2	30.5	14.1	0
Mean	27.28	34.57	20.04	19.33

Source: New-LocClim, Local climate estimator, FAO, 2005

Table 2: Temperature and rainfall data of Eldemiokya

Month	Mean Temp. [°C]	Max. Temp.[°C]	Min. Temp.[°C]	Precipitation [mm]
January	21.7	29.8	13.5	0
February	23.7	32.2	15.3	0
March	27.3	35.7	19.1	0.4
April	30.2	38.5	21.8	1.3
May	32	39.4	24.6	8.3
June	31	37.5	24.5	22.5
July	28.5	33.9	23.1	98.1
August	27.5	32.7	22.3	110.5
September	28.2	34.7	21.7	61.7
October	29.3	36.4	22.3	14.5
November	25.8	33.5	18.2	0.3
December	22.2	30.5	14.1	0
Mean	27.28	34.57	20.04	26.47

Source: New-LocClim, Local climate estimator, FAO, 2005

Table 3: Temperature and rainfall data of Dilling

Month	Mean Temp. [°C]	Max. Temp.[°C]	Min. Temp.[°C]	Precipitation [mm]
January	22.7	34.4	17.3	0
February	24.1	36	19.2	0
March	26.7	38.9	22	0
April	29.2	40	23.5	4
May	29.2	38.2	23.7	29
June	28	35	22.5	85
July	25.8	32	21.7	147
August	25.1	31.3	21.2	144
September	25.8	32.7	20.7	112
October	26.7	35.2	20.2	35
November	25.2	36.4	18.7	1
December	23.2	34.9	17.8	0
Mean	25.98	35.42	20.71	46.42

Source: New-LocClim, Local climate estimator, FAO, 2005

Density and frequency of herbaceous plants

Density is the number of plant rooted within each quadrate. The frequency is the percentage of total quadrates containing at least one rooted individual of a given species Density base Frequency readings were obtained based on (Barbour and Burket et al., 1987).

Degree of grazing intensity: The degree of grazing intensity was determined using method similar to what was used by Saltaz et al., (1999). In each quadrate percentage of vegetation cover, litter and bare soil were recorded, then the intensity of grazing was assessed as level I if it estimated <50% level (II) (within 50 %~ 75% grazed), level (III) (within 75 %~100% grazed.) level (IV) if it reached 100% grazing.

Data analysis: Data for vegetation measurement were assessed using standard range measurements equations, while grazing intensity assessed based on Saltaz et al., (1999). Other indicator such as Rieid and Love (1951) for soil erosion hazard was also used.

Results and discussion

The study investigated the effect of different grazing levels on the range plants frequency and density.

Grazing intensity :According to Table (I) the higher number of quadrates subjected to grazing were at level (I) with the percentage of 25% for both "Bara" and "Demokeya"

during early grazing season and 35% and 25% for the late grazing in the same season (2008) for both sites.

In Dilling it was 10% for early grazing, but no grazing late in the season. This could be attributed to long stay of livestock herds at rainy season domains. The absence of grazing late in Dilling may be due to the fact that pastoralists were late at the rainy season domains, and will not comean back to this area.

There was no grazing at level (IV) in the early or late in the grazing season. There were no noticeable differences between sites in Bara and Eldemokeya in grazing levels ratios, and the distribution of grazing at different levels, but there were differences between these two locations, especially at the end of the grazing season Table (4). This may be due to long stay of herders at the rainy season domains while Dilling was mainly a summer domain, associated with the reason that herders will not come back at that time

In all locations, it was found that the percentage of grazing levels observed early in the grazing season was 30% in Bara site, and 45% Demokeya site, but was 20% in Dilling site. The grazing level late, grazing in the season found to be 35% in Bara site, 30% in Demokeya site and 0% in Dilling site. This result represented the pattern of herders movement in each season, where they may stay longer at the rainy season residences in the north.

In season (2009), and as shown in table (5) it is clear that high grazing percentage obtained at level (I) reaching 55% at Bara indicating intensive grazing early in the rainy season and higher percentage of 80% was found in late in the rainy season. Obtaining similar result within two seasons may indicate that herders stayed longer at the rainy season domain due to difficulties of moving south since routes might be closed or narrowed by farming of sorghum and millet. This situation will result in excessive grazing which can lead to negative impact on rangelands. 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).

The forces and influences discussed above make grazing a valuable vegetation management tool. While the misuse of domestic livestock grazing can increase populations of invasive plants, proper grazing management can promote desirable vegetation and reduce invasive plant populations.

Table (4): Grazing levels at different sites of the study in season (2008)

Site	Number of quadrate and%																			
	No grazing				Level I				Level II				Level III				Level IV			
Bara	Early		Late		Early		Late		Early		Late		Early		Late		Early		Late	
	12	60%	13	65%	5	25 %	7	35%	1	5%	0	0%	1	5%	0	0%	1	5%	0	0%
Demokeya	12	60%	14	70%	5	25%	5	25%	3	15%	1	5%	0	0%	0	0%	0	0%	0	0%
Dilling	16	80%	20	100%	2	10%	0	0%	0	0%	0	0%	2	10%	0	0%	0	0%	0	0%

Level (I) (<50% grazed) Level (II) (>50 %< 75% grazed) Level (III) (>75 %< 100 grazed)

Level (IV) (100% grazed)

Table (5): Grazing levels at different sites of the study in season (2009)

Site	Number of quadrate and%																			
	No grazing				Level I				Level II				Level III				Level IV			
Bara	Early		Late		Early		Late		Early		Late		Early		Late		Early		Late	
	8	40%	1	5%	11	55 %	16	80%	0	0%	0	10%	0	0%	0	0%	1	5%	1	5%
Demokeya	13	65%	4	20%	2	10%	11	55%	2	10%	2	10%	3	15%	3	15%	0	0%	0	0%
Dilling	20	100%	17	85%	3	15%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%

Level (I) (<50% grazed) Level (II) (>50 %< 75% grazed) Level (III) (>75 %< 100 grazed)

Level (IV) (100% grazed)

Plant frequency

Frequency results usually indicate distribution of plants in the range area. The plant frequency for the three species with high frequency was investigated along the different grazing levels and across the three geographical sites in the area of the study. According to table (6); it is clear that there was decline in the average frequency of the species early in season 2008 between non grazed quadrates and those grazed at level I for *Cenchrus biflorus* and *Eragrostis termula* (among the three species of high frequency) from (100% to 60%) and (80% to 60%) respectively, which may indicate that these species are highly preferred by livestock.

Frequency of the species between non grazed quadrate and those grazed at Demiokeya level (III) for *Cenchrus biflorus* and *Eragrostis termula* in season of 2008 showed a frequency of (100% to 40%) early in the season and (28.6% to%0) late in the season respectively. In Dilling the Frequency of the species between non grazed quadrate and those grazed at level (I) for *Cymbogon nervatus and Sonchus oleraceous* showed values (100% to 50%) and (62.5% to50%) respectively in the early season 2008.

In season 2009 frequency of the species between non grazed quadrate and those grazed at level (I) early in the season for *Cenchrus biflorus and Eragrostis termula* showed frequency from(100% to 54.5%) and (100% to 54.5%) in Bara respectively. Frequency of the species between non grazed quadrate and those grazed at level (IV) for Cenchrus biflorus and *Eragrostis termula* from (100% to %0) and (100%to %0) in Bara respectively is given in a table. It is clear that there was drastic decrease in the frequency of preferred species with increase in grazing intensity of the study sites, which may affects the competition of Palatable species of these species and hence the vegetation composition.

Table (6): Plant frequency at the different grazing levels in season (2008)

Site	Dominate species	No grazing				Level I				Level II				Level III				Level IV			
Bara		Early		Late		Early		Late		Early		Late		Early		Late		Early		Late	
	Eragrostis termula	12	100%	10	76.9%	3	60%	7	100%	0	0%	0	0%	1	100%	0	0%	0	0%	0	0%
	Fimbirsty dichotomo	11	91.7%	9	69.2%	4	80%	5	100%	0	0%	0	0%	1	100%	0	0%	0	0%	0	0%
	Cenchrus biflorus	12	80%	4	28.6%	3	60%	5	100%	0	0%	0	0%	1	100%	0	0%	0	0%	0	0%
Dmokeya	Cenchrus biflorus	12	100%	4	28.6%	3	60%	5	100%	0	0%	0	0%	1	100%	0	0%	0	0%	0	0%
	Zalya pentandra	6	50%	0	0%	3	60%	0	0%	0	0	0	0%	0	0%	0	0%	0	0%	0	0%
	Aristida Funiculata	2	16.7%	1	7.1%	1	20%	2	40%	0	0	0	0	1	100%	0	0%	0	0%	0	0%
Dilling	Cymbogon nervatus	16	100%	17	85%	1	50%	0	0%	0	0%	0	0%	3	14.4%	0	0%	0	0%	0	0%
	Sonchus oleraceous	10	62.5%	4	20%	1	50%	0	0%	0	0%	0	0%	2	100%	0	0%	0	0%	0	0%
	Newtonya	10	62.5%	10	50%	0	0%	0	0%	0	0%	0	0%	2	100%	0	0%	0	0%	0	0%

Level (I) (<50% grazed) Level (II) (>50 %< 75% grazed) Level (III) (>75 %< 100 grazed) Level (IV) (100% grazed)

Table (7): Plant frequency at the different grazing levels in season (2009)

Site	Dominate species	No grazing				Level I				Level II				Level III				Level IV			
Bara		Early		Late		Early		Late		Early		Late		Early		Late		Early		Late	
	Eragrostis termula	8	100%	1	100%	5	54.5 %	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	Fimbirsty dichotomo	6	75%	0	0%	5	54.5 %	7	43.8%	0	0%	0	%	0	0%	0	0%	0	0%	0	0%
	Cenchrus biflorus	8	100%	0	0%	5	54.5 %	7	43.8%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Dmokeya	Cenchrus biflorus	4	26.2%	1	25%	2	100%	5	45.5%	2	100 %	1	50%	1	33.3%	0	0%	0	0%	0	0%
	Zalya pentandra	1	7.7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	Aristida funiculata	3	23.1%	3	75%	2	100%	5	45.5%	1	50%	0	0%	1	33.3%	0	0%	0	0%	0	0%
Dilling	Cymbogn nervatus	14	70%	7	41.2%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	Sonchus oleraceous	15	75%	1	5.9%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	Newtonya	14	70%	8	47%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%

Level (I) (<50% grazed), Level (II) (>50 %< 75% grazed), Level (III)(>75%<100 grazed), Level (IV) (100% grazed).

Conclusion

The study concluded that levels of grazing can be used as indicators for plant frequency and biomass 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 including frequency and intensity.

References

ARC, 2006. Agriculture Research corporation, Elobeid Agricultural research station, Diagnostic survey report prepared for WSRM program.

Barbour, M.G., Burk, E.G., 1987. Rang management under uncertainty: A conceptual Approach. Journal of range management, 55(1): 12-15.

FAO, 2005. Environment and Natural Resources, Working paper No. 20 (CD-ROM) October.

Greig-Smith, P., 1979. Pattern in vegetation. J. Ecol. 67:755-779.

Huntly, N., 1991. Herbivores and the dynamics of communities and ecosystems. Annual Review of Ecology and Systematics 22:477-503.

Reid, E. and love, L.D., 1951. Range-watershed conditions and recommendations for management, ELK Ridge and lower ELK Ridge Cattle Allotments, Roosevelt National forest, Colorado. U. S. Dept. Agr., Forest Service, 123 pp. (Proc) .

Saltaz, D., Schmidt, H. D., Brown, M. M., Karneili, A.A., Ward, D.D., Schmidt, I., 1999. Assessing grazing impacts by remote sensing in hyper-arid environments. J. Range management 52: 500-507.