Assessing Rangeland Attributes On Semi-Arid Zone Of North Darfur State, Sudan

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Abstract: The study was conducted over a two years period of 2012 and 2013 at three sites of Alfashir locality (Ummarahik 25km north of Alfashir, Fashar in eastern part of Alfashir about 5km and Berka 30km west of Alfashir), Western Sudan in semi-arid zone. The aim of this study was to assess rangeland attributes. Measurements of plant density, vegetation cover, range production and carrying capacity were assessed. Results showed that total forage production was low and inadequate to satisfy requirements of livestock for inhabiting the area, average range production all over the area was found to be 50.68 kg/ha and 59.21 kg/ha for the seasons 2012 and 2013 respectively. The average ground cover was about 34.71% and 42.41% for two seasons. The average plant density for the first season was 27.1 plant/m2, while the average plant density for the second season was 29.4 plant/m2. The study concluded that unwise utilization and exploitation of the rangelands particularly by man causes range deterioration and serious reduction in range production in both quantity and quality, so, the study suggested that improvement and rehabilitation such lands rangelands should be done. Further research work is needed to assess rangeland attributes across different ecological zones in North Darfur State.

Keywords: Vegetation cover, Plant density, Range production carrying capacity, Rangeland.

1. Introduction

Natural range supports and provides feed for large number of livestock, which plays a vital role in national economy through provision of animal product for local consumption and foreign exchange. The terms range and rangeland have often been misused in the sense that they are often equated with livestock use and production alone. An important distinction is that range is a kind of land with many uses - it is not a land use. The multiple values of rangeland include forage for domestic and wild animals, water, wood fuels, and wildlife cover. There are many competing uses for rangelands - uses that are increasing with population growth, increasing urbanization and interests in preservation (Heady and Child, 1994). North Darfur State is unique in its natural rangelands; being homeland for many nomadic tribes, capable of sustaining all kinds of livestock; and many livestock routes crossing the area. Rangelands in North Darfur State face many problems; these include seasonal fluctuation in feed quantity and quality, land degradation and desert encroachment, erratic rainfall and expansion of both traditional and mechanized rainfed cultivation. The balance between animals and feed does not exist in North Darfur 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. These constraints may be reflected in severe deterioration in both quality and quantity of rangelands and consequently reduce livestock productivity. The objective of this study is to assess range attributes in Alfashir locality, North Darfur State.

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2. Materials and methods

The study was carried out at Alfashir locality, North Darfur State, Sudan. The state lies between latitudes 12° 30' and 21° 55' N and longitudes 24° 00' and27° 30' E within the arid and semi-arid zones, with average annual rainfall about 287.7 and 252.5 for the seasons 2012 and 2013 respectively. Based on average annual rainfall amounts and soil types, the state can be divided into two main geographical zones: Desert and semi-desert, and area amounts to about 296,400 km2; about 60% of it is rangelands (Adam, 2013). The study was done at three sites: Ummarahik, Fashar and Berka. Three transect lines of 2 km length were selected randomly in each site. In each transect three points were taken with 500m apart. In each point 2 quadrates (1m2) were taken with 50 m apart, so the total number of quadrates in the area was 54. For quadrates size, (1 m2) was used as reported by Lee and Hanus, (1999). Information used in the attainment of this study included both primary and secondary data. Primary data of vegetation measurements were collected from rangeland through intensive field surveys, and secondary data was obtained through various standard published and unpublished literatures. The following data were collected: Plant density (plants/m2), %vegetation cover, carrying capacity and range production (gram/m2). Measurement tools used include the following: Measuring tape (100-meter), recording sheet, scissors, quadrate (1mx1m), paper bags and sensitive balance. The statistical package for social science (SPSS, version 16) software program was used to separate between means.

3. Result and Discussion

3.1 Vegetation Cover

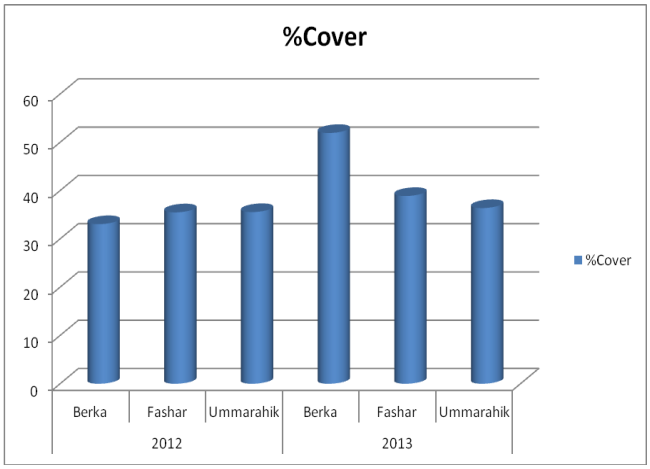
Results of ground cover percentages of the different sites were demonstrated in Table (1). The ground cover was generally low at all sites. At Berka site, cover was higher in the second season when compared with the

other sites (Fig 1). This reflects the temporal variation in the vegetation cover between the two seasons as the result of variable rainfall. Quite similar values were scored at the first season in Berka, Fashar and Ummarahik. The low vegetation ground cover in all sites was caused by low and fluctuated precipitation characterizing the semi-arid areas. The main causes of rangeland degradation were overgrazing and marginal agriculture (Nasra, 2008). Overgrazing reduced vegetation cover, increased bare ground, decreased productivity and increased soil erosion (Grainger, 1990 and Gobha, 1991). The spatial variation in vegetation cover between sites may be attributed to many factors such as the pre-existing variations in soil properties topography and that affect soil moisture and mineral content. Cayrol et al., (2000) and Loeser et al., (2007) reported that both natural and human influences are known to cause massive changes in vegetation cover and dynamics. Beside over grazing or un-controlled grazing, trampling by domestic livestock in semi-arid regions always reduces plant cover that protects the soil and generally results in soil erosion and compaction (Branson et al., 1981 and Oztas et al., 2003). Connolly et al., (1997) reported that when the percent of vegetation cover is less than 30–40%, runoff and soil loss dramatically increase.

Table (1): *The ground vegetation cover% in the study area at seasons 2012 and 2013*

	2012				2013			
	Berka	Fashar	Ummarahik	Average	Berka	Fashar	Ummarahik	Average
%Cover	33.06	35.50	35.56	34.71	51.94	38.89	36.39	42.41

Figure (1): *The ground vegetation cover% in the study area.*



3.2 Plant density

Results of the total plant density of the different sites were demonstrated in table (2). The average plant density at different sites was low. The reduction of the vegetation density may be attributed to various factors including human induced activities and severe prolonged drought, under poor land resources management. Peter 2000 mentioned that overuse and misuse activities such as heavy grazing and over cutting of trees in addition to drought and overpopulation of both human and animal have reduced the densities of plant species. The 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. Difference among sites in plant density were markedly noticed, that might be due to site characteristics and environmental conditions prevailing. Yousif (2005) stated that the clay soil have reduced water penetration, held moisture at the surface, where it readily evaporates and then often crust over the surface. While the sandy nature on other hand favor good germination and establishment. Results of density of the different species were demonstrated in Table (3), Aristida sp scored the highest density in Berka at two seasons while Alysicarpus ovalifolius and Sesamum alatum scored the lowest density at Fashar for the second season. The variation in species relative density between sites may be attributed to the spatial variation in rainfall. Grazing can also decrease plant density. Qi, (2002) reported that human activities are accelerating functional changes on fragile rangeland ecosystems.

Table (2): *The plant density (plant/m2) in the study area.*

	2012				2013			
	Berka	Fashar	Ummarahik	Average	Berka	Fashar	Ummarahik	Average
Plant density	30.06	22.67	28.61	27.1	36.17	26.11	25.78	29.4

Table (3): *The species density (plant/m2) in the study area at seasons 2012 and 2013*

Species name	2012			2013		
	Berka	Fashar	Ummarahik	Berka	Fashar	Ummarahik
Aristida sp	8.0	4.7	5.0	8.9	6.4	4.3
Eragrostis sp.	6.7	5.7	4.3	7.9	6.9	7.3
Dactyloctenium aegyptium	2.8	1.8	2.6	3.8	3.7	1.1
Cenchrus sp.	4.3	4.4	6.3	6.2	5.4	5.3
Sesamum alatum	2.1	3.2	4.6	3.4	0.7	3.3
Alycicarpus ovalifolius	2.9	1.2	2.2	2.2	0.8	1.3
Zalya pentandra	3.2	1.7	3.7	3.8	2.0	3.2

3.3 Range production

The forage biomass production showed in the table (4), Berka had the highest production for the second season while Fashar had the lowest biomass production for both seasons. The variation in biomass productivity between sites and seasons may be resulted from the variable and fluctuated rainfall. Bunderson (1984) stated that the amount and distribution of rainfall received in any given year has a profound impact on biomass, cover and composition of vegetation, particularly among the annual species. Whittaker, (1975) reported that biomass production will change with communities or ecological sites, biological diversity (Tilman and Downing, 1994), and with latitude (Cooper, 1975). If we compare the results productivity in this study with those found by Harrison and Jackson, Range and pasture department and Suliman in (1985) (Table 5). It is clear that the biomass productivity has declined substantially. This reduction may be attributed to many different factors such as increase in livestock numbers above the carrying capacity of the range. The grazing intensity is another factor that affects the distribution of biomass production in the study area. Human activities mainly overgrazing and agricultural practices are responsible for decreasing biomass production in arid and semi-arid. Results of De Leeuw and Tothill, (1990) indicated that with adequate protection and controlled grazing the forage yield on the rangeland practically doubled in about 3 to 5 years.

Table (4): *Biomass production (kg/ha) in the study area at seasons 2012 and 2013*

	2012				2013			
	Berka	Fashar	Ummarahik	Average	Berka	Fashar	Ummarahik	Average
Biomass production	49.96	44.69	57.39	50.68	72.08	50.48	55.06	59.21

Table (5): *Some changes in the herbage biomass productivity*

Ecological Zone	Productivity (Ton Dm/ha)		
	1958	1974/1975	1985/1987
	Harrison	Range and pasture	M. suliman
1) semi desert	0.2	0.1	0.05
2)Low rainfall Savanna	***	***	***
2.1 Northern part	0.24	0.1	0.14
2.2 Central part	0.33	0.1	0.14
2.3 southern part	0.66	1.5	0.2
2.4 eastern part	0.66	-	0.33
2.5 Baggara	0.99	2.5	0.8

Source: *Suliman 1985*

3.4 The Carrying capacity

It is not easy to control the carrying capacity in the open range land but its determination is essential for correct utilization of the range resources to avoid overgrazing and range deterioration. Table (6) shows the average carrying capacity for seasons 2012 and 2013. The carrying capacity was determined according to Darag, (1996) who reported that the carrying capacity is usually determined using the proper use factor (PUF) of 50% in which only one half of forage biomass produced is considered as available for grazing. This factor of proper use is rather low, this condition is caused by internal displacement people who depend mainly on green or dry plants to support the needs of their animals and improve their income. Ayuob (1998) stated that 6% of degradation was caused by human activities. The carrying capacity may vary from year to year in the same area as a result of damage by man and animals or forage production may fluctuate according to the rainy seasons. This indicates that the carrying capacity of the study area is very low if we compare it with the total numbers of the animal units utilizing the area. This can be attributed to the low forage production of the area since the determination of the carrying capacity is related to quantity of the forage that the area produces in the season.

Table (6): *Carrying Capacity (Ha/ AU/ Period) 2012 and 2013*

Carrying capacity	2012	2013
Ha/AU/Month	8.88	7.6
Ha/AU/Year	106.56	91.2

4. Conclusion

Rangeland management plan should include grazing management with the purpose of increasing the vegetation cover and decreasing the grazing pressure on the natural vegetation, controlling kinds and numbers of animals (Proper stocking), when they utilize the rangeland is absolutely essential in regulating the effects of grazing on vegetation cover. So management plan can include grazing management (proper stocking rate), protection of some areas, application of fertilizer, reseeding with the adapted and palatable grasses and legumes can be applied to the protected areas, utilization of the appropriate rainwater harvesting technique and utilization of supplementary feeds to decrease the pressure on the over graze areas.

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