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Current Assessment of Rangeland at Elain Natural Forest Reserve in North Kordofan State, Sudan

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Abstract— *Vegetation cover monitoring is very important of range management and sustainable agriculture. This study was conducted in North Kordofan State at Elain Natural Forest Reserve. The main objective of this study was to assess current range condition. Data were collected using three line transects and quadrats (1 m²) in open spaces at a radial distance of three different directions around the interior of the forest. The study showed that 15 species were located through the questionnaire, while 8 species which were encounter in the vegetation field survey showed that the 'Gao' plant was the most dominant in the area with density and frequency of 8.5 and 2.2 respectively. The findings demonstrated that one hectare of open land can produce 80 kg of dry mater which means the pasture condition is very poor. The study revealed that vegetation composition (VC) of the pasture place was dominated by litter, which covered 54.1%, meaning extensive range usage. Among the herbaceous plants, Gao exhibited the highest density (8.5) and frequency (2.2), attributed to the plant's inherent characteristics. A high density of Kiter (991.1%) was also observed, supported by the favorable clay soil conditions for its growth. The study emphasized the need for improved livestock management and controlled grazing.*

Keywords— *Forage biomass, density, Frequency, carrying capacity.*

I. INTRODUCTION

Rangelands are specially dominantly dryland ecosystems that contain many grazing animals. As well as very important to produce a wide variety of goods and services, including livestock forage, water, wildlife habitat, wood products, mineral resources, recreation space, and natural beauty [7]. In Sudan, rangelands face challenges including expansion of agriculture, climate change, and overgrazing. Climate change has caused alterations in species composition which has disturbed the ecosystem, while overgrazing has replaced palatable species with undesired ones [1]. Manmade agricultural practices in areas such as eastern Sudan have make vegetation patchy and vulnerable leading to disputes over land [6]. However, it has been suggested that the adoption of water harvesting methods could help in improving the productivity of such area from a degraded There is a need of prudent policies, restoration, and prudent practices for protection of rangelands in Sudan. Sudan's livestock is predominantly owned by the people, whose sector plays a key role in sustenance, nutrition, and ecumenical practices [11]. Nevertheless, livestock raising productivity is impeded due to insufficient fodder, poor veterinary services, and lack of reinforcement. Manure can be offered as an energy source, Availability of fodder resources is considered to be vital, especially in arid climates.

Rangeland ecosystems are dynamic and vulnerable to sudden changes, influenced by overgrazing and human activities. Management through sustainable grazing is vital to prevent irreversible damage and maintain ecosystem balance [6].

II. MATERIAL AND METHODS

A. Study Area

The forest lies between 12°52' and 13°3' N. and longitude 30°16' and 30°21' E. It is located about 26Km SE of Elobied, Shikan Locality. It covers an area of about 42609.52 fed. The forest is water reservoir and consider as source of drinking water for Elobeid town and its surrounding. The rainy season begins in June reaches its peak in July and August; Also, the Forest provide grazing for nomads who come from South Kordofan. The average rainfall is 250-450mm. The maximum temperature is reaches 34.7 in summer and the minimum temperature is 19.9 in winter. In general, the average daily temperatures reach lowest in January (31 C°, 13 C°), and highest in June (39 C°, 24 C°), [3].

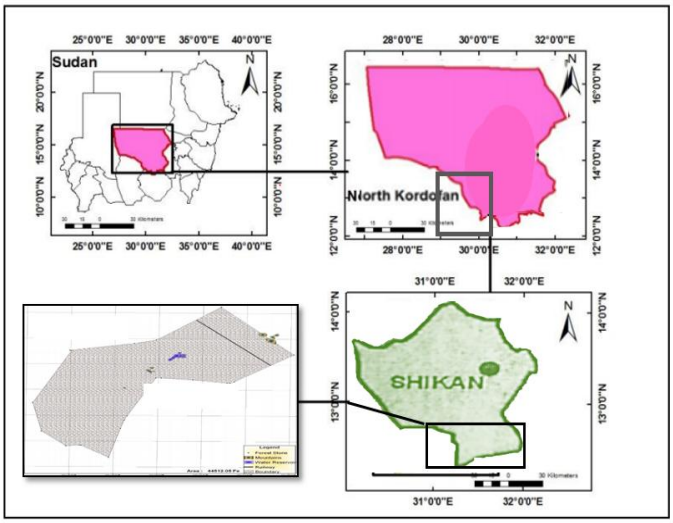

Figure 1. Geographical locations map of the study area

B. Data collection

Field survey
Sampling

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Three line transects (100 long) in open area. Five quadrates were placed along each line transect at 20 Meter interval. The variables of herbaceous plants were measured late in the rainy season (October). The vegetation survey carried out in all side of study area used Quadrate method for inventory of the flora. The inventory conducted by sampling for three (Northern) (Southern west) (Southern East) directions of forest, recording the points by using GPS as;

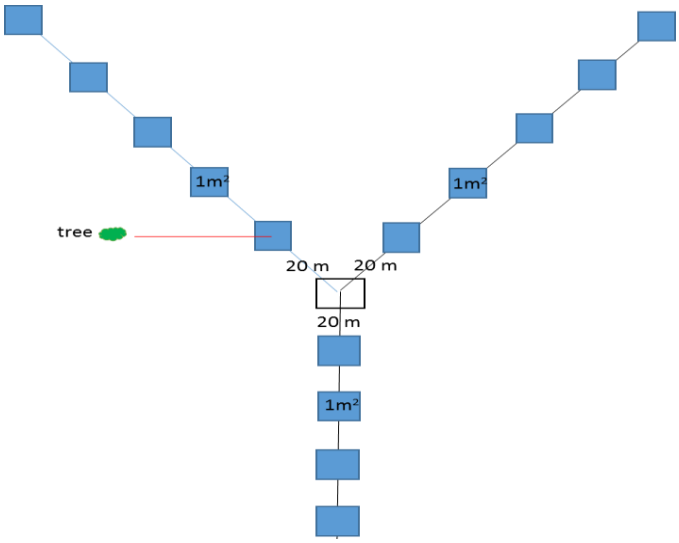

Figure 2. Research methodology framework.

Measurements of herbaceous plants:

Herbaceous plants measurements were done to collect data on the following range attributes:

- Plant% litter% bare ground%.
- Species density and frequency.
- Forage biomass yield(g\m^2).
- Carrying capacity

Range composition:

$$\text{Plant\%} = \frac{\text{The total hits of plant}*100\%}{\text{The total number of all hits}}$$

$$\text{Litter\%} = \frac{\text{The total hits of litter}}{\text{The total number of all hits}}*100\%$$

$$\text{Bare soil\%} = \frac{\text{The total hits of bare soil}}{\text{The total number of all hits}}*100\%$$

$$\text{Rock \%} = \frac{\text{The total hits of bare Rock}}{\text{The total number of all hits}}*100\%$$

The ground cover%= plant%+ Rock%+ Litter%

According to [9].

Plant Density:

$$\text{Average plant density in quadrate} = \frac{\text{Number of plant in all quadrates}}{\text{Number of all quadrates}}$$

Plant density in hectare= average plant density in quadrate*10000

Plant frequency:

Is the percentage of the quadrates that contains at least one individual of certain species according to [3]. the frequencies were calculated by using following frequency:

Species frequency= Forage biomass yield of herbaceous plant

This term means the amount of dry matter in Kg\ha that range site can

$$\frac{\text{Number of quadrates containing the individual species}*100}{\text{Total number}}$$

Biomass:

Biomass was harvested manually by clipping 2.5 cm above soil surface within each quadrate clipped plant material was oven dried 72c hr. at 70 c). The dry matter per quadrate was obtained by dividing the total weight of all quadrates by their number. Then the dry matter per hectare was calculated.

Carrying capacity:

The carrying capacity is calculated on basis of total biomass production and amount of the feed requirements per animal unit. Carrying capacity is usually determined using proper use factor (PUF), of 40% in which only half biomass produced is considered available for grazing as stated by [6]. Livestock requires daily dry matter (DM) intake equivalent to 2.5- 3% of their body weight. Thus, Tropical livestock unit (TLU) of 250 kg body weight consumer 6.25- 7.5kg dry matter per day [2].

According to [8]. Carrying capacity per months was calculated as follows:

$$\text{Carrying capacity} = \frac{\text{The consumption of tropical livestock unit in 8 month}}{\text{The desirable production (half of forage) per ha}}$$

Statistical Analysis

- Statistical Package for Social Science (SPSS) and Excel sheet used to analyze the study result.
- In addition to using tables and percentage to interpret the results

III. Result and Discussion

TABLE I. Range composition, density, forage biomass yield and carrying capacity of herbaceous plants in open area at Elian Natural forest reserve in the too late rainy seasons (October- 2022)

Dry matter Kg\H	80
Grazing capacity ha/TLU/8month	41.25
Plant%	14
Litter%	54.1
Pair land%	40.1

TABLE II. Relative Frequency (%) and Relative Density (%) of herbaceous plants in open areas at Elain Natural forest reserve in the too late rainy seasons (October 2022)

Scientific name	Local name	Relative frequency	Relative density
Cassia obtusifolia	Kawal	5.3	1.4
Solanum dubium	Guban	0.9	1.2
Aristida mutabilis	Gao	8.5	2.2
Aerva javanica	Sungud	0.3	0.6
Datura stramonium	Sukiran	*0.6*	0.2
Sida cordifolia	Nayad	1.9	1.4
Cassia senna	Snamka	0.6	0.04
Xanthium bracilicum	Ramtok	0.6	0.04

TABLE III. Relative Frequency (%) of trees in open areas at Elain Natural forest reserve in the two late rainy seasons (October 2022)

Scientific name	Local name	Density
Vachallia mellifera	Kiter	91.1
Vachallia Senegal	Hashab	4.4
Boscia senegalensis	Kursan	4.4

The results showed that one hectare of open area produces (80) kg of dry matter, indicating the rapid of range degradation. Due to A study conducted by [10] in open area found that one hectare of land produced (90.2) kg. Similarly, another study

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conducted in the forests of North Africa indicated that one hectare in arid and semi-arid areas produces 500 to 1000 ton.also mentioned that one livestock unit requires (41.25) H for grazing over a period of 8 months. The study indicated that one livestock unit needed (37.5) H for grazing over 8 months as well, which highlights the degradation of the range over the past 10 years.

The study indicated that the vegetation composition (VC) of the range is dominated by Litter, with the highest percentage reaching (54.1%), reflecting the usage of the range. Respondents confirmed that (35.1%) of the population are herders, and (98.3%) of these herders graze their livestock in open areas. Additionally, (64.9%) of respondents reported that fodder is available the year-around.

The results showed that the (Gao) plant has the highest density and frequency in the area, with values of (8.5) and (2.2) respectively, attributed the density to the nature of the plant. On the other hand, the (Sukiran) plant had the lowest density and frequency, with values of (0.6) and (0.3) respectively. This is a positive result, as (Sukiran) is a toxic and invasive plant, indicating the good health of the range.

It was observed that there is a high density of (Kiter) in the area, reaching (91.1%), which is attributed to the suitability of the clay soil which suits its growth. Additionally, the primary purpose of the forest is the production of charcoal and firewood. The presence of (Kursan) and (Hashab) trees, though in low densities at (4.4%) for both types, indicates the existence of biodiversity within the forest. Respondents confirmed the presence of 18 tree species in the forest, with (Kiter) being dominant, accounting for (64.2%).

IV. Conclusion and Recommendations

Rangeland assesssing is essential step to rehabilitation and management of degraded area the differencec in densitued of plant in forest due to humen activeties as well as overgrazing in forest Research findings indicated that averagely, open rangelands measuring up to one hectare can sustain 80 kg of dry matter with one livestock unit needing approximately 41.25 hectares for grazing within 8 months. Inconclusion rangeland in alaien forest at risk of deteruration management plan to control and mitigate invasive, unpalatable, or toxic plant species.

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