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# The Role of Browsing Trees in Providing Animal Feeding at Abu Zaid Forest, East Nile Locality, Khartoum State, Sudan

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**ABSTRACT:** Fodder trees are an important source of fodder for livestock in the dry season. Abu Zaid forest provides browsing for range animal, which was located at East Nile Locality, Khartoum State. The study aimed to determine the main browsing source and browsing productivity of Abu Zaid forest. The sampling in tree measurement was selected randomly, 1% was selected of the total forest area. The trees density was estimated using the near individual method. Browsing level, tree diameter, crown area, twig diameter, and twig account were determined. The twig weight count method was applied to determine available browse at the site. Near Infra Red spectrometer was used to determine the organic matter component of the fodder trees. Data were analyzed by the SAS statistical analysis system, using Duncan's procedure. The study found that the *Acacia ehrenbergiana* was high density (120 trees/ha) than *Acacia tortilis subsp. spirocarpa* (38 trees/ha). There were highly significant differences between the species (0.002) in terms of browsing level. *Acacia ehrenbergiana* recorded a higher browsing level (2.68m) than *Acacia tortilis* browsing level (1.77m). The total browse productivity of tree species in Abu Zaid area recorded (372.2) kg/ha represented in (300) kg/ha for *Acacia ehrenbergiana* and (72.2) kg/ha *Acacia tortilis subsp. spirocarpa*. The main dominant species in Abu Zaid area was *Acacia ehrenbergiana*. There was a variation of tree height among the two tree species. *Acacia* trees had a good nutritive value of browse fodder. The study recommended adopting sound management to ensure sustainable trees cover to providing browse for the livestock.

**KEYWORDS:** Trees density, browsing, nutritive value, animal feeding.

## I. INTRODUCTION

Rangelands in the most of the developing countries are a dominant land type and critically important in livelihoods of a major portion of the population, [1]. These rangelands contribute to the livelihood of millions of people in the globe and are important providers of ecosystem services, [2]. Rangeland livestock production is an essential form of diversified agriculture, [3]. Sudan rangeland occupies an area of 31.5% million hectares and provides about 70% of the total animal feed requirement for national herds, [4]. The most important of the browse is universal throughout the tropic, where it serves as a major feed resource, especially in the drier regions and during dry seasons. Trees and shrubs as sources of feed for domestic livestock and wildlife, [5]. During these periods' grasses, which are the major feed resource for livestock, dry up and deteriorate both in quality and quantity. Browse is a term referring to the tender shoots, twigs, and leaves of shrubs and trees that are eaten by livestock, [6]. So, the most important role of browse has been to provide fodder when grasses and other herbaceous are dry, and it provides the only source of protein and energy during drought [7]. Fodder trees are important feed source for livestock, meet the forage shortage and grow easy in a wide range, [8]. The importance of browse increase with increasing aridity especially in the dry seasons, when the most forage resource depreciates in quality and quantity, [9]. The *Acacia* tree is one of the most potential fodder sources for livestock in Sudan, [10]. The browsing is very important to provide forage for livestock, especially on period scarcity of understory during dry season. Due to limited of rainfall and seasonality of understory, the browse trees provide forage during the summer. This study is trying to understand the role of browsing trees to fulfill the gap of fodder in semi-arid areas, on East Nile area, Khartoum state.



## II. MATERIALS AND METHODS

**1. Study Area:** The study was conducted in Sharg El Neel locality, Khartoum state in Abu ziad forest, protected area about 1000 Feddan, which was fenced by State Department of Agriculture and Livestock, Administration of Range and Fodder, which is located between 15° 15'-16° 13' N and 32° 37'-34° 23' E. The area was classified as semi-desert zone with a hot tropical climate, with amount rainfall about 75 to 160mm mainly falling during August and September. The temperature is between 21.6°C in winter and 37.70°C in summer, [11].

**2. Sampling Procedure:** The measurement was taken in Abu zaid forest located in East Nile, Khartoum State. The samples of trees measurement were selected randomly. The sample size of about 10 Feddan (about 4.2 ha) which represented 1% of the total area of Abu zaid forest, and the samples were distributed systematically a long line transect.

### 3. Browsing Measurements:

**A. Trees Density:** The base line transects of 1000m was established to determine total trees density and species density using near individual method. Two trees were selected along the line transect with 20 meter interval, then recorded species name and distance in specific sheet. The following formulas were used to determine the density:

$$D = \frac{\sum D}{n} \text{ (Equation 1).}$$

$$d = \frac{10000}{D^2} \text{ (Equation 2).}$$

Where:

D = the mean distance.

D = distances.

n = number of samples.

d = total tree density (tree/ha), [12].

$$\text{Relative density} = \frac{\text{number of species distances}}{\text{all distance number}} \times \text{total tree density} \text{ (Equation 3).}$$

**B. Browsing Level (BL):** According to the dominant animal browsing species and previously browse, to determine height level that animal can reach.

**C. Diameter at Browsing Point (DBP):** The diameter of twig at browsing point was determined by using vernier to measure the twigs that were consumed by browsing animal at past browsing season.

**D. Determination of Browsing Productivity:** It was use diameter at browsing point (DBP), the height and browsing level (BL) to estimate browsing productivity of selected trees. Twig weight count method was applied to determine available browse at the site. Three twigs from each of the three randomly selected trees in the circular samples within the three plots were cut at the prescribe DBP (2.5mm) then will dry in oven for 48 hours on 75 C° then weighted to get the average weight/branch, [13].

$$\text{Productivity} = \frac{\text{Twig weight}}{\text{Number of twigs in individual tree}} \times \text{Trees density}$$

**E. Crown Area:** Crown area was estimated to give an indication of the extent of tree cover. Three trees were selected for each species. Then tape measurement was taken along two directions and took the means to calculate the average of the crown area.

**F. Stem Diameter:** The stem diameter was measured to give the dimension of the stem. Three trees were selected for each species to determine stem diameter by using caliper.

**4. Determination of Organic Matter of Browse:** Firstly, all twigs were dried, grinded and 100 g of the sample was taken to determine organic components by using (NIR) device to determine the organic matter component such as CF (Crude Fibre), CP (Crude Protien), ASH (Menirals), ADF (Acid DetergintFibre) and NDF (Neutral DetergintFibre).



**5. Data Analysis:** The results were analyzed by the SAS statistical analysis system, using Duncan's procedure to separate the means, and determined organic components by using Near Infrared (NIR) device.

### III. RESULTS AND DISCUSSIONS

**1. Trees Density at Abu Zaid Area:** The results in Table (1) showed that the relative density of *Acacia ehrenbergiana* was high density it was about (120) tree/ha, in contrast, *Acacia tortilis subsp. spirocarpa* recorded less density, was only (38) trees/ha. As for the total tree density in Abu Zaid area, it amounted only 158 trees/ha. The density of trees it may be affected by the intensive use of browsing tree by animals, especially in the dry season due to the fact that the area is located in arid area and thus is characterized by a lack of fodder in most days of the year. The intensive browsing has a negative effect on natural regeneration and tree density. According to [14], reported that the species richness, diversity and natural regeneration affected negatively in disturbed sites in the Dinder Reserve due to the intensive browsing of animals. Tree density is one of the most important indicators that help predict tree fodder production. The important result found by [15], there was strong relationship between trees density and browse availability.

Table (1): Relative trees density in Abu Zaid area

Species	Tree density (tree/ha)
<i>Acacia tortilis subsp. spirocarpa</i>	38
<i>Acacia ehrenbergiana</i>	120
Total density	158

### 2. Browsing Level:

The results represented in table (2) revealed that there were high significant differences between two *Acacia* species (0.002) in terms of browsing level. *Acacia ehrenbergiana* recorded higher browsing level (2.68m) compared to *Acacia tortilis subsp. spirocarpa* browsing level (1.77m). The variation in the browsing level of trees may be due to the differences in the trees characteristics, it was found that the *Acacia ehrenbergiana* tends to grow vertically in contrast to the *Acacia tortilis*, which tends to grow horizontally. Through this result, it is clear that *Acacia ehrenbergiana* trees are suitable for camel browsing because they can reach up to 3 meters if it compared to other browsing animals. This finding indicated that camels are dominated in the area while goats as intermediate selective feeders. The browsing level is closely related to the tree height and that can also affects the available biomass of browse trees. In that manner [15] found that there was a positive relationship between trees height and biomass yield.

Table (2): Browsing level of selected tree species

Species	Means of Browsing Level (Meter)
<i>Acacia tortilis subsp. spirocarpa</i>	1.77b
<i>Acacia ehrenbergiana</i>	2.68a
Pr>F	0.002**

\*\* Means there are high significant differences.

Means with the same letter are not significantly different at alpha 0.05.

**3. Twig Diameter:** It was found that in table (3) there were no significant difference between the two species diameter at browsing point of selected trees (0.07) at Abu Zaid area. Means of Diameter at Browsing Point (DBP) for *Acacia*



*ehrenbergiana* was (1.87) while (1.6) for *Acacia tortilissubspirocarpa*. This could be similar twig diameter for two species *Acacia ehrenbergiana* and *Acacia tortilissubspirocarpa*. The twig diameter was the important factor for the browsing fodder. [16], found that the twig thickness affects the dry matter yield of fodder trees. On the other hand the thin twig diameter is a good property of fodder quality, this agreed with [17], who stated that the thinner stem diameter is a preferable characteristic of fodder which increases the forage quality, intake and digestibility.

Table (3): The diameter at browsing point of selected trees at Abu Zaid area

Species	Means Diameter at Browsing Point (mm)
<i>Acacia tortilissubspirocarpa</i>	1.6a
<i>Acacia ehrenbergiana</i>	1.87a
Pr>F	0.07Ns

Ns means there are not significant differences.

Means with the same letter are not significantly different at alpha 0.05.

**4. Number and Weight of Twigs of Selected Tree Species:** The result in table (4) shows that there were no significant difference existed among the number and weight of twigs of selected tree species in the study area. The twig number of *Acacia tortilissubspirocarpa* recorded (555) and (311) for *Acacia ehrenbergiana*. The twig weight of *Acacia ehrenbergiana* was (8.75) and (3.62) for *Acacia tortilissubspirocarpa*. The weight of the twig is closely related to its diameter, as the diameter increases, the weight increases. Also, the increase in the twigs number is a good indicator of fodder productivity. This result indicates that *Acacia tortilis* produces many branches, and in contrast, *Acacia ehrenbergiana* has a thick branch diameter. There is a strong relationship between twig diameter and browse fodder productivity, [18].

Table (4) Average of Twig Number and Twig Weight:

Species	Means	
	Twig N	Twig W (g)
<i>Acacia tortilissubspirocarpa</i>	555 a	3.62a
<i>Acacia ehrenbergiana</i> (Salam)	311 a	8.75a
Pr>F	0.2 Ns	0.07Ns

Ns means there are not significant differences.

Means with the same letter are not significantly different at alpha 0.05.

**5. Stem Diameter and Crown Area of Tree Species at Abu Zaid Area:** Based on the results in a table (5) there were no significant difference existed between the stem diameter and crown area of the two tree species in Abu Zaid area. Stem diameter in *Acacia ehrenbergiana* recorded (8.75) cm and (8.1) cm for *Acacia tortilissubspirocarpa*. Crown area for *Acacia tortilis* was (14.17) m<sup>2</sup> and (2.95) m<sup>2</sup> for *Acacia ehrenbergiana*. The crown area is closely related to the available browse of fodder trees. This result may indicate the morphology and shape of the plant species. According to result found by [12], there were strong positive correlations between browse biomass productivity and crown area and it consider the main parameter to predict browse productivity. The stem diameter is an important characteristic of fodder trees, which reflects the trees ability to resist browsing stress and twig removal resulting from browsing process. It is observed that the average stem diameter of the two species in the Abu Zaid area is relatively thin, and therefore the ability of trees to resist browsing utilization will be weak.



Table (5): Stem diameter and crown area of tree species at Abu Zaid area

Species	Means	
	Stem Diameter (cm)	Crown Area (m <sup>2</sup> )
<i>Acacia tortilissubspirocarpa</i>	8.1a	14.17a
<i>Acacia ehrenbergiana</i>	8.75a	2.95a
Pr>F	0.12Ns	0.14 Ns

Ns means there are not significant differences.

Means with the same letter are not significantly different at alpha 0.05.

**6. Browsing Productivity:** The result in table (6) showed that the available browse of tree species in Abu Zaid area. Browse productivity for *Acacia ehrenbergiana* was (2.5) kg/tree and *Acacia tortilissubspirocarpa* (1.9) kg/tree. The total browse productivity of tree species in Abu Zaid area recorded (372.2) kg/ha represented in (300) kg/ha for *Acacia ehrenbergiana* and (72.2) kg/ha *Acacia tortilissubspirocarpa*. The browse productivity effectively contributes to feeding livestock in the East Nile rangeland, especially in the dry season when annual forage plants are absent. Fodder trees an integral part of ruminant production, feeding browse has become an essential practice especially in the dry season, [9].

Table (6): Browse productivity of tree species in Abu Zaid area.

Species	Available Browse	
	Browse Productivity kg/tree	Browse Productivity kg/ha
<i>Acacia tortilissubspirocarpa</i>	1.9	72.2
<i>Acacia ehrenbergiana</i>	2.5	300
Total	4.4	372.2

**7. Nutritive Value of Browse:** Table (7) illustrates the nutritive value of selected species, browse in the study area. Organic component represented in protein (17.02), ash (12.39) and fat (2.9) for *Acacia ehrenbergiana* (Salam) while *Acacia tortilissubspirocarpa* crude protein (15.07), ash (10.98) and fat (5.17) respectively. Otherwise, fiber and moisture the same in two plant species *Acacia ehrenbergiana* *Acacia tortilissubspirocarpa*. A significant variation in crude protein (CP) content occurs between species of trees and shrubs and even between edible parts of the same plant. [19], reported that *A. tortilis*, *A. mellifera* and *A. ehrenbergiana* may have potential value for a supplementation of energy or protein, if they were harvested at the early period of the dry season. Compared with understory plants, a tree fodder has higher protein content. [20], found that the tree fodders contain high crude protein, minerals and more digestion rate. According to [21], there are variations of crude protein in dry matter among tree species.

Table (7): Organic Matter of Selected Species Browse:

Organic component	<i>Acacia ehrenbergiana</i>	<i>Acacia tortilissubspirocarpa</i>
Ash	12.39	10.98
Fat	2.9	5.17
Fiber	26.87	26.26
Moisture	5.14	5.48
Crude Protein	17.02	15.07



#### IV. CONCLUSIONS

Total trees density in Abu Zaid Area is 158 trees/ha represented in *Acacia ehrenbergiana*(Salam) and *Acacia tortilis subsp. spirocarpa*. The main dominant species in Abu Zaid area was *Acacia ehrenbergiana*. There was variation of tree height among the two species, and there was slight difference between the total browse productivity. *Acacia* trees had good nutritive value of browse fodder. *Acacia ehrenbergiana* records high value of Ash and crude protein while *Acacia tortilis subsp. spirocarpa* reached a higher percentage of fat. The study recommended protecting, conserving *Acacia ehrenbergiana* and *Acacia tortilis subsp. spirocarpa*. Adopt sound management to ensure sustainable trees cover to providing available browse for the livestock.

#### REFERENCES

- [1] D. J. Bedunah, and J. P. Angerer. Rangeland Degradation, Poverty, and Conflict: How Can Rangeland Scientists Contribute to Effective Responses and Solutions. *Rangeland Ecol Manage* 65:606–612. DOI: 10.2111/REM-D-11-00155.1. 2012.
- [2] C. M. Godde, R. B. Boone, A. J. Ash, K. Waha, L. L. Sloat, P. K. Thornton and M. Herrero. Global rangeland production systems and livelihoods at threat under climate change and variability. *Environ. Res. Lett.* 15. doi.org/10.1088/1748-9326/ab7395. 2020.
- [3] N. F., L. Sayre, L. Carlisle, G. Huntsinger, Fisher, and A. Shattuck. The role of rangelands in diversified farming systems: innovations, obstacles, and opportunities in the USA. *Ecology and Society* 17(4): 43. <http://dx.doi.org/10.5751/ES-04790-170443>. 2012.
- [4] A. S. El Wakeel. Rangelands conservation in: National Biodiversity Planning to Support the Implementation of the CBD 2011-2020 Strategic Plan in Republic of Sudan. 2013.
- [5] R. J. Kaitho, N. N. Umunna, I. V. Nsahlai, S. Tamminga, J. Van Bruchem, and J. Hanson. Palatability of wilted and dried multipurpose tree species fed to sheep and goats. *J. Animal feed science and technology*. 65: 151-163. 1997.
- [6] A. Chriyaa. The Use of Shrubs in Livestock Feeding in Low Rainfall Areas. *Land Use, Land Cover and Soil Sciences –Vol. 5. EOLSS, Oxford, UK.* 2009.
- [7] E. C. Lefroy, P. R. Dann, J. H. Wildin, R. N. Wesley-Smith, and A. A. McGowan. Trees and shrubs as source of fodder in Australian. Kluwer academic publisher. Netherlands. 1992.
- [8] S. Franzel, S. Carsan, B. Lukuyu, J. Sinja, and C. Wambugu. Fodder trees for improving livestock productivity and smallholder livelihoods in Africa. *Environmental Sustainability, Elsevier.* 6:98–103. <http://dx.doi.org/10.1016/j.cosust.2013.11.008>. 2013.
- [9] G. Y. Jamala, I. T. Tarimbuka, D. Moris, and S. Mahai. The Scope and Potentials of Fodder Trees and Shrubs in Agroforestry. *Journal of Agriculture and Veterinary Science.* 5 (4) 11-17. 2013.
- [10] C. Orwa, A. Mutua, R. Kindt, R. Jamnadass, and S. Anthony. *Agroforestry Database: a Tree Reference and Selection Guide. Version 4.0.* World Agroforestry Centre, Kenya. 2009.
- [11] A. A. Dawa. Inventory of Trees Cover in Sharg El Nile Locality, M.Sc. Thesis forestry science, 2004, Collage of Forestry and Range Science. Sudan University of Science and Technology, Khartoum –Sudan. 2009.
- [12] N. I. Abdalla, M. I. Abdelsalam, M. Abdelkreim and A. A. Mariod. Estimation of Browse Productivity for *Acacia sayal* in Alazzazah Area, Blue Nile State, Sudan. *Journal of Rangeland Science*, (7) 4.341-347. 2017.
- [13] N. I. Abdalla. Browsing and its relation to rangelands Management in Sudan semi-arid areas. M.Sc Thesis, College of Forestry and Range Science, Sudan University of Science and Technology, Khartoum –Sudan. 2008.
- [14] E.M.I. Mohammed, E.A.M.; Ndakidemi, P.A. and A.C. Treydte. Anthropogenic Pressure on Tree Species Diversity, Composition, and Growth of *Balanites aegyptiaca* in Dinder Biosphere Reserve, Sudan. *Plants*, 10, 483. <https://doi.org/10.3390/plants10030483>. 2021.
- [15] N. I. Abdalla, G. A. Fashir, E. M. Salih, A. M. Lazim, M. I. Abdelsalam, and M. M. Mohammed. Estimation of Browse Biomass Productivity for *Acacia mellifera* (Vah) Benth. In Tendali Area of White Nile, Sudan. *Natural Resources, Agricultural Development and Food Security. International Research Network (NAF-IRN). International Working Paper Series.* 2015.
- [16] M. M. Shogar. Contribution of Browsing on Livestock Feeding in Abu Zaid Forest-East Nile Locality-Khartoum State. M. Sc Dissertation. College of Graduate Studies, Sudan University of Science and Technology. 2021.
- [17] M. I. Abdelsalam. Effect of Cultivation Practices on Al-Safari (*Crotalaria senegalensis*) for Domestication as Forage Plant. *SUST Journal of Agricultural and Veterinary Sciences (SJA VS).* (20) 2. 101-107. 2019.
- [18] M. A. Hassan, .Xiaoli, and N. I. Abdalla. Browsing Characteristics of *Acacia Seyal* Del Variety Seyal in Low Rainfall Savanna Zone of Sudan. *ARPN Journal of Science and Technology* (5) 8.393-397. 2015.



- [19]. A. M. A. FadelElseed, A. E Amin, Kh. A. Abdel Ati, J. Sekine, M. Hishinuma and K. Hamana. Nutritive Evaluation of Some Fodder Tree Species during the Dry Season in Central Sudan. Asian-Aust. J. Anim. Sci. 15 (6).844-850. 2002.
- [20] R. T. Paterson, G. M. Karanja, R. L. Roothaert, O. Z. Nyaata, and I. W. Kariuki. A review of tree fodder production and utilization within smallholder agroforestry systems in Kenya. Agroforestry Systems (41) 181–199. 1998.
- [21] H. Guérin. Alimentation des Ruminants domestiques sur pâturages naturels sahéliens et sahélo - soudaniens: étude méthodologique de la région du Ferlo au Sénégal. Thèse. École Nationale Supérieure Agronomique de Montpellier, France. 211p. 1987.





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