Original article

Available Browse of *Acacia tortilis* in Dry Areas; Taking El-Rawakeeb Area as a Case Study

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Abstract

This investigation was carried out in El-Rawakeeb area (about 33 km West Omdurman) with the objectives of assessing available browse of Acacia tortilis based on twig count method and tree density using density quadrates method. The results indicated that the mean density of Acacia tortilis is 5.23 tree/ha and the yield was found to be 2.92 kg/tree which is equivalent to 15.3 kg/ha. The results also revealed a poor correlation between the available browse of the tree and the height, diameter at root collar and crown area.

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Introduction

Browse as a term, refers to the tender shoots, twigs, and leaves of shrubs and trees the available for animal consumption (Devendra, 1989 and Anderson, 1991). It is an important part of rangelands particularly in areas that experience low and erratic rainfall because they have deep penetrating roots that make use of water deep down the soil profile (Holecheck *et al*., 1989). And due to that it provides forage all year round, even in drought years. In Africa, about 75% of the shrubs and trees serve as browses for livestock (Skerman, 1977). The most desirable browse species are legumes because they have the ability to fix nitrogen and provide a high protein feed as well as improve on soil fertility (Pamo and Pieper, 2000).

Acacia tortilis is a wide - spread and variable species, within which few species are recognized (*sub. spp. raddiana* and *sub. spp. spirocarpa*). They are separated by presence or absence of pubescence on the pods, their width and differences in the crown distinctive in the sub –species *raddiana* (Braun *et al*., 1991). The main value of this species is in its pods, which were favored by cattle and sheep (Komwihangilo *et al*., 1995). It increases milk production and it is valuable for fattening (Anttila *et al*., 1994). The foliage of this species is palatable. It is the main fodder for sheep and goats in semi –desert area of northern Sudan (NAS, 1981).

There is a scarcity of information on available browse in dry areas despite the vital role it plays in animal production. Fabregues (2003) noted that range ecologists do not put into consideration the contribution of browse to rangeland nutrition when estimating carrying capacities and stocking rates because the quantitative nature of the browse component is practically unknown and difficult to measure. The main objectives of this study were to investigate the total tree density and the available browse of *Acacia tortilis* in a dry area taking El Rawakeeb area as a case study

Materials and Methods

El Rawakeeb area where the study was conducted is located at 33 Km west of Omdurman between lat. 15˚2′ and 15˚36′ N. and long. 32˚0′ and 32˚10′ E and altitude of 420 m above mean sea level (ENRRI, 2001). It thus lies within the semi- desert were the plant cover is a mixture of grasses and herbaceous plants intermingled with Acacia trees and shrubs representing the main grazing areas for camel and sheep (HCENR, 2014).

The soil is generally characterized by sandy texture, poor organic

nitrogen and carbon, moderate bicarbonate and potassium and high sodium, calcium and chloride contents (El Hag et al., 1994). The natural vegetation of the study area lies within Acacia tortilis-Maerua crassifolia desert scrub reported by Harrison and Jackson, (1958).

For vegetation study a sample area of about 7800 ha was selected using compass taking El Rawakeeb station as a centre. This area was divided into four sites with bearing north, east, south and west, respectively. Ten sample plots each of one hectare were laid out systematically along each site with constant intervals of 500m. In each sample plot the Acacia tortilis trees were counted to obtain tree density per hectare as described by Bonham (1989).

To estimate available browse of Acacia tortilis, level of browse and diameter at browsing point were measured in well-browsed site, the twigs of three Acacia tortilis trees were counted to determine available browse using the twig-count method as described by Tarr (1953) and Uptegraft (1959). Those counts were then converted to dry weight per tree and then per area (ha). The trees were also measured for their height using Blume Lies Altimeter, diameter at root collar using Caliper and crown area. Those measures were used to relate the available browse of *Acacia tortilis* to easily measured characters as mentioned above.

A simple linear regression was used. The regression of available browse to the easily measured characters examined was described by the simple regression equation:

$Y = a + bX$

Where Y = the available browse, X=the measured characters.

Results

Tree density

The mean tree density of the different sites was shown in Table (1). It ranges from 11.3 to 23.8 tree/ha, with an overall mean of 15.13 tree/ha. Higher value (54.25 tree/ha) was reported by Mohammed (1997). The low tree density value proves that serious environmental deterioration is taking place. The low trees density seems to be affected by low amount and fluctuation of rainfall (Ellis, 1992 and Scoones, 1995) characterizing this area. It may also related to human activities for the natural forest vegetation has been subjected to heavy over-exploitation for agriculture through the removal of tree cover for crop production, felling trees for fuel wood and building poles and overgrazing (HCENR, 2014). Besides clearing for agricultural purpose, trees and shrubs are uprooted by nomads and villagers and used as fuel or a building material (more than 548 million trees and shrubs annually) (DECARP, 1976.). Mensching (1980) reported that the feeling of whole tree stock and the clearing of shrubs and bushes on cultivated land deprive the soil from the positive effect of shade. The increasing evaporation makes the soil dry up quickly. This enhances surface incrustation. It also increases the wind speed close to the ground surface causing dust storm.

Table (1) shows that *Acacia tortilis* and *Maerua crassifolia* are the key species of El Rwakeeb over story, having the highest density values 5.23 and 4.53 tree/ha, respectively. This result is in line with Hassab El Rasowl (1999) who reported that *Acacia tortilis* and *Maerua crassifolia* dominate the over story of the area located west the White Nile.

In contrast *Acacia ehrenbergiana*, *A. mellifera*, *Ziziphus spina-christi* and *Capparis deciduas* had very low mean density (Table, 1).

Table (1): Mean density (tree ha^{-1}) of woody species recorded in the different sites

Family name	Botanical name (Local name)	Mean density (tree ha^{-1}) per site				Mean
		North	**East**	**South**	**West**	
Leguminosea	*Acacia tortilis* (Seyal)	1.6	6.1	8.7	4.5	5.23
	A. nubica (Laoot)	9.3	0.1	0.1	0	2.38
	A. ehrenbergiana (Salem)	0	0	0	0.1	0.03
	A. mellifera (Kitir)	0.1	0	0	0	0.03
Capparidceae	*Maerua crassifolia* (Sareh)	5.5	4.4	4.9	3.3	4.53
	Boscia senegalensis (Mokhate)	5.1	1	0	3.4	2.38
	Capparis deciduas (Tondob)	2.1	0	0	0	0.53
Rhamnaceae	*Ziziphus spina-christi* (Sidir)	0.1	0	0.1	0	0.05
	Total	23.8	11.6	13.8	11.3	15.13

This very low density may be due to human activities such as tree cutting for fuel and building in addition to the uncontrolled browsing. El-Khalifa *et al*. (1985) reported that the vegetation of the area located west of the White Nile is severely deteriorated due to heavy grazing, woodcutting and desertification.

***Acacia tortilis* available browse:**

Results of browsing level, diameter at browsing point, twig mean weight and available browse (Kg / tree and Kg / ha) are shown in Table (2). Browsing level of *Acacia tortilis* in El Rawakeeb area was found to be 2.48 m, which was quite similar to the value (2.5 m), reported by Lazim (2001) who estimated the available browse of this species in *El Butana* area. Results revealed that the diameter at browsing point was 2.11 mm and that the mean twig weight was 3.04 g (Table 2). The mean available browse per tree was found to be 2.92 Kg. Higher value (4.5 Kg/tree) was reported by Lazim (2001). The low forage production per tree may be related to low number of twig per tree due to harsh condition and low tree density in *El Rawakeeb* area when compared to El Butana area.

Table (2): *Acacia tortilis mean* browsing level, diameter at root collar, crown area and available browse

Item	Mean
Browsing level (m)	2.48
Diameter at browsing point (mm)	2.11
Weight per twig (g)	3.04
Available browse (kg / tree)	2.92

Acacia tortilis browse biomass was found to range from 4.7 -25.4 kg /ha with an overall mean of 15.3 kg/ha (Table 3). Higher value (100 Kg/ha/ Year) was reported by El–Hassan *et al*., (1984) for available yield of browse in *A. tortilis Maerua crassifolia* desert scrub. The low available browse in the study area may be due to that we exclude the browse biomass of the other trees and shrubs reported in the density table (Table, 2). Another factor that may affect browse biomass is the general deterioration of tree cover of the Sudan due to many factors such as climate change, over-exploitation, pollution, fires and socio-economic factors (HCENR, 2014)

The results of the correlation coefficient obtained from the height, diameter at root collar and crown area with available browse, were 21%, 27% and 19%, respectively (Table 4). This indicates that there was poor relationship between the three variables and available browse. This means that only 21%, 27% and 19% of the variability in available browse can be attributed to tree height, diameter at root collar and crown area, respectively. The present findings are in line with Suliman (1986) who found poor relation between available browse and stem diameter (45.76%) and the stem height (4.36%) of *Acacia tortilis.*

Table (3): The average density (tree/ha) and available browse (kg/ha) of *Acacia tortilis* in the different sites

Sites	Density	Available browse
North	1.6	4.7
East	6.1	17.8
South	8.7	25.4
West	4.5	13.1
Average	5.225	15.3

Table (4): Correlation coefficient of height, diameter at root collar and crown area with *Acacia tortilis* available browse

Factor	Correlation coefficient %	Regression equation
Height X Available browse	21%	Y= - 4.05 + 2.13 X
Crown area X Available browse	19%	Y = - 61.17 + 2.64 X
Diameter at root collar X Available browse	27%	Y = - 4.65 + 0.41 X

Conclusions and Recommendations

- The average tree density and *Acacia tortilis* browse biomass were very low.
- In order to restore the woody layer of arid and semi arid areas, planting of multi–purpose leguminous tree especially the dominant indigenous trees, such as *Acacia tortilis, Maerua crassifolia*, *A. ehrenbergiana*, and *A. mellifera* must be practiced.
- To exploit the available browse biomass on moderate bases, heavy use and woody cover deterioration must be avoided.

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