

## Importance of Indigenous Browse Species in Improvement of Livestock Feeds in Western Bahr El Ghazal State (Sudan).

Gaiballa, A.K<sup>1\*</sup> and Lee. S.J.<sup>2</sup>

1. Department of Range Science, College of Forestry and Range Science, Sudan University of Science and Technology, P.O. Box ( ), Khartoum, Sudan

2. Department of Animal Production, College of Veterinary Sciences, University of Bahr el Ghazal, P.O. Box (10739), Khartoum, Sudan. Email: leeuguru@gmail.com

\*Corresponding author: [gaiballa@gmail.com](mailto:gaiballa@gmail.com)

**Abstract:** The aim of this study was to investigate the importance of indigenous browse species in livestock production in South Sudan. The study was conducted in three villages of River Jur County in Western Bahr El Ghazal State namely “*Marial Bai*”, “*Malwil*” and “*Kubri Kwanye*”. The area has an open to dense woodland savanna with livestock raising and subsistence agriculture being the main livelihood activities. Methodology used to collect data included tree cover assessment mainly density, relative density, height and browse level, to assess browse distribution in the area; in addition to a survey in order to evaluate the browse socio-economic aspect, and laboratory chemical analysis of the browse material to assess their nutritive components. The trees cover assessment indicated high tree density and diversification in the area, with tree density of 138 trees/ha, and relative browse species density of 6 spp./ha, and total tree density of 6 spp./ha. The results obtained in two different seasons, for the browse nutritive components for seven selected species included (*Grewia mollis*, *Leptadenia lancifolia*, *lablab* spp., *Marsdenia abyssinica*, *Pterocarpus lucens*, *Strychnos spinosa* and *Balanites aegyptiaca*), indicated their relatively high crude protein levels, with averages ranged between 2% in *Grewia mollis* up to 15% in *Marsdenia abyssinica* during the dry season. DM, CF, E.E, and Ash contents ranged between 93.20%-97.50%, 24-62%, 1.60-6.80%, and 4.60-12.66% respectively. The results of the socio-economic survey indicated that, tree utilization for both forage and non-forage uses are important in the area. The respondents were able to identify a total (43) tree and shrub species as useful browse source for livestock. The survey also highlighted the browse species with multipurpose uses and their ethno-veterinary values. Multiple uses of some important browse trees included *Terminelia brownii* and *Hymenocardia acida*, in addition to water scarcity and absence of prescribed grazing system, were identified as most affecting factors that may hamper animals browse utilization in the area. It was concluded from the results of this study that, there is a wide range and diversification of types of trees and shrubs which included many important species with browse value in the area, whereas species with browse value showed to have potential level of nutrients mainly the crude protein. Pastoralist’s indigenous knowledge was proved as significant in relation to browse knowledge and utilization. Water shortage particularly during dry season, and lack of prescribed range management, in addition to trees multiple uses, were identified as main problems to browse utilization in the area. The results of this study may be therefore used to direct the management and utilization of the browse resource in the area with the aim of achieving their conservation for improved animal feeding.

**Key words:** Browse Species, Livestock, Indigenous knowledge, Feed, Management.

### Introduction

In the Sudan, natural rangelands contribute to about 77% of the feed available for livestock, while livestock population in the country according to the last census is estimated as 138 million heads (FMAR, 1976). Southern Sudan occupies a total geographical area of 640.000 square km. which is almost one third of the Sudan (Emilio, 2007). According to land use,

this vast area is broken down into natural pastures, forests, grazable and other cultivable lands. This area had the largest livestock population estimated as 27% in Sudan and second to the Western region (Fadlalla, 1987). The tropical woodland savanna, with very rich grasslands and open stand of trees and shrubs, represent the major grazing environment in Southern Sudan. These natural rangelands

constitute an important forage source for Sudan livestock, raised particularly by the nomadic and pastoral tribes in the area, and those in Western and Central Sudan. Their livestock depend heavily on forests grazing during bad years and in their seasonal movement between North and South. Abusuwar (2007) reported that, forests in "Upper Nile" represents important grazing resources for pastoralists during summer and are used heavily. Therefore, it was estimated that, in tropical savanna, browse from trees and shrubs, represents animal feed during critical seasons particularly on ranges where grasslands are associated with open stands of trees and shrubs, spaced approximately as far as their heights (Le Houerou, 1980).

Browse is usually the primary and most economical source of nutrients for livestock, particularly meat goats. While it was reported that, goats as natural browsers, have the unique ability to select plants when they are at their most nutritious state, and that, goats which browses, have fewer problems with internal parasites. Pastures tend to be high in energy and protein when in a vegetative stage. As their plants mature, palatability and digestibility decline, thus it is important to rotate pastures so as to keep plants in a vegetative state. During the early part of the grazing season, browse species, composed of shrubs, trees, woody plants and weeds, tend to be higher in protein and energy than ordinary pasture (Schoenian, 2009).

The objectives of this study were therefore, to investigate the importance of the browse resources and their role in livestock production in South Sudan, through identifying the major species, estimating their nutritive components and to document indigenous knowledge of their uses.

## Materials and Methods:

### Study area

The study was conducted at Marial Bai, Malwil and Kubri- kwanye villages located in River Jur County in Western Bahr el Ghazal State. The three villages are 12, 7 and 6 miles from Wau town the capital city. The area lies in between 7° 53' N and 25° 52' E. It receives rainfall ranging from 900-1200mm. per year

falling between April and October with short dry spells from mid-February to mid-March. The area is mainly inhabited by the agro-pastoral Dinka and Jur tribes. The key land use system is subsistence agriculture and livestock rising including cattle, goats, sheep and poultry.

### Sampling and data collection

The Nearest Individual Method (Matthew *et al.*, 1993) was used to determine the density of trees and shrubs. A plot of standard size of 20x50m (Abusuwar, 2007) was marked on a randomly chosen browsed- site at "Kubri kwanye" village. Determination of the browsed plot depended on visual detection of browsing signs along the browsing level (Gaiballa, *et al.*, 2003). The first point was then marked and data for the nearest tree or shrub was determined and recorded included (distance, height, browsing level and tree or shrub name). Trees and shrubs distance from each sampling point was directly counted using a tape meter, while their heights and browsing level were determined using a clinometer readings from a known distance accordingly. This was then repeated until the required number of the sampling points totaling 20 was fulfilled. Similar measurements were repeated as for the assessment of their relative density. This plot was used to represent the study site, as for the other two villages, *Malwil and Kubri-kwanye*, in which the natural vegetation including shrubs and trees species, are homogenous.

Field records and relative part of questions on the survey questionnaire were directed to indicate the types and characteristics of the trees and shrubs included the most common and important species, particularly those with browse value.

A detailed questionnaire was conducted with seventy five (75) households in the three villages to cite the browse species they knew and which represent in their area. Pastoralists' indigenous knowledge on browse and their preference by cattle, sheep and goats was recorded as well as other utilization of browse species. Names of species were given in either Dinka or Luo dialects, then identified by the corresponding scientific names using a textbook (Thirakul, 1984). Average households

in each village were about (250), and each was covered with (25) questionnaires, thus representing 10% of the total households respectively. The questionnaire composed up of almost (40) open to closed questions concentrated on tree types, tree animal's relationship, uses and their socio-economic values (Onwuka, *et al.*, 1990). During the survey, focused group discussions with livestock keepers were conducted to identify species being considered important as livestock feed or having other outstanding use. Their knowledge on these aspects, particularly these shrubs and trees as potential feed for livestock was recorded. In most cases the respondents were either agro-pastoralists or farmers.

The sampling for chemical analysis was done twice; early in the rainy season in (2008) and late in the dry season in (2009). Species selected were those nominated by the pastoralists within the focused group discussions as best known browse trees and shrubs in the area. These included (*Grewia mollis*, *Pterocarpus lucens*, *Balanites aegyptiaca*, *Leptadenia spp*, *Lablab*, *Strychnos spinosa* and *Marsdenia abyssinica*). One kg. browse material (including leaves, twigs and tender branches) of each sample was collected from its tree or shrub; air dried and sent to Animal Production College Lab. in Khartoum for their chemical analysis.. Results obtained covered dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (E.E), and ash.

### Data Analysis

The data from the questionnaire survey were analyzed using the Statistical Package for the Social Sciences (SPSS). Means, showing significance differences at probability level  $P < 0.05$  were compared using the Chi-square program. The data from browse trees cover assessment including density, total and relative

densities, were analyzed and calculated using the relative standard equation as follows respectively: Total density = (*Total Distances* ÷ *Number of points*); Trees density = ( $10.000 \div 2(\text{average/species})^2$  and (*Relative density* = *species /frequency* ÷ *Number of trees* × *Trees density*). The data from the sampling for nutritive components assessment were chemically analyzed using the (AOAC, 1995) method.

## Results and Discussion

### The current state of the browse in the study area

#### The Pastoral Community

The results of the socio- economic survey indicated the status of some of the main aspects that highlight important personal characteristics of the pastoral community including age groups, income, education and gender.

The results indicated that the Dinka and Jur pastoralists have unique indigenous knowledge on browse use in the area. The results indicated that, the knowledge obtained in the survey is significantly reliable as to the maturity of the respondents whom the majority was above 40 to 60 years in age (Table 1). They were able to identify and to name the different tree types as well as those with browse value in the area using their local dialects or common Arabic. The knowledge reported by female respondents on the browse species and their uses was similar to that reported by the male respondents. This finding indicates that women are part in the livestock management activities. This could be attributing to the role livestock resource play in the community. These results are comparable to the findings of Preston, (2008) who stated that, Dinka lifestyle centres on their animals, the roles within the groups, beliefs, systems and the rituals they practice all reflect this.

**Table 1. The percentages of age groups among the respondents**

Category	Percentages
Less than 20	16%
20- 40 years	29.3%
41- 60 years	44%
Over 61 years	10.6
<b>Df.</b>	<b>3</b>
<b>SIG.</b>	<b>***</b>

### The browse trees of the area

According to the field survey and feedback of the respondents based on their indigenous knowledge, a total of (43) indigenous browse tree and shrub species were identified

representing potential source of browse for their livestock (Table 2). Consequently, they were able to tell the different aspects of their utilization (Table 3).

**Table 2. Some important indigenous browse species of the study area**

Local name	Scientific name	Family
1. Abola (Luo.dia.)	<i>Annona senegalensis</i>	Annonaceae
2. Rit (Luo/Din.dia.)	<i>Anogeissus leiocarpus</i>	Combretaceae
3. Ushier (Din.dia.)	<i>Acacia albida</i>	Mimosoideae
4. Kakamut (Ar.)	<i>Acacia polyacantha</i>	Mimosoideae
5. Garad (Ar.)	<i>Acacia nilotica</i>	Mimosoideae
6. Akiro (Luo.dia.)	<i>Albizia amara</i>	Mimosoideae
7. Bei (Luo.dia.)	<i>Azelia africana</i>	Caesalpinioideae
8. Thau (Luo/Din.dia.)	<i>Balanites aegyptiaca</i>	Balanitaceae
9. Abinaj (Luo.dia.)	<i>Burkea africana</i>	Caesalpinioideae
10. Dorot (Ar.)	<i>Combretum glutinosum</i>	Combretaceae
11. Akud kuda (Luo.dia.)	<i>Detarium microcarpum</i>	Caesalpinioideae
12. Dual yat (Luo.dia.)	<i>Marsdenia abyssinica</i>	Asclepiadaceae
13. Amboloto (Ar.)	<i>Entada africana</i>	Mimosoideae
14. Jumeiz (Ar.)	<i>Ficus spp.</i>	Moraceae
15. Apaba (Luo.dia.)	<i>Grewia mollis</i>	Tiliaceae

16. Doung (Luo.dia.)	<i>Gardenia lutea</i>	Rubiaceae
17. Akanga (Luo.dia.)	<i>Hymenocardia acida</i>	Euphorbiaceae
18. Um-shatur (Ar.)	<i>Kigelia africana</i>	Bignoniaceae
19. Mahogany (Ar.)	<i>Khaya senegalensis</i>	Meliaceae
20. Akuar (Din.dia.)	<i>Leptadenia lancifolia</i>	Asclepiadaceae
21. Lablab (Ar.)	<i>Lablab purpureus spp.</i>	Papilionoideae
22. Alana (Luo.dia.)	<i>Pterocarpus lucens</i>	Papilionoideae
23. Upat (Luo.dia.)	<i>Piliostigma thonningii</i>	Caesalpinoideae
24. Homeid (Ar.)	<i>Sclerocarya birrea</i>	Anacardiaceae
25. Akwalkwala (Luo.dia.)	<i>Strychnos spinosa</i>	Loganiaceae
26. Dorot (Ar.)	<i>Terminalia brownii</i>	Combretaceae
27. Chuah (Luo/Din.dia.)	<i>Tamarindus indica</i>	Caesalpinoideae
28. Kurnyuk (Ar.)	<i>Vitex doniana</i>	Verbenaceae
29. Alemo (Luo.dia.)	<i>Ximenia americana</i>	Olacaceae
30. Lang (Luo/Din.dia.)	<i>Ziziphus spina christi</i>	Rhamnaceae

(Luo.dia.)= Luo dialect, (Luo/Din.dia)= Luo and Dinka dialects, (Ar.)= Arabic.

According to the respondents, nearly all the domesticated ruminants in the survey area consumed browse species. Browsers were utilized in both wet and dry seasons. Certain browse species are deciduous, while others keep leaves late in the dry season. Field investigation showed that, most species are widespread in Jur River and Raga Counties. Both leaves and pods are used by various kinds of livestock and wildlife. It was observed that; the browse identified included a number of legume trees such as *Entada africana*, *Pterocarpus lucens*, *Albizia amara*, *Prosopis africana*, *Tamarindus indica* and *Dalbergia melanoxylon*, which respondents described as of good feed source for their animals.

The *Lablab spp.*, *Strychnos spinosa*, *Grewia mollis*, *Leptadenia spp.*, *Hymenocardia acida* and *Ziziphus spina christi* were reported by the respondents as the most known browse shrubs, while *Pterocarpus lucens*, *Balanites aegyptiaca*, *Combretum glutinosum*, and *Terminalia*

*spp.* are the common browse trees respectively. Comments made by the respondents on the use of browse species in the area were comparable in many cases with that of Smith, (1986) on browse use in tropical Africa, These findings are in accordance with Wickens (1969) and Giffard, (1971) who reported the important browse species in the humid tropical West African zone.

The results of this study showed that most of the tree and shrub species found in the area are used in a way or another as feed source by the animals with some being quite reliable source of fruits or edible leaves for human consumption. This is similar to the reports by Wickens (1980) who stated that at least 75% of the 7,000 to 10,000 species of trees and shrubs in tropical Africa are used as forage. This may therefore be used as indicator that the browse resource in the area is high compared to other parts of the Sudan.

Table 3. Utilization of some browse species by livestock as assessed by the respondents

Species	Animal species	Edible plant parts
<i>Annona senegalensis</i>	sheep, goats	Leaves, twigs
<i>Anogeisus leiocarpus</i>	sheep, goats	Leaves, flowers
<i>Azelia africana</i>	Cattle, sheep, goats	Leaves
<i>Butyrospermum paradoxum</i>	Goats	Fruits
<i>Ficus spp.</i>	Cattle, sheep, goats	Leaves, twigs, fruits

### Tree Types

The findings of the current study indicated that the majority of the tree species in the area belongs to the families *Mimosoideae*, *Combretaceae*, *Caesalpinioideae*, and *Anacardiaceae*. Consequently, field observations revealed that, most of the common browse species identified in the study concentrate in these families (Table 2). These findings are comparable to Toutain (1980) who reported that, from the tree and shrub types of the Sudanian zone, *Piliostigma reticulatum*, *Isobertina doka*, *Tamarindus indica*, *Entada Africana*, *Parkia clappertoniana*, *Terminelia spp.*, *Anogeisus leiocarpus*, *Pterocarpus lucens*, *Gardenia lutea*, *Butyrospermum paradoxum* and many others, are among the common browse species of the tropical savanna in the area. These species were reported by the respondents in the present study as important browse species. Further, similar comments were made by Norton (1994) that the *Caesalpinioideae* and *Mimosoideae* tree families which contain about 2,800 species each, most are trees of tropical savannah and forests of Africa.

The majority of the tree types encountered during the study appeared to be of the deciduous, broadleaf which constitute the main feature of the natural flora in the area. This observation may be a positive indicator of browse availability on natural rangelands in the area.

### Distribution

Based on observations and field investigations,

findings on trees distribution in the area, indicated that types that are used to a varying degree for browse are naturally widespread within the woodland savanna in the area, in the lower areas, and along the Jur River banks. These areas represent common sites for grazing in the surveyed area. Moreover, around the towns, villages and on farm plots in the surveyed area, most of these species also exist. Acacia species including *Acacia seyal*, *Acacia sieberana*, *Acacia polyacantha* and *Acacia nilotica* were observed in good stands over the plain areas with wet habitat locally called 'Toj' particularly in "Marial Bai". Other common browse shrubs and small trees such as *Hymenocardia acida*, *Grewia mollis*, *Annona senegalensis* and *Gardenia lutea* combine high frequency with high local abundance on certain sites, forming predictable coverage that dominates several hundred square kilometers of the forest at each site. This finding may indicate a quantitatively available browsing site compared to rangelands with more open and scattered tree stands.

Table (4) summarizes the results obtained for the assessment of trees cover distribution in the area. These results may help to create picture on varying relationships of trees, certain tree species and particularly those with browse nature within the limits of their range to the mass of the other tree species present in the area.

**Table 4. Spatial results of trees and browse distribution in the area**

Measurements	Results
Tree density per ha	138 tree/ha
Relative density of browse species	6 trees/ha
Average total density of trees/one species	6 tree/ha
Average tree height	2- 20m.
Average browse level	1- 2m.

The trees density obtained was 138 trees per ha, while relative density of the browse species for *Strychnos spinosa*, *Grewia mollis*, *Combretum spp.*, *Hymenocardia acida* and *Gardenia lutea* was 6 spp. each per ha. This indicates an average of less or more than 30 browse species per hectare accordingly. Average tree height ranged between 2 and 20m, while average browse level was determined at 1- 2m in small trees and most shrubs of browse use. Similar results were indicated by Toutin (1980) who reported that, savanna browse species widely differ in height with common averages of 2 to 20m.

The results indicated that, the tree density in the area is clearly high. This could be attributed to the vegetation nature in the high rainfall zone of the Sudan of mainly deciduous and wide crown trees. This may explain the large number of trees that are used as browse source in the area. Lowry, (1989) indicated that for many native browse species, the deciduous foliage could be of higher feed value than the intact mature grasses during the dry season. Browsers limit on site with open tree stands or along road side. This could be also indicating difficulty for animals to utilize the browse in high density sites.

In relation to browse availability, it can be assumed that, browse is available in the area

based on these results, whereas the study suggests good grazing management to make the available browse resource more utilizable.

Findings on browse availability in relation to trees density was reported by Gaiballa, *et al.*, (2003) who established that there is a positive relation between browse availability and trees density. Similar comments were made by Cisse and Wilson (1980) indicating strong positive correlations between foliage biomass and the height and crown of the trees.

These findings may be used for future forecast of browse productivity in the area based on tree average production. The study suggests adoption of such measurements related to rangeland resource inventory for the purpose of obtaining more detailed information on browse productivity and utilization levels in the area. This will also help using available browse within the recommended quantity.

#### **Pattern of the browse utilization**

##### **Browse as livestock feed**

Based on the results of the survey shown in Tables (5) and (6), and the field observation, it was clear that browse makes up an important animals feed source in the area as indicated by 60% of the respondents who stated that goat's depend on browse, while 96% of them believed in the role of browse as feed source for their livestock.

Browse species are mainly utilized in the dry season i.e. from (February to May) with browsing reaches an extensive point when rains delay or fail. These findings agree with those of Kadzere, (1995) who reported that, the longer and more intensive the dry season, the greater is the degree of dependence of livestock on browse. Ruminants on free ranging were observed browsing the leaves from trees and shrubs, or the fallen ones, flowers, pods and to a varying extent some fruits and bark of certain species such as *Vitex doniana*, *Mangifera indica*, *Butyrospermum paradoxum* and *Khaya senegalensis* respectively. This finding may so far indicate browse species preference by livestock in the area in addition to their ability of selection Table (5), and (6) respectively. Baumer (1978) reported that the browsers in the ‘Buranas’

give a much appreciated fodder for the dry season and the leaves, pods and even bark are palatable to animals. However, leaves were the most preferred plant fraction utilized by livestock. Consequently, herders tend to loop branches from various palatable browse trees such as *Combretum spp.*, *Pterocarpus lucens*, *Azelia africana* and *Tamarinds indica* to feed their animals. Field investigations indicated that, *Mangifera indica* ‘mango tree’ was early introduced into Southern Sudan but has a wild growing tree throughout the towns and villages and that goats were reported browsing its leaves while rarely feed on the fruits.

These findings typically indicate the browse importance on natural rangelands in the area and that, the browse is perceived as a necessity by traditional herders in the area.

**Table 5. The percentages of animal species dependence on browse as assessed by the respondents**

Category	Percentages
Cattle	12%
Goats	60%
Sheep	1.3%
Sheep and Goats	26.6%
<b>SIG.</b>	<b>***</b>

**Table 6. The percentages of respondents who believed in role of browse as source of feeds for their livestock**

Category	Percentages
Yes	96%
No	4%
<b>Df.</b>	<b>1</b>
<b>SIG.</b>	<b>**</b>

### Multipurpose use of browse species

The respondents stated that, people utilization of trees and shrubs including those with browse value varies quantitatively and qualitatively. During the rainy season, most used types are those with feed component and

firewood. During the dry season, species with edible fruits and leaves, firewood, construction and building material are extensively used. They mentioned that *Combretum spp.*, *Acacia spp.*, *Ziziphus spina christi*, *Leptadenia spp.*, *Burkea African cana*, *Khaya senegalensis*, *Hymenocardia acida*, *Terminelia spp.* and



*Prosopis spp.* are the most used species. This further indicates that, some of the browse species which could be important are mainly utilized as source for housing, livelihood, and energy material. Remarkably, the study observed that out of the (43) species identified as potential browse Table (2), some (34)

species are of multi-purpose use (Table 7). These results may indicate that, under the current situation, with multi-users and absence of a good grazing management in the area, some of the important browse species such as *Hymenocardia acida*, *Terminelia spp.(brownii)* may be at risk of becoming endangered, since they are preferred types for firewood.

**Table 7. Some multi-purpose browse species of the area**

No.	Local name	Scientific name	Uses*
1.	Ushier	<i>Acacia albida</i>	1, 4, 7, 10
2.	Garad	<i>Acacia nilotica</i>	1, 3, 4, 5, 6
3.	Lulu	<i>Butyrospermum paradoxum</i>	1, 2, 3, 4, 7
4.	Lalob	<i>Balanites aegyptiaca</i>	1, 2, 3, 5, 6, 7
5.	Khaj	<i>Combretum glutinosum</i>	1, 4, 5, 6
6.	Koffo	<i>Isobertina doka</i>	1, 4, 6, 7
7.	Mahogany	<i>Khaya senegalensis</i>	1, 3, 4, 6, 7
8.	Alana	<i>Pterocarpus lucens</i>	1, 2, 4, 6
9.	Dorot	<i>Terminelia brownii</i>	1, 4, 5, 6
10.	Chua	<i>Tamarindus indica</i>	1, 2, 3, 4, 6, 7

\* 1 edible as browse to livestock, 2 edible fruits, leaves as vegetables, 3 medicines, 4 providing building poles, 5 providing fuel woods, 6 making furniture stick and tool handles, 7 provide shade, indicator of good soils fertility.

### Trees and shrubs uses for animal treatment

The respondents were able to report number of trees with medicinal value in the area. Based on their indigenous knowledge, practices and values, agro-pastoralists use some of these trees and shrubs in the treatment of animal

diseases and disorder (Table 8). This could be attributed to pastoral long experience with these species. This suggests further scientific studies on actual qualities and quantities of chemicals that could be extracted from such species for different ethno- veterinary uses.

**Table 8. Use of part of some trees and shrubs in animal treatment**

Tree species	Animal	Comments
<i>Khaya senegalensis</i>	Cattle, sheep and goats	Leaves mixed with water to treat Diarrhea and rumen disorders
<i>Butyrospermum paradoxum</i>	Cattle	Stem pound and liquor used to treat swallows and 'Jong nial' (anthrax) disease
<i>Hymenocardia acida</i>	Cattle, sheep, goats	stem powder used to treat wounds, abscess

## Browse and water availability

The results of the survey have indicated water scarcity in the area during the dry season as stated by 60% of the respondents. This could be due to the inefficient water conservation methods in the area as observed, since rainfall is sufficient. This finding may significantly reduce browse utilization by the animals.

## Rangeland utilization in the area

The respondents reported that, rangelands in the area are periodically used by other pastoral groups from Western and Central parts of the Country, including the nomad tribes such as “Al Rizeigat”, “Fallata”, and “Ambororo”. This is due to the seasonal movements by these groups with their animals in search for grassland and water resources southward. According to the respondents, they reside therein for almost 2-3 months, mostly between February and May. This finding may significantly indicate an over use of the available browse resource and subject range resources in the area to a damage as a result of increase in the carrying capacity.

Related findings on browse over-use and damage was made by Pollock and Montague, (1990) who reported that, at recent times in Australia as in many similar parts of the world, forests, trees and shrub plantations are most susceptible to browsing animals damage.

## Nutritive Components

The chemical composition of *Grewia mollis*, *Leptadenia spp.*, *lablab spp.*, *Marsdenia abyssinica*, *Pterocarpus lucens*, *Strychnos spinosa* and *Balanites aegyptiaca* browse species are given in Tables (9) and (10) as for the wet and the dry seasons respectively.

There was no significant difference among the species for CP content in the wet season, while light to major drop was remarkably observed as for the dry season results particularly in *Grewia mollis* and *Leptadenia spp.* The variation in nutrients contents among the species could be attributed to variation in seasons or changes in plant structure especially at time of harvest (Dicko, 1992).

The CP ranged from 7.51% to 13.19% and 2.11% to 15.17% in the species *Strychnos spinosa*, *Grewia mollis*, *Marsdenia abyssinica* for both seasons respectively. The CF, E.E contents varied with species and in both seasons ranging between 28-43%, 24-62% and 2-6.80%, 1.60-3.60% as for *Grewia mollis*, *Pterocarpus lucens*, *Leptadenia spp.*, *Strychnos spinosa*, *Pterocarpus lucens*, *Lablab spp.*, *Balanites aegyptiaca* and *Marsdenia abyssinica* respectively. While the E.E contents obtained may suggest that the species have medium to high energy contents compared to grass pastures. *Marsdenia abyssinica* had the highest content of 15.17% CP in the dry season followed by *Lablab* 12.88% and *Balanites aegyptiaca* 8.44%. All the species except *Leptadenia spp.* appeared to have increase in CF content during the dry season (Table 10). *Pterocarpus lucens* was replaced by *Marsdenia abyssinica* during the second analysis as it become leafless in the midst dry season. The results obtained for E.E content on the other hand, may strongly suggest that the species contain high energy levels compared to grass pastures. Forage husbandry strategies and browsing management for the preservation of such species are hereby suggested since they show nutritive potential.

Table 9. Chemical composition of some selected browse sample from the study area (in the wet season)

Species	DM%	CP%	CF%	E.E%	Ash%
<i>Balanites aegyptiaca</i>	93.80	9.13	34.00	2.00	11.73
<i>Marsdenia abyssinica</i>	94.60	8.93	43.00	2.00	5.50
<i>Grewia mollis</i>	95.00	13.19	28.00	6.80	12.66
<i>Leptadenia lancifolia</i>	94.40	11.77	38.00	3.20	8.47
<i>Lablab purpureus</i>	95.00	13.19	28.00	6.80	12.66
<i>Strychnos spinosa</i>	93.80	7.51	34.00	4.40	8.53

DM= dry matter, CP= crude protein, CF= crude fiber, E.E= ether extract.

Protein value to livestock was indicated by Le Houerou (1980) who stated that, the generally high protein values in browse species may be an advantage to browsing sheep and goat, especially during the dry season when the nutritive values of tropical grasses are usually low. This finding therefore, indicates that these species are nutritive potential browsing source for goats and sheep in the area. It has been reported that the minimum average CP suggested for animal's maintenance requirement is 4%. (APRC, 2009). These results are comparable to results obtained in previous studies in similar areas in tropical Africa regarding browse nutritive value (Le Houerou, 1980). The DM content of the species obtained ranging between 93- 97g/kg is quite high and

could be taken as good indicator for nutrients supplement to feed intake of browse component. This is important for the maintenance requirements. Higher DM may indicate species free of fiber tissues.

This finding may be used to explain browse high intake by the animals in the area; as the local goats were observed during the field of the study to consume more browse components when their rumen has actually reached a bloat status.

Finally, these results could be estimated as reliable for the browse chemical composition in the area as the sampling and laboratory analysis was carried out in both wet and dry seasons. The study suggests further research particularly in the area of browse minerals, vitamin contents as well as their digestibility

**Table 10. Chemical composition of some selected browse sample from the study area (in dry season)**

Species	DM%	CP%	CF%	E.E%	Ash%
<i>Balanites aegyptiaca</i>	97.50	8.44	45.50	1.60	6.25
<i>Marsdenia abyssinica</i>	96.20	15.17	31.00	3.60	9.98
<i>Grewia mollis</i>	95.40	2.11	38.50	2.00	8.28
<i>Leptadenia lancifolia</i>	93.20	5.70	24.00	3.20	6.55
<i>Lablab purpureus</i>	94.80	12.88	42.50	2.00	7.91
<i>Strychnos spinosa</i>	95.70	3.59	62.00	2.40	4.60

DM= dry matter, CP= crude protein, CF= crude fiber, E.E= ether extract.

## Conclusion and Recommendations

This study has concluded that, there is a wide range of types of trees and shrubs in the study area including significant potential browse sources. Among these species, many are of multipurpose use.

The study has shown the critical importance browse trees have in livestock feeds in the area as reported by the majority of the respondents. The findings of the survey have indicated that, browse contribution in diet improvement for livestock is significant during the dry season as many of the tree species keep their leaves green up to the end of the season. Consequently, implication from the trees and browse cover shows that their high density proves browse availability in the area.

The browse material investigated in the study has shown good nutritional components with relatively high crude protein levels in the species. In addition, the wide range of legume species among the indigenous browse identified in the area, highlights their role as important forage supplements for livestock especially goats.

The study has also shown that most of the livestock keepers are knowledgeable of the vast browse resource available in their areas. The study has also revealed the need to raise awareness among the agropastoral communities in the area with focus on the importance of browse and sustainable utilization.

Water scarcity among other important factors including absence of prescribed grazing mana-

gement, were pointed out by this study as some obstacles that may hamper animals- browse efficient utilization of animal browse on natural rangelands in the area.

Therefore, for improved livestock production and increased household food security in Southern Sudan, it is recommended that, browse species that shows potential nutritive values should be well managed and conserved, awareness on their uses and utilization need to be performed, and the pastorals indigenous knowledge to be validated, all through further studies which are based on profitable utilization of such a diverse browse resource.

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## أهمية الأشجار الرعوية المحلية في تحسين المصادر العلفية الحيوانية (شرق بحر الغزال -السودان)

عبدالعزیز كرم الله جیب الله<sup>1</sup> صمویل لی<sup>2</sup>

1.قسم المراعي - كلية علوم الغابات والمراعي جامعة السودان

2.قسم الإنتاج الحيواني - كلية العلوم البيطرية - جامعة جوبا

### المستخلص

هدفت هذه الدراسة لتقصي أهمية أنواع الأشجار العلفية بالنسبة للإنتاج الحيواني بجنوب السودان. تم إجراء الدراسة بمقاطعة نهر الجور بولاية غرب بحر الغزال في ثلاث قرى هي "مريال باي"، "مالويل" و "كبرى كوانبي". تمتاز منطقة الدراسة بمراعي طبيعية مفتوحة وغطاء من الأشجار والشجيرات من متفرقة إلى كثيفة التواجد بينما يمتن سكانها الرعي والزراعة معا كحرفة رئيسة. شملت الأدوات التي استخدمت لجمع البيانات مسح إستبيان لتقييم الجانب الإقتصادي الإجتماعي لإستخدامات الأشجار العلفية، وقياسات الغطاء الشجري بالطرق المحددة شمل الكثافة، الكثافة النسبية، الإرتفاع ومستوى الرعي الشجري، بالإضافة إلى التحليل المعمل للمحتوى الكيميائي لعينات من مادة علف الأشجار بغرض تحديد محتواها الغذائي. اشارت نتائج تقدير الغطاء الشجري إلى الكثافة العالية والتنوع للأشجار في المنطقة، وذلك بواقع 138 شجرة/هكتار، والكثافة النسبية لأنواع العلفية وصلت 6 نوع/هكتار، الكثافة الكلية للأشجار 6 نوع/هكتار، وإرتفاع الأشجار تراوح في المعدل بين 2- 20م ، ومستوى الرعي الشجري (Browsing level) تراوح بين 1-2م على التوالي. النتائج التي توصلت إليها الدراسة في موسمين مختلفين، للمحتوى الغذائي لعلف 7 أنواع تم اختيارها شملت (*Grewia mollis*, *Leptadenia lancifolia*, *Lablab purpureus* spp., *Marsdenia abyssinica*, *Pterocarpus lucens*, *Strychnos spinosa* and *Balanites aegyptiaca*). أكدت محتواها العالي نسبياً من البروتين الخام بمعدل تراوح بين 2% إلى 15% في كل من *Grewia mollis* و *Marsdenia abyssinica* خلال فصل الجفاف على التوالي. وكانت نتائج محتويات المادة الجافة، الألياف الخام، الرماد والدهون هي 93.20% ، 24- 62% ، 1.60- 6.80% ، 4.60- 12.66% على التوالي. اوضحت نتائج المسح الإجتماعي الإقتصادي أن إستغلال وإستخدام الأشجار للأغراض العلفية وغير العلفية يعتبر نشاطاً رئيساً في المنطقة. وذكر المشاركون في الإستبيان ان (43) نوعاً من الأشجار والشجيرات تعتبر مصدراً لعلف الحيوان في المنطقة. وأبرزت النتائج أهم الأنواع ذات الإستخدام المتعدد إلى جانب الإستخدامات في المجالات التقليدية لصحة الحيوان. وإستنتجت الدراسة كذلك، أن الإستخدام المتعدد لبعض أنواع الأشجار العلفية الهامة مثل *Terminelia brownii* و *Hymenocardia acida*، إضافة إلى شح مصادر المياه وغياب نظم رعي جيدة، تمثل أكثر العوامل التي تعوق إستفادة الحيوان من العلف الشجري في المنطقة. خلصت نتائج هذه الدراسة إلى وجود تنوع كبير في أنواع الأشجار والشجيرات في المنطقة بما فيها أنواعاً هامة ذات قيمة علفية جيدة ، كما وبينت النتائج كثافتها وقيمتها الغذائية العالية نسبياً خاصة في محتوى البروتين الخام. كما ووضحت النتائج أهمية المعارف التقليدية للرعاة المحليين

بالنسبة الى استخدامات الاشجار العلفية. وكشفت الدراسة عن ان شح المياه تحديدا اثناء فصل الجفاف، وغياب الممارسات الجيدة لادارة الرعى فى المنطقة، بالاضافة الى الاستخدامات المتعددة الاخرى للأشجار ، تمثل ابرز المشكلات التى تواجه استغلال الاشجار والشجيرات العلفية. يمكن تبني نتائج هذه الدراسة لتوجيه إدارة وإستغلال موارد الرعى الشجرى فى المنطقة بهدف صيانتها وضمان حفظها من أجل تحسين تغذية الحيوانات.