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An Assessment of the Diversity of Indigenous Forage Plant Species of the Dry Season in Dry Lands of North Western Ethiopia: Implication for Their Conservation and Sustainable Use

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Abstract
This study was done to assess the diversity of indigenous forage plants of the dry season in *Combretum-Terminalia* woodlands of Guba District, North West of Ethiopia. A total of 69 species of plants were identified and of which all are consumed as a feed resource by the local animal breeds during dry season. The diversity (H) values of the forage plant species ranged between 0.65 to 1.67 across the plots sampled. The similarities (J) between the plots in terms of species composition of all forage species were 0.56 and 0.94. The evenness (E) values of all forage species were in between 0.78 and 0.86 across the sampled plots. The densities of all forage species, including seedlings, were 1216 stems ha^{-1}. In the study area *Combretum colinum*, *Lonchocarpus laxiflorus, Terminalia laxiflora, Acacia polycantha* and *Ziziphus mucronata* were the five relatively abundant forage species. The Importance Value Index (IVI) values of all the forage species ranged between 0.31 (*Strychnos innocua*) and 81.67 (*Combretum colinum*). Particularly local goat breeds of the study area were known to feed on various plant resources than other breeds. Moreover, **Bigariya** local cattle breeds were also know to feed on various similar plant resources hence adapted to harsh environmental condition known in western Ethiopia. Pounded barks of *Cordia Africana and roots of Securidaca longepedankulata* is used in treatment of diarrhoea and common cold cases of goats. Moreover the sheath of *Hyphenea thebiaca* is used to treat the eye disease of Goats, sheep and cattle.
Keywords: Bigariya cattle, density, diversity, evenness, frequency, Importance Value Index
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1. Introduction

Rangelands are defined as those areas of the world, which by reasons of physical limitation, low and erratic precipitation, rough topography, poor drainage, or cold temperatures are unsuited for cultivation and which are a source of forage for free ranging native and domestic animals, as well as a source of wood products, water and wildlife (Herlocker 1999). Of these, extensive livestock production is the major land use on rangelands with large areas of land required per head of livestock (Zhou et al, 1998). Accordingly, the condition of the rangelands which Trollope et al. (1990) defined; the state of health of the rangeland in terms of its ecological status, resistance to soil erosion and potential for producing forage for sustained optimum livestock production must be investigated. Furthermore, rangeland condition is a function of all plant forms (trees, grasses and shrubs) that occur in it (Friedel 1991). Rangeland condition cannot, therefore, be simply indexed according to its usefulness for a single priority land use. As with grassland, the composition and structure of each of the other components vary, which adds an extra and complicating dimension to rangeland assessment. In addition, the rangeland is frequently used by pastoralists who own different animal types (browsers and grazers). Assessment techniques need to consider the different vegetation components for the proper utilization of the available rangeland resources. Until recent times, research on rangeland dynamics has historically focused on the effects of various management practices on forage production and animal response, with little attention given to the impact of grazing on the condition of the soil. Since animal production is directly related to rangeland condition, rangeland degradation will result in a lower income (Danckwerts and Tainton 1996).

In Western Ethiopia, semi-pastoralists of different ethnic groups are found predominately in BenishangulGumuz Regional State (BGRS) which are primarily dependent on natural range based livestock production. Even though the study areas have a vast area of rangeland, there was no research study undertaken to assess the condition of the rangelands and take appropriate management interventions in relation to livestock production. Accordingly, the objective of this study was to assess the forage resource diversity and condition of the grazing by livestock in the mentioned study district.

2. Materials and methods

2.1. Description of the study area

The study was conducted in one district (Guba) which was purposely selected from Benishangul-Gumuz Regional

State western Ethiopia. Benishangul-Gumuz Regional State. **GubaWoreda** is one of the 20 woredas in the Benishangul-GumuzRegion of Ethiopia. It is located 894km northwest of Addis Ababa and about 220km northeast of Assosa, the capital city of Benishangul-Gumuz Regional State.The district is geographically located at ′11° 16′ 0" N latitude and 35° 17′ 0" E longitude.It is a part of the Metekel Zone, Guba is bordered by the Abay River on the south which separates it from the Kamashi Zone, Sudan on the west, Amhara Region on the north, Dangur on the east, and on the southeast by the Beles River, which separates it from Wenbera (CSA, 2012).

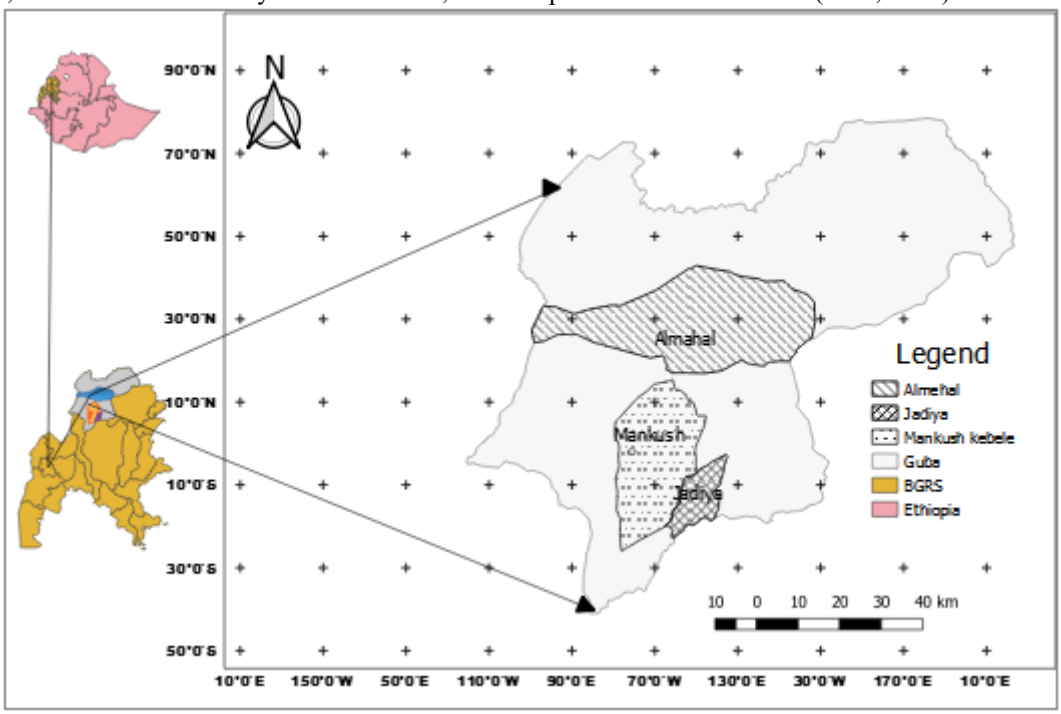

Figure 1. Map of the study area

2.2. Study Methodology

Formal surveys were conducted in Guba district in 2020 dry seasons, as part of the diagnostic first phase. "The potential of crop residues and natural vegetation as ruminant feeds during the dry season in Guba district of Benishangul Gumuz Regional State". The district is in the semi-humid zone. A total of 100 (20 m £ 20 m) sample plots were laid along the transect lines, following the procedures described by Kent and Coker (1992). In each plot, the identity, number of individuals, diameter at breast height (DBH) and height of all woody species having a height above 1.5 m were recorded.

A total of 30 structured questionnaires were developed and used. Only the crop/livestock farmers from the selected kebeles were interviewed. The respondent was the household head. Information from the questionnaire, related to utilization of trees and shrubs and other natural vegetation, were coded and summarized using a SPSS calculator. Before social survey field assessment was done to identify the overall vegetation type and feed materials by the live stocks on field. A total of 12 sample plots were taken to visualize and represent the vegetation of the area.

2.2.1. Forage Preference by Livestock

Direct observation of animals using feeding minutes (Bgugstad*et al.*, 1970) was adopted to assess forage preference by timing the animal as they feed. Moreover, cattle owners were interviewed to rank the mostly preferred species by their livestock's.

2.3. Statistical analyses

Diversity of all woody species was determined using the Shannon – Wiener Diversity Index (H) and evenness (E) (Kent & Coker 1992). Jaccard's Similarity Coefficient (S_j) was used to compute similarity in woody species composition of the area. The indices were computed using the following formulas:

$$H = -\sum_{i=1}^{S} Pi \ln pi$$

where H = Shannon – Wiener diversity index and P_i = the proportion of individuals found in the i^{th} species;

$$E = \frac{H}{Hmax} = \frac{H}{lns'}$$

where E = evenness, H_{max} is the maximum level of diversity possible within a given population, which equals ln (number of species); and

$$J = \frac{C}{A + B + C}$$

where J = Jaccard's similarity coefficient, C = the number of species common to both sites, A = the number of species present in one of the sites to be compared and B is the number of species present in the other site.

Density was calculated by converting the total number of individuals of each species to equivalent numbers per hectare (absolute density), and as the percentage of the absolute density of each species divided by the total stem number of all species ha^{-1} (relative density). Frequency distribution of each species was determined from the number of plots in which the species was recorded (absolute frequency) (Kent & Coker 1992), and as a percentage (relative frequency) by dividing the absolute frequency of the species by the sum of the absolute frequencies of all the species. The absolute dominance of woody species with DBH 2.5 cm was determined from summing the basal area (BA) of all individuals of a species. Relative dominance was calculated as the percentage of the BA of a species divided by the total BA of all species.

The relative ecological importance of each woody species, commonly referred to as Important Value Index (IVI), was determined by summing its relative frequency, relative density and relative dominance (Kent and Coker 1992).

The population structures woody vegetation and that of forage woody species was assessed from the frequency distribution of diameters based on histograms constructed by grouping all individuals of each woody species into the following successive diameter classes: 1 = 0 – 10, 2 = 10– 20, 3 = 20– 30, 4 = 30– 40 and 5 > 40 cm (Peters 1996; Teketay 1997; Ogbazghi et al. 2006; Sop et al. 2011). The data were analyzed using Biodiversity Professional Software version 8.2.

Plant identification was carried out mostly in the field, and for those species, which could not be identified in the field, herbarium voucher specimens were prepared, transported to and identified in the Ethiopian Biodiversity Institute Herbarium. Plant nomenclature in this article follows the published volumes of Flora of Ethiopia, and Flora of Ethiopia and Eritrea (Hedberg & Edwards 1989, 1995; Edwards et al. 1997; Edwards et al. 2000).

3. Results and Discussion

3.1. Species Richness

As it was observed on field survey that the woodland vegetation of Guba district is characterized by small to moderately sized trees, herbs, grasses and sedges. The ground cover is dominated by herbaceous geophytes at the beginning of rainy season (May and June). Towards the end of rainy season (September to November) tall strata perennial grasses become dominant. A total of 69 plant species were recorded in the study area of which all are consumed as a feed resource by the local breeds during dry season (Table 1).

Table 1: List of some common plant species encountered in Guba district

No	Local Name (Gumuzigna)	Botanical Name	Family
1	Achiquwa	*Leonotis nepetifolia*	Lamiaceae
2	Amberta	*Andropogon schirensis*	Poaceae
3	Adegila	*Streospermum kunthianum*	Bigniniaceae
4	Anderkukuwa	*Strychnose spinosa*	Loganiaceae
5	Hanguga/Hangua	*Ziziphus abyssinica*	Rhamnaceae
6	Siya/Gaba	*Ziziphus mucronata*	Rhamnaceae
7	Antsiqina Guanja	*Cissus cornifolia*	Vitaceae
8	Antutiya	*Solanum alatum*	Solanaceae
9	Babegoha/Bogoha	*Terminalia macroptera*	Combretacaea
10	Babenga	*Hyphaene thebiaca*	Arecaceae
11	Bambeluwa	*Entada africana*	Fabaceae
12	Bambuta	*Annona senegalensis*	Annonaceae
13	Banja	*Cordia africana*	Boraginaceae
14	Banshzegona	*Wissadula rostrata*	Malvaceae
15	Bebdaja	*Tragia doryodes*	Euphorbiacea
16	Bewa	*Lonchocarpus laxiflorus*	Fabaceae
17	Begiya	*Strychnos innocua*	Loganiacea
18	Bora	*Terminalia laxiflora*	Combretaceae
19	Bembeda	*Maytenus senegalensis*	Celastraceae
20	Bidiguwa	*Hyparrhenia anthistirioides*	Poaceae
21	Biilga	*Lannea welweschii*	Anacardiaceae
22	Yempite	*Lannea fruticosa*	Anacardiaceae
23	Mamusa	*Cymbopopogon caesuis*	Poacea

No	Local Name (Gumuzigna)	Botanical Name	Family
24	Chaya	*Pterocarpus lucens*	Fabaceae
25	Dijiha	*Breonadia salicina*	Rubiacea
26	Diwa	*Syzygium guineense*	Myrtaceae
27	Dhoga	*Tamarindus indica*	Fabaceae
28	Mecha	*Piliostigma thonningii*	Fabaceae
29	Fuqa	*Ficus sycomorus*	Moraceae
30	Eboba	*Rottboellia cochinchinensis*	Poaceae
31	Asiya	*Ficus lutea*	Moraceae
32	Bambichowa	*Asparagus flagellaris*	Asparagaceae
33	Engifa	*Combretum collinum*	Combretaceae
34	Elta/Enta	*Oxytenanthera abyssinica*	Poacea
35	Ephuwa	*Sterculia africana*	Sterculiaceae
36	Etissayaquwa	*Pennisetum thumbergii*	Poacea
37	Gideya	*Grewia velutina*	Tiliacea
38	Goha	*Phoenix reclinata*	Aracaceae
39	Golgola	*Boswellia papyrifera*	Burseraceae
40	Hesiniya	*Hyparrhenia filipendula*	Poacea
41	Heya	*Ximenia americana*	Olacaceae
42	Jiggnewiya	*Clerodendrum alatum*	Verbanacea
43	Jipiwa/Chamda	*Combretum hartmanianum*	Combretacea
44	Liffa	*Luffa cylinderica*	Cucurbitacea
45	Machanchiga	*Lagenaria siceraria*	Cucurbitacea
46	Meela	*Acacia seyal*	Fabacea
47	Mejira	*Trigonella foenum-graecum*	Fabaceae
48	Meetsiya	*Tristemma mauritianum*	Melastomataceae
49	Piwe	*Crossopteryx febrifuga*	Rubiacea
50	Qota	*Balanitus aegyptiaca*	Balanitaceae
51	Quatsirqa	*Acacia hecatophylla*	Fabaceae
52	Sasiqida	*Cynodon nlemfuensis*	Poacea
53	Sipe	*Acasia polyacantha*	Fabaceae
54	Siqida/Si-Eda	*Securidaca longepedunculata*	Polygalaceae
55	Songah	*Ziziphus mauritiana*	Rhamnaceae
56	Tisheza	*Vitex doniana*	Verbanaceae
57	Dimquri	*Ipomoea eriocarpa*	Convolvulaceae
58	Tara/Geret	*Acacia senegal*	Fabaceae
59	Mureb	*Pennisetum unisetum*	Poacea
60	Kota	*Gardenia ternifolia*	Rubiacea
61	Weela	*Dicrostachus cinerea*	Fabacea
62	Weela	*Flueggea virosa*	Euphorbiaceae
63	Sigah	*Anogeissus leiocarpa*	Combretaceae
64	Insiya	*Ficus vasta*	Moraceae
65	Duruba	*Dalbergia melanoxylon*	Fabaceae
66		*Saspania spp*	Fabaceae
67	Dadiha	*Acanthus polystachyus*	Acanthaceae
68	Ansisiwa	*Albizia malacophylla*	Fabaceae
69	Unkown	*Vernonia purpurea*	Asteracea

3.2. Diversity of forage plant species of the drier season in the study area

The diversity (H) values of the forage plant species ranged between 0.65 to 1.67 across the plots sampled. The similarities (J) between the plots in terms of species composition of all forage species were 0.56 and 0.94. The evenness (E) values of all forage species were in between 0.78 and 0.86 across the sampled plots (Table 2). The numbers of forage plant species recorded at the study sites are comparable to those reported from Gambella, southwestern Ethiopia (Eshete *et al*. 2011) and Yabello, southern Ethiopia (Worku *et al*. 2012).

Table 2. List of forage plant species encountered in the study area with their IVI values.

Botanical Name	Family	DE	RDE	DO	RDO	FR	RFR	IVI
Acacia polycantha	Fabaceae	45	13.21	7.24	39.02	59	10.01	62.24
Acacia seyal	Fabaceae	78	20.85	1.02	15.79	80	17.2	53.84
Streospermum kunthianum	Bigniniaceae	7	1.65	1.05	5.96	83	13.7	21.31
Strychnose spinosa	Loganiaceae	62	13.04	2.4	13.6	78	12.9	39.54
Ziziphus abyssinica	Rhamnaceae	70	14.21	2.13	12.1	66	10.89	37.2
Ziziphus mucronata	Rhamnaceae	76	6.65	1.44	8.15	49	8.09	22.89
Cissus cornifolia	Vitaceae	23	7.6	0.31	1.77	51	8.42	17.79
Acacia hecatophylla	Fabaceae	61	14.34	1.69	13.94	37	13.11	41.39
Terminalia macroptera	Combretacaea	50	15.5	0.21	13.19	34	25.61	54.3
Hyphaene thebiaca	Arecaceae	48	22.82	6.3	25.52	26	14.29	62.63
Entada africana	Fabaceae	17	11.65	0.08	0.48	14	2.31	14.44
Annona senegalensis	Annonaceae	26	10.05	0.18	1.01	12	1.98	13.04
Cordia africana	Boraginaceae	1	0.11	0.49	2.78	2	0.33	3.22
Wissadula rostrata	Malvaceae	4	0.75	0.01	0.08	10	1.65	2.48
Tragia doryodes	Euphorbiacea	1	0.11	0.18	1.01	2	0.33	1.45
Lonchocarpus laxiflorus	Fabaceae	89	16.05	0.03	15.62	1	16.47	48.14
Strychnos innocua	Loganiacea	1	0.11	0	0.03	1	0.17	0.31
Terminalia laxiflora	Combretaceae	76	19.65	0	32.26	1	25.26	77.17
Maytenus senegalensis	Celastraceae	12	8.02	1.8	10.04	14	11.1	29.16
Acacia senegal	Fabaceae	13	4.9	3.04	34.91	20	10.99	50.8
Lannea welweschii	Anacardiaceae	62	24.21	0.64	7.37	33	18.13	49.71
Lannea fruticosa	Anacardiaceae	50	19.69	1.07	12.23	19	10.44	42.36
Dicrostachus cinerea	Fabaceae	37	13.75	1.09	12.49	18	19.89	46.13
Pterocarpus lucens	Fabaceae	54	17.14	0.25	22.74	15	14.15	54.03
Anogeissus leiocarpa	Combretaceae	30	11.67	0.2	2.34	6	3.3	17.31
Syzygium guineense	Myrtaceae	6	2.37	0.62	7.11	11	6.04	15.52
Tamarindus indica	Fabaceae	9	3.46	0.37	4.25	9	4.95	12.66
Piliostigma thonningii	Fabaceae	5	2	0.29	3.37	6	3.3	8.67
Ficus sycomorus	Moraceae	4	1.64	0.34	3.92	5	2.72	8.28
Flueggea virosa	Euphorbiaceae	6	2.55	0.12	1.37	7	3.85	7.77
Ficus lutea	Moraceae	6	2.19	0.08	0.88	5	2.75	5.82
Asparagus flagellaris	Asparagaceae	2	0.91	0.22	2.58	4	2.2	5.69
Combretum collinum	Combretaceae	92	21.1	0.1	38.35	4	22.22	81.67
Oxytenanthera abyssinica	Poacea	4	1.45	0.1	1.15	3	1.65	4.25
Sterculia africana	Sterculiaceae	3	1.28	0.02	0.19	4	2.2	3.67
Pennisetum thumbergii	Poacea	2	0.91	0.03	0.36	4	2.2	3.47
Grewia velutina	Tiliacea	1	0.36	0.03	0.3	2	1.1	1.76
Phoenix reclinata	Aracaceae	1	0.36	0.02	0.26	2	1.1	1.72
Boswellia papyrifera	Burseraceae	1	0.36	0.02	0.19	2	1.1	1.65
Hyparrhenia filipendula	Poacea	1	0.18	0.04	0.52	1	0.55	1.25
Ximenia americana	Olacaceae	1	0.18	0.01	0.1	1	0.55	0.83
Clerodendrum alatum	Verbanacea	1	0.18	0	0.02	1	0.55	0.75
Combretum hartmanianum	Combretacea	76	28.35	3.8	33.25	69	15	76.6

Note: DE ¼ absolute density (ha^{21}), RDE ¼ relative density (%), FR ¼ absolute frequency (%), RFR ¼ relative frequency (%), DO ¼ absolute dominance (m^2), RDO ¼ relative dominance (%) and IVI ¼ Importance Value Index.

3.3. Density, frequency and dominance

The densities of all forage species, including seedlings, were 1216 stems ha^{-1} (Tables 2). Few of the species dominated the woody vegetation and exhibited higher frequency values. In the study area *Combretum colinum*, *Lonchocarpus laxiflorus, Terminalia laxiflora, Acacia polycantha* and *Ziziphus mucronata* were the five relatively abundant forage species (Table 2). However, Phoenix reclinata, *Clerodendrum alatum, imenia americanaand Grewia velutina,* were represented with few individuals. At Guba, the majority of the forage species exhibited high density values (Table 2). However, the species richness values at the current study sites are far lower than those reported from Combretum-Terminalia forests of Anbessa forest of Assosa district (Tamene Yohannes, 2016) and of Wisin woodland of Bullen districts (Dereje Mosissa and Birhanu Abraha, 2012)

3.4. Importance Value Index

The Importance Value Index (IVI) values of all the forage species ranged between 0.31 (*Strychnos innocua*) and 81.67 (*Combretum colinum*). The most dominant woody species were *Acacia polycanta*, *Hyphaene thebiaca, Lonchocarpus laxiflorus*, *Lanea. fruticosa*, *Pilostigma thunningii* and *Acacia senegal*. Species with the least values of IVI were *Clerodendrum alatum* and *Ximenia Americana* (Tables 2). The forage plant species reported from Guba are among the woody species with relatively high ecological importance, which is clearly reflected in their contribution to the overall IVI of the study sites. Similar results were also reported from Metema districts in Amhara Regional State where woody species contributed 65% and 75% of the total IVI, respectively (Worku *et al*. 2012).

3.5. Utilization of plants for livestock feeding

The interviewed farmers (agro-pastoralists) were able to identify which plant species and which vegetative part was favoured by which class of livestock (Table 2). The farmers, however, named these trees and shrubs in their vernacular language (Table 1).

Acacia hecatophylla, Pilostigma thonnongii, Dicrostachus cinerea was the most known tree species as indicated by 100 percent of respondents (n = 30). Some farmers collect pods of this tree species and keep them at their homes for the purpose of feeding calves and sick animals which cannot walk long distances in search of feed and water during the dry season. Unfortunately, no grinding or any other physical treatment was reported to be practised for the purpose of improving the nutritive value of the pods. Reasons given to the question as to why they do not grind the pods varied. Some indicated that the work is laborious especially for those with large herds of cattle. However, the majority did not know if this could be of value in feeding practices. During dry season when all the grasses burnt out the fallen dry leaves and pods of the family Fabaceae were known to be consumed whit no choices by the local breeds of the area to transit the harsh environment of Guba area (Figure 2). The study indicated that all the local breeds would like to be collectors of the fallen leaves of the drier area which opposes the natural habit of the animals. However, study by Marissa Ames , 2020 indicated that If forage is limited or unavailable due to seasonal conditions, bad weather, or limited pasture space, goats should be fed good hay (free-choice) from a manger or feeder. Hay for goats can be either legume hay (alfalfa or clover) or carbonaceous hay (timothy, brome, orchard grass, mixtures). Legume hay is pricier but has higher nutrition. It's an excellent feed for pregnant or lactating does, and kids. Grass hay is less nutritious and also less expensive, so homesteaders often feed a 50-50 grass-legume mix. All hay should be fine-stemmed, leafy, and green in color. Choose hay meant for horses rather than cows.

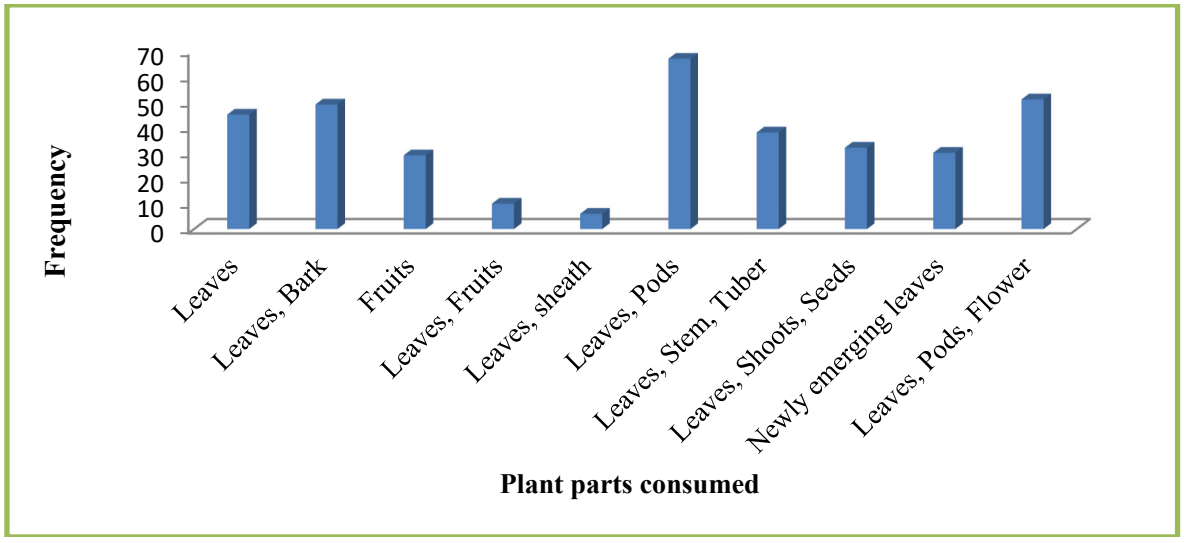

Figure 2. Parts of the forage plants preferred by the local breed during dry season

Apart from Acacia *hecatophylla* and Dichrostachys cinerea *Anogeissus leiocarpa* was reported to be known and used by all of respondents (n = 30). Its dry leaves were reported to be favoured particularly by small ruminants such as goats.

Other high ranking species were *Lonchocarpus laxiflorus, Acacia* species, *Hyphenea thebiaca* and *Ziziphus mucronata* were also mentioned and utilized for livestock feeding.

Table 3: Knowledge on utilization of some plant species for livestock feeding in Guba district

Local Name (Gumuzigna)	Plant species	Animal species	Favoured plant parts
Amberta	*Andropogon schirensis*	Cattle, Goats, sheep and Donkeys	Leaves
Adegila	*Streospermum kunthianum*	Cattle, Goats, Donkeys	Leaves, Bark
Anderkukuwa	*Strychnose spinosa*	Donkey, Goats	Fruits
Hanguga/Hangua	*Ziziphus abyssinica*	Cattle, Goats	Leaves, Fruits
Siya/Gaba	*Ziziphus mucronata*	Cattle, Goats	Leaves, Fruits
Antutiya	*Solanum alatum*	Goats	Leaves
Babegoha/Bogoha	*Terminalia macroptera*	Cattle, Goats	Leaves
Babenga	*Hyphaene thebiaca*	Cattle, Donkeys	Leaves, Fruits
Bambeluwa	*Entada africana*	Goats	Leaves
Bambuta	*Annona senegalensis*	Cattle, Goats	Leaves, Fruits
Banja	*Cordia africana*	Cattle, Goats, Sheep	Leaves, Fruits
Bewa	*Lonchocarpus laxiflorus*	Cattle, Goats	Leaves
Begiya	*Strychnos innocua*	Donkey, Goats	Fruits
Bora	*Terminalia laxiflora*	Cattle, Goats	Leaves
Bembeda	*Maytenus senegalensis*	Cattle, Goats	Leaves
Bidiguwa	*Hyparrhenia anthistirioides*	Cattle, Goats, Sheep, Donkeys	Leaves, sheath
Biilga	*Lannea welweschii*	Cattle, Goats	Leaves
Mamusa	*Cymbopopogon caesuis*	Cattle, Goats, Sheep, Donkeys	Leaves
Chaya	*Pterocarpus lucens*	Goats	Leaves
Dhoga	*Tamarindus indica*	Cattle, Goats, Donkeys	Leaves, Pods
Mecha	*Piliostigma thonningii*	Cattle, Goats, Sheep	Leaves, Pods
Fuqa	*Ficus sycomorus*	Cattle, Goats, Sheep, Donkeys	Leaves, Fruits
Asiya	*Ficus lutea*	Cattle, Goats, Sheep, Donkeys	Leaves, Fruits
Bambichowa	*Asparagus flagellaris*	Cattle	Leaves, Stem, Tuber
Engifa	*Combretum collinum*	Cattle, Goats, Sheep	Leaves
Elta/Enta	*Oxytenanthera abyssinica*	Cattle, Goats, Sheep, Donkeys	Leaves, Shoots, Seeds
Etissayaquwa	*Pennisetum thumbergii*	Cattle, Goats, Sheep, Donkeys	Leaves, Sheath
Gideya	*Grewia velutina*	Cattle, Goats, Sheep	Leaves, Fruits
Hesiniya	*Hyparrhenia filipendula*	Cattle, Goats, Sheep, Donkeys	Leaves, Sheath
Heya	*Ximenia americana*	Cattle, Goats	Newly emerging leaves
Jipiwa/Chamda	*Combretum hartmanianum*	Cattle, Goats	Leaves
Meela	*Acacia seyal*	Cattle, Goats, Sheep, Donkeys	Leaves, Pods, Flower
Qota	*Balanitus aegyptiaca*	Cattle, Goats, Sheep	Leaves, Fruits
Quatsirqa	*Acacia hecatophylla*	Cattle, Goats, Sheep, Donkeys	Leaves, Pods, Flower
Sasiqida	*Cynodon nlemfuensis*	Cattle, Goats, Sheep, Donkeys	Leaves
Sipe	*Acasia polyacantha*	Cattle, Goats, Sheep	Leaves, Pods
Siqida/Si-Eda	*Securidaca longepedunculata*	Cattle, Goats	Newly emerging leaves
Songah	*Ziziphus mauritiana*	Cattle, Goats, Sheep	Leaves, Seeds
Dimquri	*Ipomoea eriocarpa*	Cattle	Whole part
Tara/Geret	*Acacia senegal*	Cattle, Goats, Sheep	Leaves, Pods
Mureb	*Pennisetum unisetum*	Cattle, Goats, Sheep, Donkeys	Whole part
Kota	*Gardenia ternifolia*	Cattle, Goats	Leaves, Fruit
Weela	*Dicrostachus cinerea*	Cattle, Goats	Leaves, Pods
Weela	*Flueggea virosa*	Goats	Leaves
Sigah	*Anogeissus leiocarpa*	Goats	Leaves
Insiya	*Ficus vasta*	Cattle, Goats, Sheep, Donkeys	Fruits
	Saspania spp	Cattle, Goats, Sheep	Leaves, Pods
Bufa	*Unidentified grass*	Cattle	Whole part
Moringa	*Moringa Olifera*	Cattle, Goats, Sheep, Donkeys	Leaves, Flower, Barks

The response given by the interviewed farmers on their experiences on utilization of various plants were comparable to observations made by Backlund and Bellskong (1991) who closely followed the herds of livestock grazing in selected farms in Metema district, Amhara region.

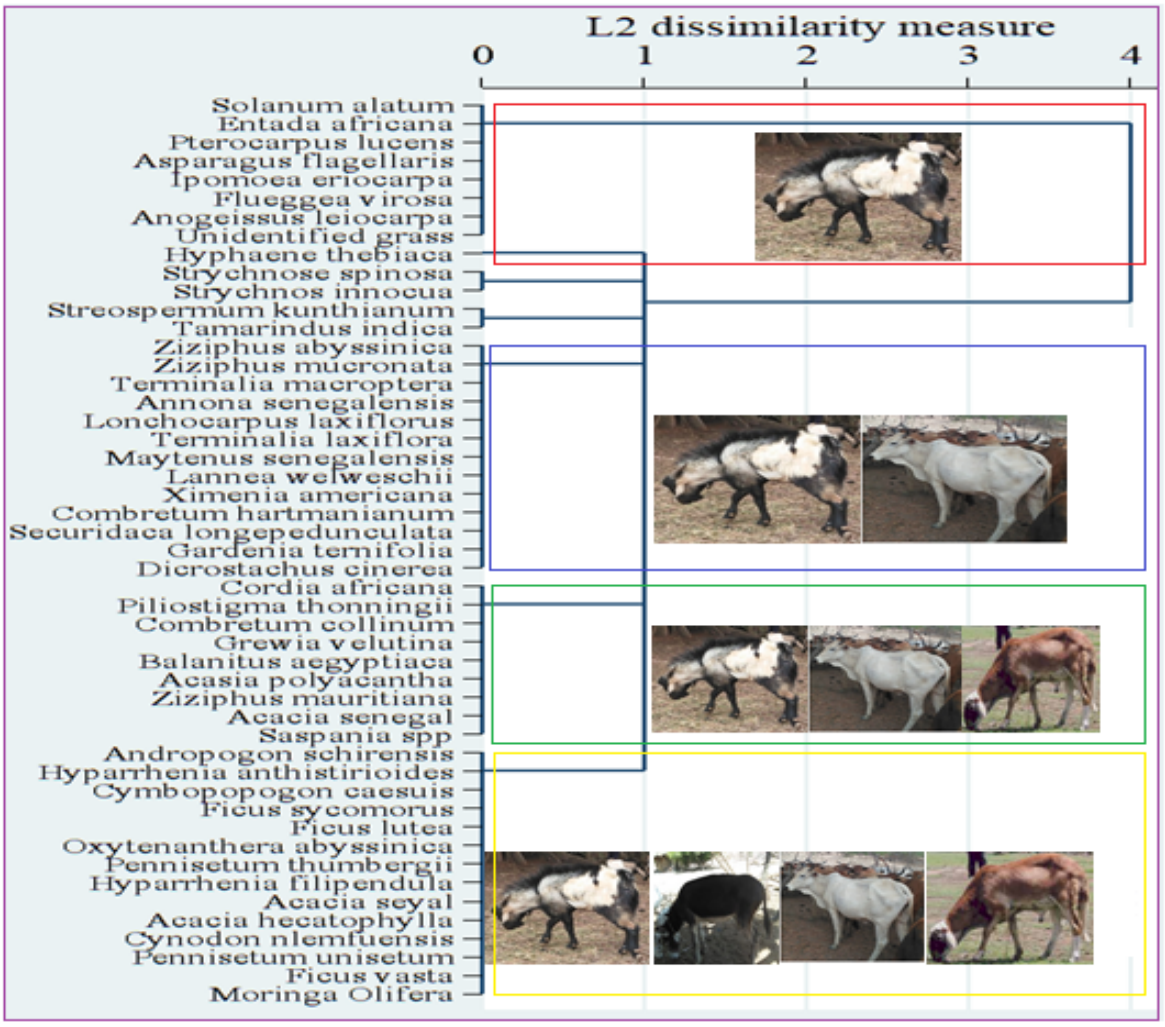

Figure 3: Dendrogram showing the classification of forage plant species based on the preferences by local animal breeds. The horizontal axis represents the distance or dissimilarity between clusters and the vertical axis represents the local animal breeds and clusters.

Particularly local goats' breeds of the study area were known to feed on various feed resources than other breeds. Moreover, Bigariya cattle breeds were also know to feed on various similar plant resources hence adapted to harsh environmental condition known in western Ethiopia (Figure 3). Similarly the study of Jackson, 2008 stated that "Goats have a huge diversity of other plants to choose from than ones we would normally consider traditional forages like fescue, orchard grass, white and red clover, etc." To the contrary mixed grazing particularly goats with cattle is no common in other areas of the world this is because "When goats graze first and then the cattle come in, they are doing what we call 'clean up grazing' in the pasture. At the end of the first grazing season, it was found that cattle that followed goats weighed on average 30 pounds less than cattle that were grazing with goats all the time (Jackson Ky, 2008)."

Table 4.ANOVA Results

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between groups	194.417687	11	17.6743352	2.93	0.0070
Within groups	223.133333	37	6.03063063		
Total	417.55102	48	8.69897959		

As illustrated in table 4 above, the significance value in testing the reliability of the model for the relationship between the local animal breeds with their sources of feed materials (plant species) was obtained as 0.007 which is less than 0.05 the critical value at 95% significance level. That means most of the local breeds feed differently on different parts of plant materials that are available during dry season in the study area. This statement is similar with the study of Jackson Ky, 2008 stating that "Goats have a huge diversity of other plants to choose from than ones we would normally consider traditional forages like fescue, orchard grass, white and red clover, etc." .

3.6. Veterinary Use of plant species

Some trees and shrubs are utilized by agro-pastoralists in treatment of animal diseases and disorders. For example, the stem of a mistilto plant "Ewa" is pounded and mixed with water. The material is squeezed out into the reproductive tract of a cow leaving the mother liquor to induce the expulsion of the retained placenta. On the other hand, pounded barks of *Cordia Africana and roots of Securidaca longepedankulata* is used in treatment of diarrhoea and common cold cases of goats. Moreover the sheath of *Hyphenea thebiaca* is used to treat the eye disease of Goats, sheep and cattle

Table 5. Veterinary use of some trees and shrubs

Plant species	Animals	Comments
Cordia africana	Goats	Bark powdered and mixed with water to treat diarrheal diseases
Securidaca longepedanculata	Goats	Chopped and squeezed roots extracts were used to treat respiratory diseases (e.g. common cold)
Hyphaene thebiaca	Cattle	Chopped sheath of Hyphaene is used to treat eye diseases
Euphorbia sp	Cattle	Stem pound and mother liquor used (Mistilto) to expel retained placenta

3.7. Treatment of Livestock Products

Some farmers use trees and shrubs to enhance livestock products such as milk. Leafs and Wood from some of the plant species (Table 4) is used to feed the animals specially caws to increase the milk content and even its smoke is believed to increase the shelf life of milk and to impart desirable flavours to the "clotted" and concentrated product. Studies conducted at Sokoine University of Agriculture (SUA) on traditional smoking of milk practised by different tribes in Tanzania show that smoke treatment inhibits growth and activity of mesophyllic and thermophilic lactic acid bacteria, although the treated product might not be favoured by everybody tasting the milk (Chenyambuga et al. 1993).

Table 6. Plant species used as milk enhancer in Guba district

Ipomoea eriocarpa
Asparagus flagellaris
Bufa grass
Hyparrhenia anthistirioides

3.8. The impact of Seasonal Dynamics and management on the availability of Forage Plant Species

The owners and herders of the study area identified a total of 49 dominant forage species distributed over the seasonal grazing areas (Table 2) and were also able to rank their abundance in the vegetation across seasons. A significant proportion of pastoralists/owners stated that there is a shortage of forage plant species in March, April and May because of late burning which massively distracts the whole part of the plants. Moreover, a decline in wet weight forage quantity is not a problem to **Bigariya** cattle breed because mostly these breeds are not like other breeds in that they adopted to browse on thorny and longer dominant Acacia species of the area.

Since animals feed resource is not a problem the pastoralists keep their herd of cattle in communal grazing, and herd splitting based on the number of cattle's owned. To the contrary Pastoralist households across East Africa face major livestock losses during dry periods that can cause persistent poverty (Anton Vrielinga *et al*., 2016).

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