

CHECKLIST OF FORAGE PLANTS UTILIZED FOR SHEEP FEEDING IN NSUKKA AREA OF ENUGU STATE, SOUTHEASTERN NIGERIA.

Obua, B.E

Department of Animal Production and Livestock Management
College of Animal Science and Animal Production
Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
Tel. +2348033676606 Email: benobua@gmail.com

ABSTRACT

A survey of the diversity of forage plants fed to indigenous West African Dwarf sheep was conducted using one hundred and fifty (150) households with the aid of structured questionnaire, interactive interviews, farm visits and observations in Nsukka area of Enugu State, Southeastern Nigeria. Questionnaire forms were administered to 15 households that kept sheep in each of the 10 out of the 17 communities that make up the survey area. The data collected were analyzed using simple descriptive statistics such as averages and percentages. One hundred and sixty (160) plant species which comprised five plant life forms were identified. Grasses, trees, shrubs, lianas and herbs belonging to 130 genera and 45 families were inventoried in this checklist. Trees accounted for 49.38 % of all the species in the study area, followed by the herbs (23.12%), shrubs (15.0%), grasses (11.25%) and lianas (1.25%). Important plant families that contribute to the forage resource base for sheep feeding include legumes, which formed 24.37% with families Fabaceae (=Papilionaceae), Mimosaceae and Caesalpinaceae comprising 14.38%, 6.87% and 3.12%, respectively. The grass family, Poaceae formed 11.25% of the plants identified and were spread across 16 genera and 6 major tribes. The tribes, Paniceae and Andropogoneae formed the bulk of the grasses and contributed 27.78 and 38.90%, respectively of the forage grasses observed in the study. The families Euphorbiaceae, Moraceae, Rubiaceae, Asteraceae, Loganiaceae and Combretaceae formed 8.12%, 5.62%, 3.12%, 3.12%, 3.12% and 2.50%, respectively of the forage plants identified in this study. Thirty-five plants were identified as much relished and most preferred and they include *Microdesmis puberula*, *Albizia lebbek*, *Alchornea cordifolia*, *Anthocleista djalensis*, *Aspilia africana*, *Dialium guineense*, *Treculia africana*, *Pentaclethra macrophylla*, *Khaya senegalensis*, *Milicia excelsa*, *Costus afer*, *Panicum maximum* among others. The diversity of the forage plants and preferences shown by sheep for plants were influenced by the feeding / management systems, location/source, availability and utilization of forage plants. The future of sheep rearing in Nsukka area lies partly in identifying and expanding the vast plant nutritional resource base for sheep, ensuring year round feed availability and updating farmers with current knowledge and wide array of plants as feed resource for sheep.

Keywords: Forage plants, diversity, feeding, sheep, tropics

INTRODUCTION

The traditional concept in Nigeria that pasture (and invariably forage) is a natural feed resource, freely available and of no intrinsic monetary value and can therefore be put through grazing animals with little or no production cost can no longer hold (Obua, 2008). Trees, shrubs, pods, woody vines, lianas, grasses, forbs and herbs form a natural part of the diet of many ruminant species and have been used traditionally as sources of forage for domesticated livestock in Nigeria. Nigeria has been ranked 11th in Africa for plant diversity with plant species estimated at about five thousand (FGN, 2002). Stanfield (1970) indicated that Nigeria has over 90 genera and 330 grass species while Aigbokhan (2014) identified 60 grass plants and inventoried in a checklist of vascular plants of southern Nigeria, one thousand three hundred and twelve (1312) plant taxa distributed in 141 plant families. Given the diversity of fodder plants, there is a critical need to study and identify promising species for specific agro-ecological environments and ruminant production systems in Nigeria. Studies have shown that farmers are familiar with the vegetation present in their areas (Briggs *et al.*, 1999; Thorne *et al.*, 1999) and surveys of farmers, generate more important information on the diversity of plants species in their area than field observations (Bayer, 1990; Okoli *et al.*, 2003b). In Southern Nigeria, only a few plant species have been incorporated into small ruminant feeding systems, despite the vast array of plant species with forage potential in the area. Earlier reports indicate that a detailed inventory of trees, shrubs, twigs, shoots, woody vines, grasses, lianas, fruits and pods available for feeding animals do not exist for Nigeria (Agishi, 1985). Indeed, there is reason to believe that the future of sheep rearing in South East Nigeria lies partly, in identifying and expanding the vast plant nutritional resource base for our ruminant animals. This would contribute to ensuring year round feed availability and provide farmers with a wider knowledge on the use of plants as feed for sheep and goats (Obua, 2013). Available information on the diversity and distribution of browse and other forage crops of Southeastern Nigeria (SE) Nigeria are also scanty, mostly informal assessment and unpublished reports (Okigbo, 1980; Mecha and Adegbola, 1980; Okafor and Fernandez, 1987; Okeke, 1996; Ebere, 2000).

However, Okoli *et al.* (2003b), Onyeonagu and Asiegbu (2006) and Chah and Igbokwe (2011) listed 163, 86 and 46 indigenous and exotic plants respectively utilized as primary food and fodder for both sheep and goats in SE Nigeria. Recently, Obua (2013) listed 177 browse plants for feeding goats in Ohaji/Egbema/Oguta meteorological area Imo State, SE Nigeria. Against the backdrop of the array of plants available for feeding sheep and goats, these are indications that there were much more forage resources in the region than the few highlighted by these studies.

However, it is noteworthy that most of these studies on plants available for feeding were on both sheep and goats. There is limited information on the diverse plant species available for feeding of only one species such as sheep in Nsukka area, Enugu State of Southern Nigeria. Indeed Nsukka area may harbor different fodder utilization information from the other areas in SE Nigeria. Sheep are known to be grazers, selecting primarily grasses and herbs and yet they browse (Valderrabano, *et al.*, 1996; Ngwa *et al.*, 2000; Castro and Fernandez-Nunez, 2016) and plants consumed by sheep differ from those consumed by goats (Bartolome *et al.*, 1998; Omphile *et al.*, 2003). A survey of the diversity and distribution of forage plants of the region is therefore needed to provide a comprehensive inventory of the important plant families and preferred species that contribute significantly to the forage resource base of sheep. This would help in making appropriate recommendations to sheep farmers who practice cut-and-carry feeding system on the forage plants to use. The depletion of forest resources of SE Nigeria (Njoku, 2006; Njoku, 2009) coupled with the recent reports on the activities of migrant pastoralists in the region, which result in soil impaction, deforestation of remaining fragile vegetal cover thereby complicating the perilous forest ecosystem depletion of the region (Okoli *et al.*, 2012). The overall effect is the depletion of browse plants with increasing prevalence of grass species in the region. Other, entrenched human activities that drive environmental changes in the region, especially rapid urbanization, population growth and inefficient use and destruction of forest resources in the region create the need to study the issues surrounding the sustenance of plant biomass used by rural communities in feeding their livestock (Okoli *et al.*, 2014). The present study would tend to identify the diverse forage plants, availability, their families and preferred forage species used in feeding sheep in Nsukka area of Enugu State, Nigeria.

MATERIALS AND METHODS

Study area:

Enugu state, comprises seventeen Local Government Areas (L.G.As) but Nsukka L.G.A was chosen. Nsukka L.G.A lies within latitude 6° 45' N and 7° N and longitude 7° 12.5' E and 7° 36'E (Ofomata,

1975). It has a total land area of 475 square kilometers, with elevation of 447.26 meters and a population of about 309,448 people (FRN, 2009). Nsukka area is in Southeastern (SE) Nigeria and is characterized by 4 and 8 months of dry and rainy seasons, respectively.

Field survey:

A survey was conducted with the aid of structured questionnaires, personal interviews and observations in ten out of the seventeen communities in Nsukka L.G.A of Enugu state, SE Nigeria. Communities were selected randomly and fifteen respondents were interviewed in each community making up a total of one hundred and fifty (150) respondents in the L.G.A. Selected respondents comprised households, which kept sheep at the time of the study. The communities were Nsukka, Obukpa, Ede-Oballa, Alor Uno, Ibagwa-Ani, Eha –Alumona, Lejja, Eha-Ndiagu, Okpuje and Opi. The study was conducted between the months of March and November of the year to cover both dry and rainy seasons.

The aspects covered by the questionnaires were various categories or types of forage plants, availability, sources across the seasons and preferred forage plant species used in feeding sheep. The forage plants were ranked based on the rating by the smallholder sheep farmers on the acceptability and preferences of the plants by sheep. The palatability forage rating included three categories, least preferred, preferred and most preferred plants. The availability rating of the plants were based on mean scores to the nearest whole number (Key: 1 = scarce: 2 = moderately available: and 3 = easily available). The availability was also based on if the plant is available all year round, during the dry season or in the wet season (Onyeonagu and Asiegbu, 2006).

Each household was visited once during the study period. On each visit, sampling and identification of the plants was undertaken. Small stock holders were asked to list the plants they offered as feed to their sheep. Subsequently, in company of the farmers, plants were identified with their local names, collected, tagged and preserved for subsequent botanical identification. Plants sampled at the different sites were identified at the Botany Department, University of Nigeria, Nsukka, Enugu State and Forestry Department, Ministry of Agriculture and Environment, Owerri, Imo State, Nigeria.

Data analysis:

The data collected were analysed using simple descriptive statistics such as averages and percentages.

RESULTS AND DISCUSSION

This study revealed a striking rich array of plant species utilized by farmers for feeding sheep. A total of 160 plant species which comprised five plant life forms were identified and include trees, shrubs, grasses, herbs, and lianas belonging to 130 genera

and 45 families were identified for feeding sheep (Table 1). The list of forage plants in the present study is more diverse than previously reported

studies (Mecha and Adegbola, 1980; Orok and Duguma, 1987; Okafor and

Table 1a: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common name	Vernacular name	Availability/ Rating
Acanthaceae			
<i>Asystasia gangetica</i> (Linn.) T Anders	Bush green	Ekere	*** 1
Amaranthaceae			
<i>Alternanthera bettzickiana</i> (Regel) Voss	Red Amaranth		*** 3
<i>Amaranthus hybridus</i> (L)	Green Amaranth	Inine	* 1
<i>Amaranthus viridis</i> (L)	Slender Amaranth	Inine oji	* 1
Anarcadiaceae			
<i>Anarcadium occidentale</i> (Linn.)	Cashew	Kashu	* 3
<i>Mangifera indica</i> (L)	Mango	Mangolo	***3
<i>Spondias mombin</i> (L)	Hog plum	Ijikara	***3
Annonaceae			
<i>Annona muritica</i> (L)	Sour sop		*3
<i>Annona senegaliensis</i> Pers	Wild custard apple		*3
<i>Annona squamosa</i> (L)	Custard Apple		*3
Apocyanaceae			
<i>Alstonia boonei</i> De wild		Egbu	*3
<i>Rauwolfia vomitoria</i> Afzel	Swizzle stick	Akanta	*3
<i>Voacanga africana</i> Stapf.	Oval tree	Ukwa ofia	*3
Arecaeae			
<i>Cocos nucifera</i> (L.)	Coconut	Aki bekee	*3
<i>Elaeis guinensis</i> Jacq	Oil palm	Nkwu	*3
Asteraceae (=Compositae)			
<i>Agerantum conoizoides</i>	Goat weed		*1
<i>Aspilia africana</i> Pers. C.D. Adams	African marigold	Oranjila	***1
<i>Emilia coccinea</i> (Sms). G. Don	Emilia		**1
<i>Emilia sonchifolia</i> (L.). Dc	Tassel flower	Nti ele	**1
<i>Syndrella nodiflora</i> Gaertn	Yellow starwort		**1
<i>Tridax procumbens</i> (L)	Tridax		**1
<i>Vernonia amygdalina</i> Del	Bitter leaf	Olugbu	*3
Bignonaceae			
<i>Newbouldia laevis</i> P. Beauv		Ogirishi	*3
Burseraceae			
<i>Dacryodes edulis</i> (G. Don)	African native pear	Ube	***3
Caesalpinaceae			
<i>Anthonata macrophylla</i> P. Beauv		Ububa	*3
<i>Daniella oliveri</i> (Rolfe). Hutch & Dalz	Ilorin Balsam		*3
<i>Dialium guineense</i> Willd	Velvet taramind	Icheku	***3
<i>Piliostigma reticulatum</i> (Dc) Hochst	Camels foot		*3
<i>Taramind indica</i> L.	Taramind		*3

Table 1b: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular names	Availability/rating
Casuarinaceae			
<i>Casuarina equisetifolia</i> Forst & Forst	Whistling pine		**3
Chrysobalanaceae			
<i>Dactyladenia bateri</i> (Hook. F. ex.Oliv)	Monkey fruit	Ahaba, Nkwa	*3
Combretaceae			
<i>Combretum paniicullatum</i> Vent		Otudo	*3
<i>Combretum racemosum</i> P. Beauv	Christmas tree	Alagame	**2
<i>Terminalia catapa</i> L.	Indian almond	Uru	*3
<i>Terminalia mantaly</i> H. Perrier	Step plant		**3
Commelinaceae			
<i>Commelina benghaliensis</i> (L.)	Spiderwort	Obogu	*1
<i>Commelina erecta</i> (L.)	Wandering jew	Ebisango	*1
<i>Palisota hirsuta</i> (Thumb.) K. Schum		Ikpere aturu	**2
Connaraceae			
<i>Gnestis ferruginea</i> Dc		Amunkita	*3
Convolvulaceae			
<i>Ipomoea batatas</i> L.) Lam	Sweet potato	Jinwanu	**2
<i>Ipomoea involunrata</i> P. Beauv.	Morning glory		*1
Costaceae			
<i>Costus afer</i> Ker-Gawl	Ginger lily	Okpete	***
Cucurbitaceae			
<i>Telfairia occidentalis</i> Hook.f.	Fluted pumpkin	Ugu	***2
Dioscoreaceae			
<i>Dioscorea rotundata</i> Poir	White yam	Ji ocha	**2
Euphorbiaceae			
<i>Alchornea cordifolia</i> (Schum & Thonn). Mull.Arg	Christmas bush	Mbubo	***3
<i>Alchornea laxiflora</i> (Benth) Pax.			**3
<i>Acalypha wilkesiana</i> Muell. Arg	Red leaved croton		*3
<i>Bridelia ferruginea</i> Benth	Bridelia	Ola	*3
<i>Eurphobia heterophylla</i> L	Spurge weed	Ogbaraohu	***1
<i>Hura crepitans</i> L.	Sand box tree		*3
<i>Macaranga bateri</i> Muell. Arg.	African thorn	Owariwa	**3
<i>Maesobotrya dusenii</i> (Pax) Hutch	Squirrel cherry	Ubene	*3
<i>Mallotus oppositifolius</i> (Geisel.) Mull. Arg.			*3
<i>Manihot esculenta</i> Krantz	Cassava	Akpu	**3
<i>Manniophyton fulvum</i> Mill.Arg.	Gasso nut	Egenwanu	***3
<i>Margaritaria discoidea</i> (Baill)Webster			**3
<i>Ricinodendron heudelotti</i> Baill	African-nut wood oil	Okwe	***3

Table 1c: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular	Availability/ Rating
Fabaceae (Papilionoideae)			
<i>Arachis hypogea</i> L.	Groundnut	Opupa	**1
<i>Baphia nitida</i> Lodd	Camwood	Aboshi	***3
<i>Cajanus cajan</i> Harms	Pigeon pea	Agbugbu	*3
<i>Calopogonium mucunoides</i> Desv.	Calopo	Ogbanala	***1
<i>Centrosema pubescens</i> Benth	Centro		***1
<i>Dalbergia melanoxylon</i> Guill & Perr.	African blackwood	Akpa anya	*3
<i>Erythrina senegalensis</i> Dc	Coral tree		*3
<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp	Mexican lilac		*3
<i>Glycine max</i> (L.) Merriell	Soyabean		*1
<i>Lonchocarpus laxiflorus</i> Guill & Perr			*1
<i>Milletia abonensis</i> (Hook. F.) Bak		Kpukpumme	*3
<i>Mucuna pruriens</i> (L) Dc	Devil bean	Agbara	*1
<i>Pterocarpus erinaceus</i> Poir	African rose wood		***3
<i>Pterocarpus mildbraedii</i> Harms	White camwood	Oha ojii	***3
<i>Pterocarpus osun</i> Craib	African padouk	Ohaohia	***3
<i>Pterocarpus santalinoides</i> L'Hér. ex DC.	Waterside camwood	Nturukpa	***3
<i>Pterocarpus soyauxii</i> Taub.	Barwood		**3
<i>Pueraria phaseoloides</i> (Roxb.) Benth.	Tropical Kudzu		**1
<i>Sesbania grandiflora</i>			*3
<i>Sesbania sesban</i> (L.) Merrill	Sesban		*3
<i>Stylosanthes guianensis</i> (Aubl.) Sw	Stylo		*1
<i>Tephrosia brateolata</i> Guill & Perr			*3
<i>Vigna subterranea</i> (L.) Verdc	Bambara groundnut	Okpa	*1
<i>Vigna unguiculata</i> Walp	Cowpea	Agwa	*1
Guttiferae (=Clusiaceae)			
<i>Harungana madagascariensis</i> Lam ex Poir	Dragon blood tree	Otiri/Uturu	*3
<i>Garcinia kola</i> Heckel	Bitter cola	agbailu	*3
Irvingiaceae			
<i>Irvingia gabonensis</i> (O'Rorke) Baill	Bush mango	Ugiri	*3
<i>Irvingia grandiflora</i> Engl	Bush mango	Ogbono	*3
Lauraceae			
<i>Persea americana</i> Mill	Avacardo pear	Ube bekee	***3
Loganiaceae			
<i>Anthocleista djalensis</i> A. Chev.	Cabbage tree	Oroghopo	***3
<i>Anthocleista procera</i> Lepr. Ex Bureau	Cabbage tree		***3
<i>Anthocleista vogelli</i> Planch	Cabbage tree		***3
<i>Spigelia anthelmia</i> (L)	Worm bush		***1

Table 1d: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular name	Availability/ Rating
Loganiaceae			
<i>Strychnos spinosa</i> Linn	Monkey ball tree	Agba	*3
Malvaceae			
<i>Hibiscus rosa-sinensis</i>	Hibiscus		*3
<i>Sida acuta</i> Burm	Broom weed		*2
<i>Sida rhombifolia</i> (L)	Wire weed		*2
<i>Urena lobata</i> (L)	Congo jute	Udo	*2
Maranthaceae			
<i>Maranthocloa cuspidata</i>	Soft cane	Etere	**1
<i>Maranthocloa leucantha</i>	Etere		**1
Meliaceae			
<i>Azadirachata indica</i> A.Juss	Neem	Ochonyeogwo	*3
<i>Khaya senegalensis</i> (Desr) A. Juss	Mahogany	Ono	*3
Mimosoideae (Mimosaceae)			
<i>Acacia sp</i>		Ahaba/Uke	**3
<i>Albizia adianthifolia</i> (Schumach)		Avu	**3
<i>Albizia ferruginea</i> (Guill & Perr.) Benth		Ngwu	**3
<i>Albizia lebbbeck</i> (L.) Benth		Avu nkirishi	***3
<i>Albizia zygia</i> (Dc.) J.F. Mahr.			**3
<i>Leucaena leucocephala</i> (Lam.)	Ipil ipil		***3
<i>Cylicodiscus gabunensis</i> Harms		Uzi	***3
<i>Parkia biglobosa</i> (Jacq) R.Br. ex. Don	African locust bean		*3
<i>Pentaclethra macrophylla</i> Benth	Oil bean	Ugba, Ukpaka	***
<i>Prosopis africana</i> (Guill. & Perr.) Taub	Iron wood		**3
<i>Tetrapleura tetraptera</i> (Schumach) Taub	Aidon tree	Oshosho	*3
Moraceae			
<i>Artocarpus communis</i> Forst	Bread fruit	Ukwa oyibo	*3
<i>Artocarpus heterophyllus</i> Lam	Jack fruit		*3
<i>Ficus asperifolia</i> (Miq)	Sand paper tree	Asisa	*3
<i>Ficus capensis</i> Thunb			**3
<i>Ficus exasperata</i> Vahl	Sand paper tree	Anwrinwa	**3
<i>Ficus ingens</i> (Miq)	Rock fig	Ogbu	***3
<i>Ficus thonningii</i> Blume			**3
<i>Milicia excelsa</i> (Welv)	African oak	Oji	***3
<i>Treculia africana</i> Decne	African bread fruit	Ukwa	***3
Moringaceae			
<i>Moringa oleifera</i> Lam	Ben oil tree	Okwe oyibo	*3
Musaceae			
<i>Musa paradisiaca</i> (L.)	Plantain	Ipa/Abirika	**2
<i>Musa sapientum</i> (L.)	Banana	Unere/Ogede	**2

Table 1e: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular names	Rating
Myrtaceae			
<i>Psidium guajava</i> (L.)	Guava	Gova	*1
Nyctaginaceae			
<i>Boerhavia diffusa</i> Linn	Hog weed		*1
Pandaceae			
<i>Microdesmis puberula</i> (Hook.f.) ex Planch	Little clusters	Mkpiri	***1
Passifloraceae			
<i>Barteria nigritiana</i> Hook.f.	Ant tree	Ukwa ofia	*1
Portulacaceae			
<i>Talinum triangulare</i> Jacq	Water leaf	Gbolongi	**3
Rubiceae			
<i>Ixora coccinea</i> (L)	Ixora		*2
<i>Mitragyna inermis</i> (Willd) Kuntze	False afara	Akpatenyi	**1
<i>Mitragyna stipulosa</i> (Dc) Kuntze	African linden	Uburu	**1
<i>Nauclea diderrichi</i> De wild & Th. Dur). Merrill	Opepe	Uburu	**1
<i>Nauclea latifolia</i> Sm	Guinea peach	Uburu-ilu	**1
Poaceae			
<i>Andropogon gayanus</i> Schum & Thonn	Gamba	Ikpoko	***2
<i>Andropogon tectorum</i> Kunth	Giant blue stem	Ikporoto	***2
<i>Anthephora ampullacea</i> Stapf e Hubbard	File grass		***1
<i>Bambusa vulgaris</i> Schrad. Wendl	Bamboo	Otoshi	*3
<i>Cymbopogon citratus</i> (Dc). Stapf. Kew	Lemon grass		*1
<i>Cynodon plectostachyus</i>	Giant star grass		**2
<i>Eleusine indica</i> (L) Gaertn	Goose grass	Ichita	*3
<i>Hyparrhenia rufa</i> (Nees) Stapf.	Jaragua/Thatching grass		***2
<i>Imperata cylindrica</i> (L). Raeush Nom	Spear grass	Ata	*3
<i>Loudetia orundinacea</i> (A.Rich) Hochst ex Steud	Big russet	Izue	*1
<i>Oxythenthera abyssinica</i> (A.Rich) Munro	Bamboo		*3
<i>Panicum maximum</i> (Jacq)	Guinea grass	Achara	***3
<i>Pennisetum polystachion</i> (L). Schult			**2
<i>Pennisetum purpureum</i> Schumach	Elephant grass	Ikpo ukwu	*2
<i>Saccharum officinarum</i> (L)	Sugar cane		*3
<i>Setaria barbata</i> (Lam) Kunth	Bristly foxtail	Ele ododo	*1
<i>Sporobolus pyramidalis</i> (Beauv)	Drop seed grass		*2
<i>Zea mays</i> (L)	Maize	Oka	***1
Rutaceae			
<i>Citrus sinensis</i> (L.) Osbeck	Sweet orange	Oroma/Epe	*3
Samydaceae			
<i>Homalium aylmeri</i> Hutch & Dalz			*1

Table 1f: Diversity of plant species used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular names	Availability/ Rating
Sapotaceae			
<i>Chrysophyllum albidum</i> G, Don	african star apple	Udara	* 2
Sterculiaceae			
<i>Cola acuminata</i> P.Beauv. Schott &Endl	Cola nut	Oji igbo	* 1
<i>Sterculia tragnacantha</i> Lindl	Sterculia	Otoko	* 1
<i>Walteria olitoris</i> Linn		Olugbuagu	*2
Tiliaceae			
<i>Corchorus olitoris</i> Linn	w. african sorrel	Krin krin	*1
<i>Glyphea brevis</i> (Spreng.) Monachino		Anyachu	**1
<i>Triumfeta cordifolia</i> A.Rich			*2
Verbanaceae			
<i>Gmelina arborea</i> Roxb	Gmelina		**3
<i>Vitex doniana</i> Sweet	Black plum	Uchakoro	*1

*** Most preferred, ** preferred, * least preferred. Availability rating : Mean scores to the nearest whole number (Key: 1 = scarce; 2 = moderately available; and 3 = easily available).

Fernandez, 1987; Onyeonagu and Asiegbo, 2006; Chah and Igbokwe, 2011). However, it is less diverse than the reports of Okoli *et al.* (2003b) and Obua (2013) of forage plants and browse plants, respectively fed to both sheep and goats in Southeastern Nigeria. In Southern Nigeria, Reynolds and Atta-Krah (1987), Orok and Duguma (1987) and Okafor and Fernandez (1987), listed 30, 44 and 27 browse species respectively for feeding small ruminants. Okoli *et al.* (2003b) and Onyeonagu and Asiegbo (2006) had listed 86 and 46 indigenous and exotic forage plants respectively utilized as primary food and fodder for sheep and goats in Southeastern Nigeria. Recently, Obua (2013) had inventoried 177 plant species distributed in 49 families in Ohaji/Egbema/Oguta area, Imo State, Southeastern Nigeria. These are indications that there is much more browse and forage resources in the region than the few highlighted by these studies.

It is noteworthy that in the present study out of 160 forage plants listed, 18 (12.25%) were grasses, 39 (24.37%) plants were legumes spread across 31 genera. The family Fabaceae (=Papilionoideae) accounted for 14.38%, the highest proportion of

forage plants, while the other legume families Caesalpinoideae and Mimosaceae formed 3.12% and 6.87% of the forage plants, respectively (Table 2). This is contrary to Chah and Igbokwe (2011), who listed only four legume species, *Calopogonum spp.*, *Leucaena spp.*, *Pentaclethra mycrophylla* and *Daniellia oliveri* fed to sheep and goats in Nsukka area. In Akwa Ibom state, Southern Nigeria Ifut *et al.* (2010) listed only four legume species, *Cajanus cajan*, *Leucaena leucocephala*, *Gliricidia sepium* and *Centrosema pubescens* and reported that legumes were least used feed (9.61%) fed to small ruminants and ascribed it to seasonal availability. Agishi (1985) had earlier identified 143 legume genera in Nigeria rangelands in which 55.0% of the browse plants were in the family Mimosaceae. Onyeonagu *et al.* (2011) had similarly reported the highest number of plants in the family Fabaceae in Nsukka area. Indeed, Chah and Igbokwe (2011) had opined on the need to extend to farmers the advantages of legumes, in grass/legume mixtures in feeding small ruminants in Nsukka area and other areas in Eastern guinea savanna of Nigeria due to the limited

Table 2: Proportion, number of species and genera of forage plants used for sheep feeding in Nsukka area of Enugu State, Nigeria.

Family	Number of genera	Number of species	Percentage of plants (%)
Acanthaceae	1	1	0.62
Amaranthaceae	2	3	1.87
Anarcadiaceae	3	3	1.87
Annonaceae	3	3	1.87
Apocyanaceae	3	3	1.87
Areaceae	2	2	1.25
Asteraceae	6	7	4.37
Bignoniaceae	1	1	0.62
Burseraceae	1	1	0.62
Caesalpinoideae	5	5	3.12
Casuarinaceae	1	1	0.62
Chrysobalanaceae	1	1	0.62

Combretaceae	2	4	2.50
Commelinaceae	2	3	1.87
Connaraceae	1	1	0.62
Convolvulaceae	1	2	1.25
Costaceae	1	1	0.62
Cucurbitaceae	1	1	0.62
Dioscoreaceae	1	1	0.62
Eurphobiaceae	12	13	8.12
Fabaceae	18	23	14.38
Guttiferae	2	2	1.25
Irvingiaceae	1	2	1.25
Lauraceae	1	1	0.62
Loganiaceae	3	5	3.12
Malvaceae	3	4	2.50
Marathaceae	1	2	1.25
Meliaceae	2	2	1.25
Mimosoideae	8	11	6.87
Moraceae	4	9	5.62
Moringaceae	1	1	0.62
Musaceae	1	2	1.25
Myrtaaceae	1	1	0.62
Nyctaginaceae	1	1	0.62
Pandaceae	1	1	0.62
Passifloraceae	1	1	0.62
Poaceae	16	18	11.25
Portulacaceae	1	1	0.62
Rubiaceae	3	5	3.12
Rutaceae	1	1	0.62
Samydaceae	1	1	0.62
Sapotaceae	1	1	0.62
Sterculiaceae	3	3	1.87

Table 2: Proportion, number of species and genera of forage plants used in feeding sheep in Nsukka area of Enugu State, Nigeria

Family	Number of genera	Number of species	Percentage of plants (%)
Tiliaceae	3	3	1.87
Verbanaceae	2	2	1.25
Total (45)	130	160	100.00

number of legumes they encountered in their study. Several other families such as Euphorbiaceae, Moraceae, Rubiaceae, Asteraceae, Loganiaceae and Combretaceae formed 8.12%, 5.62%, 3.12%, 3.12%, 3.12% and 2.50%, respectively of the forage plants identified in this study. Each of these families, Sterculiaceae, Annonaceae, Anarcadiaceae, Apocyanaceae and Tiliaceae also formed 1.87%, respectively of the plants identified in the present study (Table 2). These families are therefore

important plant families that contribute to the forage resource base of sheep in the study area. Several other families accounted for between 0.65% and 1.87% of the forage plants, an indication of their limited role in their overall contribution to the forage resource base of sheep in the area (Table 2).

The plant group with the highest diversity of species, was the trees which accounted for 49.38 % of all the species in the study area (Table 3).

Table 3: Proportion of forage plants according to plants types used in feeding sheep in Nsukka area of Enugu State, Nigeria

Type of forage	Number of plants	Percentage (%)
Tree	79	49.38
Shrub	24	15.00
Grasses	18	23.12
Herbs	37	11.25
Lianas	2	1.25
Total	160	100.00

They were followed by the herbs (23.12%) and shrubs (15.0%). The remaining plant life forms: grasses and lianas formed 11.25% and 1.25%, respectively. Broad leaved herbs include *Spigelia anthelmia*, *Ageratum coinozoides*, *Euphorbia heterophylla* and *Syndrella nodiflora*. Most grasses are grazed by livestock and grasses form the most important component in the diet of herbivores (Agishi, 1985), such as sheep, however, in this study grasses were not readily available for grazing by free ranging sheep or for feeding confined sheep. Field observations have shown that there are at least 202 forage grass species from 65 genera in Nigeria (Agishi, 1985). In the present study, grasses formed 11.25% of the plants identified, made up 18 species

and spread across 10 genera. The grass species were distributed in 7 major tribes out of 28 tribes in the family Poaceae (Table 4). The tribes, Paniceae and Andropogoneae (Sacchareae) were made up of 5 and 7 plants, and therefore contributed 27.78 and 38.89%, respectively of the forage grasses used in feeding sheep in this study. The remaining grasses were spread across the tribes, Cynodonteae, Bambuseae, Tristachyideae and Zoysieae (Table 4). Agishi (1985) had similarly reported in field observations in Nigeria, that the tribe Andropogoneae and Paniceae contributed the bulk (26 and 35%) of the total known forage grasses south of the derived savanna zone.

Table 4: Tribes of grass species fed to sheep in Nsukka Area of Enugu State, Nigeria

Family/Botanical names	Tribe
Poaceae	
<i>Andropogon gayanus</i> Schum & Thonn	Andropogoneae
<i>Andropogon tectorum</i> Kunth	Andropogoneae
<i>Anthephora ampullaceal</i> Stapf e Hubbard	Paniceae
<i>Bambusa vulgaris</i> Schrad. Wendl	Bambuseae
<i>Cymbopogon citrates</i> (Dc). Stapf. Kew	Andropogoneae
<i>Cynodon plectostachyus</i>	Cynodonteae
<i>Eleusine indica</i> (L) Gaertn	Cynodonteae
<i>Hyparrhenia rufa</i> (Nees) Stapf.	Andropogoneae
<i>Imperata cylindrica</i> (L). Raeush Nom	Andropogoneae
<i>Loudetia orundinacea</i> (A.Rich) Hochst ex Steud	Tristachyideae
<i>Oxythenthera abyssinica</i> (A.Rich) Munro	Bambuseae
<i>Panicum maximum</i> (Jacq)	Paniceae
<i>Pennisetum polystachion</i> (L). Schult	Paniceae
<i>Pennisetum purpureum</i> Schumach	Paniceae
<i>Saccharum officinarium</i> (L)	Andropogoneae
<i>Setaria barbata</i> (Lam) Kunth	Paniceae
<i>Sporobolus pyramidalis</i> (Beauv)	Zoysieae
<i>Zea mays</i> (L)	Andropogoneae
Andropogoneae (Syn =Sacchareae)	

Against the backdrop of sheep being grazers, the total contribution of grasses to the forage resource base of sheep in Nsukka area is poor. This is an indication of a narrow range of the available germplasm of grass species accessible to and used by smallholder farmers to feed their small ruminants. This really limits the overall number of grass species fed to sheep in Nsukka area. There is a need to broaden the array of grass species used in feeding sheep in other to increase the feed resource base of sheep in Nsukka area. This could be achieved by extending information on such grass species to the farmers, facilitating the use of such grass species in future.

Nsukka L.G.A of Enugu State, Southeastern Nigeria is an area on the fringe of the rain forest and typically within the derived savanna ecological zone. Okeke (1996) had reported that within the derived savanna zones in Southeastern Nigeria, the removal or opening of woodlands is a major determinant of the

amount of vegetation and the species composition. IITA (1992) and Nzegebulu (2002) had reported of a shift in plant community composition of tree and woody plant species to grass vegetation in Nsukka area, Southeastern Nigeria. However, this though truly understandable, was not reflected in the number and diversity of grass species used in feeding sheep in Nsukka area in this study.

The number of plant species used for sheep feeding in Nsukka area in this study was less than those reported by Obua (2013) in Ohaji/Egbema/Oguta meteorological area and Okoli *et al.* (2003b) in other parts of SE Nigeria. However, Chah and Igbokwe (2011) reported fewer plants in Nsukka area for sheep and goats feeding compared to the present study. The observed difference probably derives from climatic and vegetation differences between the locations (Chah and Igbokwe, 2011). Nsukka area in Enugu state is located in the Southeastern Guinea Savanna with a lower amount and shorter duration of

rainfall than Ohaji/Egbema/Oguta area in Imo State which is in the humid tropical rain forest zone of Nigeria. This probably accounted for the larger number of plant species reported in study areas in Anambra and Imo states of SE Nigeria by Okoli *et al.* (2003b) and Obua (2013) compared to the present study.

In this study, the forage plants were ranked based on the rating by the smallholder farmers on the

acceptability and preferences of the plants. The rating included three categories, least preferred, preferred and most preferred plants by sheep. The least preferred plants formed the highest proportion (52.50%) followed by the preferred (25.62%) while the most preferred formed the least proportion (21.88%) (Table 5). Similar decreasing number of forage plants has been reported for forage plants having varying degrees of preference and palatability in Mexico (Foroughbakhch, *et al.*, 2013).

Table 5: Ranking of forage plants according to preference used in feeding sheep in Nsukka area of Enugu State.

Preference rating	Number of plants	Percentage (%)
Most preferred	35	21.88
Preferred	41	25.62
Least preferred	84	52.50
Total	160	100.00

Thirty-five plants out of 160 plants were identified as much relished and therefore classified as most preferred forage plants by the small holder sheep farmers (Table 6). The families Poaceae, Fabaceae, Moraceae, Euphorbiaceae and Mimosaceae made up of 7, 5, 3, 4, and 4 species formed 20.0%, 14.28%, 8.57%, 11.43% and 11.43 % of the most preferred plants. They included *Microdesmis puberula*, *Albizia lebbek*, *Alchornea cordifolia*, *Anthocleista djalensis*, *Aspilia africana*, *Dialium guineense*, *Treculia africana*, *Pentaclethra macrophylla*, *Ficus ingens*, *Khaya senegalensis*, *Manniophyton fulvum*, *Spondias mombin*, *Magnifera indica*, *Persea americana*, *Pterocarpus santalinoides*, *Ricinodendron heudelotti*, *Baphia nitida*, *Tridax procumbens*, *Dacryodes edulis*, *Melicia excelsa*, *Leucaena leucephala*, *Alternanthera betzickiana* and *Telfaria occidentalis*. Trailing legumes such as *Calopogonium mucunoides*, *Centrosema pubescens* and herbs such as *Palisota hirsuta*, *Costus afer*, *Asystasia gangetica*, *Euphorbia heterophylla*, *Spigelia anthelmia* and grasses such as *Panicum maximum*, *Hyperhenia rufa* and *Andropogon gayanus* were also among the most preferred plants (Table 6). Similar forage plants have been reported as highly preferred in the region (Umoh and Udoh, 1993; Larbi *et al.*, 1993; Aju, 1999; Okoli *et al.*, 2003b; Oji and Kalio, 2004; Onyeonagu and Asiegbe, 2006; Ahamefule *et al.*, 2006a; Onyeonagu and Asiegbe, 2008; Onyeonagu *et al.*, 2011; Chah and Igbokwe, 2011; Obua, 2013).

The forage plants especially species in the family Poaceae were not easily available in the study area, especially during the dry season (Table 1). Onyeonagu and Asiegbe (2006) had made similar observations in Nsukka area. Most grass species were available during the months of March to November except *Saccharum officinarum*, *Cymbopogon citratus*, and *Bambusa vulgaris* which were available all year round. Decreases in the yield of grass species in Nsukka, in derived savanna zone

with advancing season when moisture stress is high had been reported (Onyeonagu and Asiegbe, 2005). An abundance of grass becomes available quickly following rains and annual burn. The availability rating of the plants based on mean scores to the nearest whole number for grasses was scarce to moderately available, except for a few species. Grasses were generally mainly available in the wet season. Trees, shrubs and lianas were moderately available to easily available all year round (Table 1). The evergreen nature of these browse plants is one of the advantages of browse plants to the feeding of sheep. The availability rating was also based on if the plant is available all year round, during the dry season or in the wet season.

Proximate evaluation of some of these plants (Mecha and Adegbola, 1980; Okoli *et al.* 2001; Okoli *et al.*, 2003a; Ahamefule *et al.*, 2006a; Ahamefule *et al.*, 2006b; Obua, *et al.*, 2012; Obua, 2014a) have yielded promising values thus highlighting the importance of indigenous empirical knowledge residing in livestock farmers (Gbejo and Van den Broek, 1996; Thorne *et al.*, 1999; Walker *et al.*, 1999; Komwihangilo *et al.*, 2007). Interestingly, their results suggested that the knowledge of fodder quality by farmers is quite consistent with the information that may be generated from laboratory analysis (Thorne *et al.*, 1999; Walker *et al.*, 1999). In several separate studies which involved preference ranking and trials of some of these plants, *Asystasia gangetica*, *Centrosema pubescens*, *Euphorbia heterophylla* (Asiedu *et al.*, 1978), *M. puberula* (Meregini, 1985; Okoli *et al.*, 2003b), *Glyphea brevis* (Umoh and Udoh, 1993; Larbi *et al.*, 1993), *Manniophyton fulvum* (Larbi *et al.*, 1993; Okoli *et al.*, 2001), *Alchornea cordifolia*, *Dialium guineense* (Kalio *et al.*, 2006;), *Spondias mombin* (Carew *et al.*, 1980; Ahamefule *et al.*, 2006a) and *Pterocarpus santalinoides* (Anyanwu *et al.*, 2011) were among the prominent most preferred browse plants.

Preferences of forage plants have been associated with succulence and dry matter (Palmer and Schlink, 1992; Kaitho *et al.*, 1996; Omokanye *et al.*, 2001; Ben Salem *et al.*, 2006), high ash (Ben Salem *et al.*, 2006; Ikhimiya, 2008), high crude protein (Bamikole *et al.*, 2001; Anyanwu *et al.*, 2001; Rogosic *et al.*, 2006) and ether extract (Louw *et al.*, 1967). Several research reports have shown that plants high in ether extract are very palatable to small ruminants (Okoli *et al.*, 2001; Obua, 2007). Factors other than nutritional composition (Kaitho *et al.*, 1997; Laca *et al.*, 2001; Ibeawuchi *et al.*, 2002; Animut *et al.*, 2005; Ahamefule *et al.*, 2006a; Babayemi, 2007) and previous experience (Provenza and Cincotta, 1994; Provenza *et al.*, 2003; Ikhimiya, 2008) were complimentary to the palatability and intake of browse plants to ruminants. Palatability of plants could depend on the stage of growth and most have greatest appeal at flowering stage (Hagstrom *et al.*, 1993). The intake of forages is influenced by plant species, form of presentation, stage of maturity, methods of processing and chemical constituents of the fodder (Kalio *et al.*, 2006). Plant species preferences by sheep and goats are influenced by specific plants available (Penning *et*

al., 1997; Odo *et al.*, 2001; Animut *et al.*, 2005). Several plants were commonly well accepted by stock in the study area (Table 1), however, the most preferred forage plants are as shown in Table 6a and Table 6b. The diversity and preferences by sheep for some plants in the study area in the present study reflects extent of knowledge of the plants by the farmers, seasonal differences, the effect of different feeding and management systems adopted by the farmers, availability of specific plant species and probably extent of utilization by the sheep. Aregheore *et al.* (2006) reported that preference is influenced by species of forage available for grazing. Obua (2013) had made similar observations in Ohaji/Egbema/Oguta area, an area within SE Nigeria as Nsukka area.

Feeding a variety of most preferred browse plants available in a locality to sheep would ensure adequate dry matter and nutrient intake from the forage and contribute to overcoming low dry matter intake, a constraint to the use of browse plants in small ruminant feeding (Obua, 2014a). In other to underline the significance of greater preference of a forage plant relative to others,

Table 6a: Most preferred forage plants fed to sheep in Nsukka Area of Enugu State, Nigeria

Family/Botanical names	Common names	Vernacular names
Acanthaceae		
<i>Asystasia gangantica</i> (Linn.) T Anders		
Amaranthaceae		
<i>Alternanthera bettzickiana</i>	Red amaranth	
Anarcadiaceae		
<i>Mangifera indica</i> (L)	Mango	Mangolo
<i>Spondias mombin</i> (L)	Hog plum	Ijikara
Burseraceae		
<i>Dacryodes edulis</i> (G.Don)	Native pear	Ube
Caesalpinaceae		
<i>Dialium guineense</i> Willd	Velvet taramind	Icheku
Commelinaceae		
<i>Palisota hirsuta</i> (Thumb.) K. Schum		Ikpere aturu
Costaceae		
<i>Costus afer</i> Ker-Gawl	Ginger lily	Okpete
Cucurbitaceae		
<i>Telfairia occidentalis</i> Hook.f.	Fluted pumpkin	Ugu
Euphorbiaceae		
<i>Alchornea cordifolia</i> (Schum & Thonn). Mull.Arg	Christmas bush	Mbubo
<i>Eurphobia heterophylla</i> L	Spurge weed	Ogbara-ohu
<i>Manniophyton fulvum</i> Mill.Arg.	Gasso nut	Egenwanu
<i>Ricinodendron heudelotti</i> Baill	African-nut wood oil	Okwe
Fabaceae (Papilionoiceae)		
<i>Arachis hypogea</i> L.	Ground nut	Opupa
<i>Baphia nitida</i> Lodd	Camwood	Aboshi
<i>Calopogonium mucunoides</i> Desv.	Calopo	Agbara/Ogbanala
<i>Centrosema pubescens</i> Benth	Centro	
<i>Pterocarpus santalinoides</i> L'Her ex Dc		Ntururopa
Lauraceae		
<i>Persea americana</i> Mill	Avacardo pear	Ube bekee

Loganiaceae		
<i>Anthocleista djalensis</i> A. Chev.	Cabbage tree	Oroghopo
<i>Spigelia anthelmia</i> (L)	Worm bush	
Mimosoideae (Mimosaceae)		
<i>Albizia lebbek</i>		Avu nkirishi
<i>Cylicodiscus gabunensis</i> Harms		Uzi
<i>Leucaena leucocephala</i> (Lam.)	Ipil ipil	
<i>Pentaclethra macrophylla</i> Benth	Oil bean	Ugba, Ukpaka

Table 6b: Most preferred forage plants fed to sheep in Nsukka Area of Enugu State, Nigeria

Family/Botanical names	Common names
Moraceae	
<i>Ficus ingens</i> (Miq)	Rock fig
<i>Milicia excelsa</i> (Welv)	African oak
<i>Treculia africana</i> Decne	African bread fruit
Pandaceae	
<i>Microdesmis puberula</i> (Hook.f.) ex Planch	Little clusters
Poaceae	
<i>Andropogon gayanus</i> Schum & Thonn	Gamba grass
<i>Andropogon tectorum</i> Kunth	Giant blue stem
<i>Anthephora ampullacea</i> Stapf e Hubbard	File grass
<i>Hyparrhenia rufa</i> (Nees) Stapf.	Thatching grass
<i>Loudetia arundinacea</i> (A.Rich) Hochst ex Steud	Big russet grass
<i>Panicum maximum</i> (Jacq)	Guinea grass
<i>Zea mays</i> (L)	Maize

Lacher *et al.* (1982) reported that when preferred browse species were available, less preferred species were either rejected or rarely consumed regardless of their abundance.

However, these differences in preference may alter depending on the adaptation of animals or large variation of their nutritional status throughout the year (Osuga *et al.*, 2008). This is because some browse species that are least preferred during periods when fodder availability is high could be relished during periods when available feeds are scarce (Osuga *et al.*, 2008). The rejection or preference of a species by an animal is closely related to the availability in the pasture. It is possible that a plant could be rejected under certain conditions but preferred under other circumstances (Foroughbakhch *et al.*, 2013).

Eighty four plants which formed the highest proportion (52.5%) of the identified plants were the least preferred plants. The preferred plants formed 25.62%, while the most preferred plants formed the least proportion (21.88%) (Table 5). This is contrary to observations made by Obua (2013) in Ohaji/Egbema/ Oguta area in Imo State, Nigeria where the preferred plants formed the highest proportion of the identified plants. However, it is consistent with the report of Obua (2013) who reported that the most preferred formed the least proportion of the identified plants. Least preferred plants are minimally consumed when several plants are presented to or are accessible to goats at the same time (Obua, 2014b). On the other hand, the least

preferred plants in favorable periods for grazing such as the rainy season are those least desired species such as *Amaranthus viridis*, *Anarcadium occidentale*, *Annona species* e.t.c (Tables 1a -1f), could become part of the sheep diet during the most critical times of the year such as the dry season when critical shortage of fodder occurs in Southern Nigeria. Foroughbakhch *et al.* (2013) had made similar observations in Mexican range lands.

Despite high nutrient concentrations, low palatability may reduce forage feeding value (Marten *et al.*, 1987). Acar *et al.* (1999) reported that although *Amaranth* species had high nutrient contents, they were not preferred by livestock. Instability of mineral matter ratios (Belesky *et al.* 2001) and some secondary phenolic components (Barry, 1998) may reduce palatability and affect preference.

Throughout the year, the consumption of these feed resources differs according to several factors such as forage availability and accessibility, plant phenological stage (Moore and Jung 2001), plant content in anti-nutritional or toxic compounds (Bryant *et al.*, 1992), the physical defences of plant itself, animals' species and breed, and the nutritional and physiological state of the animals.

In Southeastern Nigeria, the degree of compound farming limits diversity of plant species available for small ruminant feeding (Meregini, 1999). Recently, dwindling proceeds of browse feed resource for ruminant livestock have been ascribed to deforestation, urbanization, bush burning and activities of Fulani pastoralists (Ahamefule *et al.*,

2006b; Okoli *et al.*, 2014) and are in danger of extinction due to overuse (Mtengeti and Mhelela, 2006).

The diversity of the forage plants used in feeding sheep in the present study is largely comparable with the diverse forage crops reported in the area (Mecha and Adegbola, 1980; Okeke, 1996; Okoli *et al.*, 2003b; Ahamefule *et al.*, 2006b; Onyeonagu and Asiegbu, 2006; Onyeonagu and Asiegbu, 2008; Onyeonagu *et al.*, 2011; Chah and Igbokwe, 2011; Obua, 2013). Osuga *et al.* (2008) had observed that having a variety of browse plants in farming systems will ensure year-round availability of fodder for increased animal productivity. Recently, it has been advocated to select candidate indigenous browse plants for possible domestication in SE Nigeria (Okoli *et al.*, 2014). This would serve as *in-situ* conservation strategy to provide forage during the off season, contributing to ensuring feed availability all year round.

CONCLUSION

There is a wide variety of forage plants utilized as forage for sheep in Nsukka area, Enugu State of Southeastern Nigeria. It is noteworthy that in the present study out of 160 forage plants listed, 18 (11.25%) were grasses, 39 (24.37%) plants were legumes spread across 31 genera. The family Fabaceae (=Papilionoideae) accounted for 14.38%, the highest proportion of forage plants, while the other legume families Caesalpinaceae and Mimosaceae formed 3.12% and 6.87% of the forage plants, respectively. Several other families such as Euphorbiaceae, Moraceae, Rubiaceae, Asteraceae, Loganiaceae and Combretaceae formed 8.12%, 5.62%, 3.12%, 3.12% and 2.50%, respectively of the forage plants identified in this study. They were the major plant families that contribute to the forage resource base of sheep. The plant group with the highest diversity of species, was the trees which accounted for 49.38 % of all the species in the study area, followed by the herbs (23.12%) and shrubs (15.0%). The remaining plant life forms: grasses and lianas formed 11.25% and 1.25%, respectively.

REFERENCES

- Acar, Z., Sancak, C., and Genç, N. (1999). Amaranth (*Amaranthus* spp.). *Turkish-Coop. Ekin J.* 8: 71-74.
- Agishi, E.C. (1985). Forage resources of Nigerian rangelands. In: *Small Ruminant Production in Nigeria*. Proceedings of National Conference on Small Ruminant Production, 6th -10th October, 1985, Zaria, Nigeria. Pp. 115-140.
- Ahamefule, F.O., Ibeawuchi, J.A. and Agu, C.I. (2006a). Comparative evaluation of some forages offered to goats in Umudike Southeastern Nigeria. *Journal of Sustainable Tropical Agricultural Research* 18: 79-86.
- Ahamefule, F.O., Obua, B.E., Ibeawuchi, J.A. and Udosen, N.R. (2006b). Nutritive value of some plants browsed by cattle in Umudike, Southeastern Nigeria. *Pakistan Journal of Nutrition* 5(5): 404-409.
- Aigbokhan, E.I. (2014). *Annotated Checklist of Vascular Plants of Southern Nigeria - a quick reference guide to the Vascular Plants of Southern Nigeria: a systematic approach*. Uniben Press, Benin City. 346p.
- Aju, P.C. (1999). Determination of the uses of fallow and on farm tree/shrubs and farm practices in Imo State, Nigeria. MSc Thesis, University of Ibadan, Nigeria.
- Animut, G., Goettsch, A.L., Aiken, G.E., Puchala, R., Detweiler, G., Krehbel, C.R., Merkel, R.C., Sahl, T., Dawson, I.J. Johnson, Z.B., Gipson, T.A. (2005). Performance and forage selectivity by sheep and goats co-grazing grass/forb pastures at three stocking rates. *Small Ruminant Research* 59: 203 -215.
- Anyanwu, N.J., Oji, U.I. and Anegebeh, P.O. (2001). Voluntary feed intake and dry matter digestibility of indigenous browse species among sheep and goats in the humid zone of Southeastern Nigeria. *Proceedings 6th Annual Conference of Animal Science Association of Nigeria*, September, 2001, Maiduguri, Nigeria. pp. 145-147.
- Anyanwu, N.J., Etela, I. and Anegebeh, P.O. (2011). Voluntary feed intake and dry matter digestibility of three acid-tolerant multipurpose tree species by West African Dwarf sheep. *Proceedings of the 36th Annual Conference of the Nigerian Society for Animal Production*, Abuja, Nigeria, pp: 516-518.
- Aregheore, E. M., Ali, I., Ofori, K. and Tiria, R. (2006). Studies on grazing behavior of goats in the Cook Islands: The animal-plant complex in forage preference/palatability phenomena. *International Journal of Agriculture and Biology*, 8(2): 147 – 153.
- Asiedu, F.H.K., Oppong, E.N.W. and Opoku, A.A. (1978). Utilization by sheep of herbage under tree crops in Ghana. *Tropical Animal Health and Production* 10: 1 - 10.
- Babayemi, O. J. (2007). In vitro fermentation characteristics and acceptability by West African Dwarf goats of some dry season forages. *African Journal of Biotechnology*, 6(10): 1260 - 1265.
- Bamikole, M.A., Ikhatua, U.J., Babayemi, O.J., Arigbede, O.M. Etela, I. and Osajie, P. (2001). Assessment of forage acceptability, some nutritive and anti-nutritive components of *Ficus* species in Benin, Nigeria. *Proceedings of the 26th Annual Conference of the Nigerian Society of Animal Production*, Zaria, Nigeria, pp. 310-313.

- Barry, T.N. 1998. The feeding value of chicory (*Cichorium intybus*) for ruminant livestock. *Journal of Agricultural Science* 131: 251-257.
- Bartolome, J., Franch, J., Plaixats, J. and Seligman, N.J. (1998). Diet selection between sheep and goats on Mediterranean heathwoodland range. *Journal of Range Management* 51: 383 – 391.
- Bayer, W. 1990. Use of native browse by Fulani cattle in central Nigeria. *Agroforestry Systems* 12: 217-228.
- Belesky, D.P., Turner, K.E., Fedders, J.M. and Ruckle, J.M. (2001). Mineral composition of swards containing forage chicory. *Agron. J.* 93: 468-775.
- Ben Salem, H., Nefzaoui, A. and Ben Salem, L. (2006). Sheep and goat preferences for Mediterranean fodder shrubs. Relationship with the nutritive characteristics. *Cahiers Options Mediterraneennes* 52: 155 - 159.
- Briggs, J., Badri, M. and Mekki, A.M. (1999). Indigenous knowledges and vegetation use among Bedoins in the eastern desert of Egypt. *Appl. Geog.* 19: 87-103.
- Bryant, J.P., Reichardt, P.B. and Clausen, T. P. (1992). Chemically mediated interactions between woody plants and browsing mammals. *Journal of Range Management* 45 (1): 18-24.
- Carew, B.A.R., Mosi, A.K., Mba, A.U. and Egbunike, G.N. (1980). The potential of browse plants in the nutrition of small ruminant in the humid forest and savanna zones of Nigeria. In: *Browse in Africa: The current state of knowledge*. Le-Houerou, H.N. (Ed.). ILCA, Addis Ababa, Ethiopia Pp. 307-312.
- Castro, M. and Fernandez-Nunez, E. (2016). Seasonal grazing of goats and sheep on Mediterranean mountain rangelands of Northeast Portugal. *Livestock Research for Rural Development*, Volume 28, Article#91. Retrieved March 16, 2017, from <http://www.lrrd.org/lrrd/28/5/cast28091.html>.
- Chah, J. M. and Igbokwe, E. M. (2011). Plants used for small ruminant nutrition in eastern Guinea savanna region of Nigeria. *Livestock Research for Rural Development*, 23(8). Article #173 <http://www.cipav.org.co/lrrd/lrrd23/8/chah23173.htm>. Retrieved 8th January, 2013.
- Ebere, C.S. (2000). Studies on the diversity, ethno-veterinary uses and nutrient composition of plants used for ruminant feeding in Southeastern Nigeria. B. Agricultural Technology (Animal Science) Project report, Federal University of Technology, Owerri, Nigeria.
- FGN (Federal Government of Nigeria) (2002). National Assessment Report on sustainable development in Nigeria. Ten years after Rio (UNICED). World summit in Sustainable Development. Abuja. Government Press, 2002.
- Foroughbakhch, R., Hernández-Piñero, J.L., Carrillo-Parra, A. and Rocha-Estrada, A (2013). Composition and animal preference for plants used for goat feeding in semiarid Northeastern Mexico. *The Journal of Animal and Plant Sciences* 23(4): 1034 – 1040.
- FRN (2009). Official gazette No 2 Abuja, 2nd February, 2009, Vol. 96. Legal notice on Publication of 2006 Census, Final results. Federal Government of Nigeria Printer, Abuja, Nigeria.
- Gbego, I.J. and Van den Broek, A. (1996). Rapid appraisal and in Depth tropical surveys in participatory diagnostic research on small ruminant systems: Southern Benin. In: *Focusing Livestock System Research* In: Reoleveld, A.C.W. and Van den Broek, A. (Eds.). Royal Tropical Institute, KIT Press, Amsterdam, Netherlands.
- Hagstrom, K., Christiansen, M.L. and Cleveland, E.R. (1993). Plants in Hawaii that are eaten by goats. *J. Haw. Pac. Agric.* 4: 101 – 05.
- Ibeawuchi, J.A., Ahamefule, F.O. and Oche, J.E. (2002). An assessment of the nutritive value of browse plants in Makurdi, Nigeria. *Nigerian Agricultural Journal* 33: 128-135.
- Ifut, O. J., Inyang, U.A. and Ogiribo, O.A. (2010). Feeds and feeding stuffs fed small ruminants in Akwa Ibom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment* 6(3&4): 25 -28.
- IITA International Institute of Tropical Agriculture (1992). Sustainable food production in sub-Saharan Africa 1. IITA's contributions, IITA Ibadan, Nigeria. Pp.208.
- Ikhimioya, I. (2008). Acceptability of selected common shrubs /tree leaves in Nigeria by West African Dwarf goats. *Livestock Research for Rural Development* Volume 20, Art #90. Retrieved March 16, 2017 from <http://www.lrrd.org/lrrd20/6/Ikhi.20090.htm>.
- Kaitho, R.J., Umunna, N.N., Nsahlai, I.V., Tamminga, S., Van Bruchem, J. and Hanson, J. (1997). Palatability of wilted and dried multipurpose tree species fed to sheep and goats. *Animal Feed Science and Technology* 65: 151-163.
- Kalio, G.A., Oji, U.I. and Larbi, A. (2006). Preference and palatability of indigenous and exotic acid-soil tolerant multipurpose trees and shrubs by West African Dwarf sheep. *Agroforestry Systems* 67: 123-128.
- Komwihangilo, D. M., Lekule, F. P., Kajembe, G. C., Mgheni, D. M. and Peterson, P. H. (2007). Implications of local knowledge in the utilization of forage resources in mixed livestock systems of Eastern Tanzania.

- International Journal of Agricultural Sustainability 5(4): 269 - 279.
- Laca, E.A., Shipley, L.A. and Reid, E.D. (2001). Structural anti-quality characteristics of range and pasture plants. *Journal of Range Management* 54: 413-419.
- Lacher, T.E., Willing, M.R. and Mares, M.A. (1982). Food preference as a function of resource abundance with multiple prey types: an experimental analysis of optimal foraging theory. *The American Naturalist* 120: 297 - 314.
- Larbi, A., Jabber, M.A., Orok, E.J., Idiong, N.B. and Cobbina, J. (1993). *Alchornea cordifolia*, a promising indigenous browse species adapted to acid soils in southeastern Nigeria for integrated crop-livestock agroforestry production systems. *Agroforestry Systems* 22(1): 33-41.
- Louw, G.N., Steenkamp, C.W.P. and Steenkamp, E.L. (1967). Diet verwantstkap tussen die eterekstrakinhoud van karoobossies en hul smackliheid vir skape S. Afr. Tydsk. Landbouwet, 10; 867-873.
- Marten, G.C., C.C. Sheaffer and D.L. Wyse. 1987. Forage nutritive value and palatability of perennial weeds. *Agronomy Journal* 79: 980-986.
- Mecha, I. and Adegbola, T.A. (1980). Chemical composition of southern Nigerian forages eaten by goats. In: *Browse in Africa: The current state of knowledge*. Le-Houerou, H.N. (Ed.). ILCA, Addis Ababa, Ethiopia Pp. 303-306.
- Meregini, A.O. (1985). *Microdesmis* and other fodder plants for rearing goats in parts of Imo state, Nigeria. *Proceedings of Annual Conference of the Ecological Society of Nigeria (Ecosan)*, 3rd -5th May, 1985, Port-Harcourt, Nigeria.9: 111-119.
- Meregini, A.O. (1999). Plant species in compound farms in selected communities in southeastern Nigeria. *Journal of Sustainable Agriculture and the Environment* 1(1): 61-67.
- Moore, K. J. and Jung, H. J. G. (2001). Lignin and fiber digestion. *Journal of Range Management* 54: 420-430.
- Mtengeti, E.J. and Mhelela, A. (2006). Screening of potential indigenous browse species in semi-arid central Tanzania. A case of Gairo division, *Livestock Research for Rural Development* 18(8):<http://www.cipav.org.co/lrrd/lrrd18/8/mt.en.188.htm>.
- Ngwa, A.T., Pone, D.K. and Mafeni, J.M. (2000). Feed selection and dietary preferences of forage by small ruminants grazing natural pastures in the Sahelian zone of Cameroon. *Animal Feed Science and Technology* 88: 253 -266.
- Njoku, J.D. (2006). Analysis of the effects of global warming on the forest cover of southeastern Nigeria, using remotely sensed data. Ph.D Thesis, Imo State University, Owerri, Nigeria.
- Njoku, J.D. (2009). Temperature anomaly and responses by rain forest cover: Potential Implications for food availability in S.E. Nigeria. *Proceedings of International Conference on Global Food Crisis: The way forward*. Federal University of Technology, Owerri, Nigeria.
- Nzegbule, E.C. (2002). Contemporary environmental issues with respect to food production. In: *Perspectives on food security in Eastern Nigeria*. Nwajiuba, C. (ed.). Farming and Rural systems Economics (Werner Doppler and Siegfried Bauer (Eds.). Margraf verlag. Kanalstr. Weikersheim, Germany. 46: 69 -78.
- Obua, B.E. (2007). Utilization of selected browse plants by West African dwarf goats in Southeastern Nigeria. Ph.D Dissertation, Michael Okpara University of Agriculture, Umudike, Nigeria. pp. 335
- Obua, B.E. (2008). Feed resources management of smallholder sheep and goat producers in Imo and Enugu states of Southeastern Nigeria. *Animal Production Research Advances* 4(3&4): 201 - 205.
- Obua, B.E. (2013). Survey of the diversity of browse plants utilized for goat feeding in Ohaji/Egbema/Oguta area of Imo State Nigeria. *International Journal of Tropical Agriculture and Food Systems* 7 (1): 54 – 66.
- Obua, B.E. (2014a). Survey of the diversity and proximate composition of selected most preferred browse plants utilized for goat feeding in humid Southeastern Nigeria. *International Journal of Agriculture and Rural Development* 17 (3): 1947 – 1958.
- Obua, B.E. (2014b). Assessment of nutritive value of selected least preferred browse plants by goats in Ohaji/Egbema/Oguta agro meteorological zone of Southeastern Nigeria. *Journal of Sustainable Agriculture and the Environment* 15 (2): 232 -246.
- Obua, B.E., Okocha, C.N. and Nwaoha, L.E. (2012). Proximate composition and anti-nutritional factors of some forage species used in feeding rabbits in Umudike, humid Southeastern Nigeria. *International Journal of Agriculture and Rural Development* 15(3): 1275 - 1286.
- Odo, B.I., Omeje, F.U. and Okwor, J.N. (2001). Forage species availability, food preference and grazing behaviour of goats in Southeastern Nigeria. *Small Ruminant Research* 42: 163 – 168.
- Ofomata, G.E.K. (1975). *Nigeria in maps*, Eastern states Ethiope Publishing House, Benin City, Nigeria. Pp.52.

- Oji, U.I. and Kalio, G.A. (2004). Dry matter degradation characteristics and preference of acid tolerant multipurpose fodder trees by West African Dwarf sheep. Proceedings 9th Annual Conference of Animal Science Association of Nigeria, September 13th-16th, 2004, Abakiliki, Nigeria. Pp. 126-129.
- Okafor, J.C. and Fernandez, E.C. (1987). Compound farms of Southeastern Nigeria: A predominant Agroforestry Home gardens system with small livestock. *Agroforestry Systems* 5:153-168.
- Okeke, A.I. (1996). The distribution of browse plants in Southeastern Nigeria and the management of selected species in agroforestry ecosystems. Ph.D Thesis, University of Nigeria, Nsukka, Nigeria.
- Okigbo, B.N. (1980). Plants and foods in Igbo culture. Ahiajoku Lecture, 28th November, 1980. Imo State Government Press, Owerri.
- Okoli, I.C., Anunobi, M.O., Obua, B.E. and Enemu, V. (2003a). Studies on selected browses of Southeastern Nigeria with particular reference to their proximate and some endogenous anti-nutritional constituents. *Livestock Research for Rural Development* 15(9): <http://www.cipav.org.co/lrrd/lrrd15/9/okol159.htm>. Accessed 30th December, 2013.
- Okoli, I.C., Ebere, C.S., Emenalom, O.O., Uchegbu, M.C. and Esonu, B.O. (2001). Indigenous livestock paradigms revisited. 11: Assessment of proximate value of most preferred indigenous browses of southeastern Nigeria. *Tropical Animal Production Investigation* 4(2): 99-107.
- Okoli, I.C., Ebere, C.S., Uchegbu, M.C., Udah, C.A. and Ibeawuchi, I.I. (2003b). Survey of diversity of plants utilized for feeding small ruminant feeding in Southeastern Nigeria. *Agriculture, Ecosystem and Environment* 96: 147-154.
- Okoli, I. C., Enyinnia, N. C., Elijah, A.G., Omede, A.A. and Unamba-Opara, C.I. (2012). Animal reproductive management practices of Fulani pastoralists in the humid rainforest of Imo State, Nigeria. *Journal of Animal Science Advances* 2(2): 221 -225.
- Okoli, I.C., Ogundu, E.C., Achonwa, C.C., Obichili, E., Kubkomawa, H.I. and Okoli, C.G. (2014). Selection of candidate indigenous browse plants for domestication in the rain forest zone of Southeastern Nigeria. *International Journal of Agriculture, Forestry and Fisheries* 2(5): 73 -80.
- Omokanye, A.T., Balogun, R.O., Awemu, E., Afolayan, R.A., Olayemi, M.E. and Onifade, O.S. (2001). Crude protein content, preferences and short term intake of nine herbaceous legumes by adult Yankasa sheep. *Proceedings of Nigerian Society for Animal Production* 26: 297-300.
- Omphile, U.J., Aganga, A.A., and Malamba, M. (2003). Diets and forage preference of goats in an Acacia bush savanna in Southeast Botswana. Eds. Allsopp, N., Palmer, A.R., Milton, S.J., Kirkland, K.P., Kerley, G.I.H., Hurt, C.H. and Brown, C.J. Proceedings VII th Int. Rangelands Congress. 26th July – 1st August, 2003, Durban, South Africa.
- Onyeonagu, C.C. and Asiegbu, J.E. (2005). Herbage leaf to stem ratio and yield distribution over time as influenced by cutting frequency and N-fertilizer application in an old run-down *Panicum maximum* pasture. *Journal of Agriculture, Food, Environment and Extension* 4(1): 74 -77.
- Onyeonagu, C.C. and Asiegbu, J.E. (2006). Frequency of collection, distance from source of collection, seasonality and preference rating of identified forage species in Nsukka rural communities of Enugu State, Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension* 5(2): 33-39.
- Onyeonagu, C.C. and Asiegbu, J.E. (2008). Estimation of availability and distribution of browse species and number of small ruminant animals among farmers in selected communities of Nsukka area of Enugu state. *Nigerian Journal of Animal Production* 35(2): 252-258.
- Onyeonagu, C.C., Asiegbu, J.E., Nweke, A.R. and Akagha, C.S. (2011). Multiple uses of forage species, estimation of availability and distribution of grass species and effect of location on the crude fibre and ash contents of common browse species in Nsukka, Nigeria. *Nigerian Journal of Animal Production* 38(1):116-124.
- Orok, E.J. and Duguma, B. (1987) Sheep and Goat Production in Southeastern Nigeria. In: Browse and Small ruminant Production. Reynolds, I. and Atta-krah, H.N. (Eds.). Proceedings of a symposium, ILCA humid zone programme, Ibadan, Nigeria.
- Osuga, I.M., Wambui, C.C., Abdulrazak, S.A., Ichiohe, T. and Fujihara, T. (2008). Evaluation of nutritive value and palatability by goats and sheep of selected browse foliage from semi-arid area of Kenya. *Animal Science Journal* 79: 582-589.
- Palmer, B. and Schlink, A. C. (1992). The effect of drying on the intake and the rate of digestion of the shrub legume *Calliandra calothyrsus*. *Tropical Grassland* 26: 89 - 93.
- Penning, P.D., Newman, J.A., Parsons, A.J., Harvey, A., Orr, R.J. (1997). Diet preferences of adult sheep and goats grazing ryegrass and white clover. *Small Ruminant Research* 24: 175 – 184.

- Provenza, F. D. and Cinacotta, R. P. (1994). Foraging as a self-organizational learning process: Accepting adaptability at the expense of predictability. In: Hughes, R. N. (Ed.), Diet selection. Blackwell Scientific Publication, Oxford, pp. 79 - 101.
- Provenza, F. D., Villalba, J. J. and Dziba, L. E. (2003). Linking herbivore experience, varied diets and plant biochemical diversity. *Small Ruminant Research*, 49(3): 257 - 274.
- Reynolds, L. and Atta-krah, A.N. (1987). Browse use and small ruminant production in southeastern Nigeria. In: Browse and Small ruminant Production. Reynolds, L. and Atta-Krah, A.N. (Eds.). Proceedings of a symposium, ILCA humid zone programme, Ibadan, Nigeria.
- Rogosic, J.B., Pfister, J.A., Provenza, F.D. and Grbesa, D. (2006). Sheep and goats preference for and nutritional value of Mediterranean marquis shrubs. *Small Ruminant Research* 64: 169 - 179.
- Stanfield, D.P. (1970). The flora of Nigeria grasses, Ibadan University Press, pp. 118.
- Thorne, P. J., Subba, D. B., Walker, D. H., Thapa, B., Wood, C. D. and Sinclair, F. L. (1999). The basis of indigenous knowledge of tree fodder quality and its implications for improving the use of tree fodder in developing countries. *Animal Feed Science and Technology* 81: 119 - 131.
- Umoh, B.I. and Udoh, U.J. (1993). Plant preferences for goats. Book of Abstracts, 18th Annual Conference of Nigerian Society for Animal Production, Federal University of Technology, Owerri, Nigeria, 21st -26th March, 1993, pp.103.
- Valderrabano, J., Munoz, F. and Delgado, I. (1996). Browsing ability and utilization by sheep and goats of *Altriplex halimus* L shrub. *Small Ruminant Research* 19: 131 – 136.
- Walker, D.H., Thorne, P.J., Sinclair, F.L., Thapa, B., Wood, C.D. and Subba, D.B. (1999). A systems approach to comparing indigenous and scientific knowledge: Consistency and discriminatory power of indigenous and laboratory assessment of the nutritive value of tree fodder. *Agriculture System* 62:87-103.