Major Sources of Plant Fodder Species of South East Nigeria, Associated Livestock, Percentage Preferences, a Few Physiognomic Attributes and Potential New Sources

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ABSTRACT

Sixty (60) species of plant fodder belonging to 34 families were utilized in this study. Goat, sheep and rabbits were the experimental livestock. For a period of one year, each species was offered to the animals first thing in the morning. Attitude (reaction) of each animal to each plant species were observed and recorded. Observations revealed that most species were acceptable on a daily bases. Most species were completely consumed ravenously: (Persea, Gmelina, Zea, Ficus, Ricinodendron, Vernonia, Colocasia, Elacis). Others were consumed more reluctantly but consumed nevertheless (Cola, Cocos, Treculia, Mangitena, Psidicem, Banbusa); In some cases, the fruits were preferred to the leaves (Citrus, Carica, Treculia, Dacryodes, Dioscorea, Mangifera, Arachis, Abelmoscus, Musa). In others, leaves were preferred to fruits (Dialum, Milicia, Pterocarpus, Elaeis, Capsicum, Telfairia). The goats fed more voraciously than others. The rabbits preferred tender and softer food (Daucus, Tridox, Setaria, Bambusa, Ipomoea, Andropogon, Vernonia, Zea (*et cetera*). Most species were evergreen perennials, therefore food was available all year round. Potential new sources of fodder were also suggested (Ceiba, Spondias, Vitex, Justicia, Duranta, Mariscus). Waste products of harvest and discarded peels and rinds of foodstuff were also taken into consideration.

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INTRODUCTION

More than two-thirds of the estimated World population of goats (391 million) are found in the tropics and sub-tropics (FAO, 1973). The most important Centres for goat-keeping are in Africa where in certain countries (Niger, Mauritania and Somalia) more than one goat is kept per person (FAO, 1973). There are 224 million goats in Nigeria and this is exceeded only by India with a goat population of 69.2 million (FAO, 1973). Moreover, the FAO (1966) found that goats provided over 25% of total lean meat consumed in Nigeria between 1963 and 1964. Many forest tree species provide fodder for livestock production, especially during the dry season when livestock feed becomes scarce and is of poor nutritional quality. Thus, availability of tree fodder enhances the productivity of livestock as well as of wild game. Since these animals contribute to human food supply, forest tree species contribute indirectly through them to human nutrition. Apart

from the destruction of farms by livestock, herdsmen lop branches of trees conserved on farmland to provide fodder for their livestock. As fodder resources dwindle, wild game migrate to other areas where they can have access to sources of food supply. Consequently deforestation results in shortage of fodder supply and is detrimental to sustainable livestock and wildlife management (Otegbeye and Onyeausi, 2006). The grazing pressure has been increasing with the increase in human and livestock populations. Consequently, uncontrolled heavy grazing is causing great damage to soil and vegetation due to compaction and trampling. This creates gaps in the forest and retrogression in certain localities. Local people use trees, shrubs, and herbs as fodder for their livestock. Primarily, the members of the family Poaceae are used as fodder in both fresh and dry forms throughout the year (Abbasi *et al.*, 2012).

In modern times with the harsh economic realities globally, global inflation, glut in crude oil prices; for countries like

Nigeria, Agriculture is regaining prominence and sources of livestock food that will neither compete with nor drain man's already overstretched food sources is a very welcome idea. Even plant sources hitherto labelled unwanted, together with Agricultural /food wastes (plant leaves, stalks, glumes, fruit pericarp, rinds, tuber peelings, herbaceous stems, food fibre, end products of plant food processing) have become very important and in much demand these days. This justifies continuous research in this area. As established plant food sources are documented, potential sources of likely new sources of plant fodder will be exploited, to accumulate a broad based inexhaustible, renewable livestock food base that will ensure long term sustainability in this respect.

MATERIALS AND METHODS

This Research work was carried out in Nnokwa, Idemili South Local Government Area of Anambra State. Firstly a long shed was built for the animals (a fundamental requirement for shelter, if they most thrive). Several goats

(billy, nanny and maturing kids); several sheep (local ram, sheep and young); and many rabbits (all white, all black and mixed colouration). They were positioned separately, with the rabbits in their cages (males and females). Each morning, they were given a different fodder species and their feeding observed. These observations were recorded. The ones they savoured were retained while the ones they disliked were removed immediately. Water was served twice daily. The shed and cages were swept out, first thing in the morning and last thing in the night. Ash and used motor oil were sprinkled round the shed to prevent ant infestation. It took a period of one year to observe their preference for particular fodder species. The fodder were tied to stakes for easy accessibility/consumption by the goats and sheep. Baskets were also used. That of the rabbits were placed inside the cages. Bits of human food and leftover food were also given at intervals. Pregnant ones were sheltered separately and mature offsprings were sold in the market. Other materials used included: Machetes, stakes, generator, torch light, rafters and calabashes, disinfectants, brooms, bowls, pans et cetera (Akobundu and Agyakwa, 1998; Nyananyo, 2006).

RESULT AND DISCUSSION

Results obtained from the study was presented in Table 1, 2 and 3.

Table 1: Major sources of plant fodder species of South East Nigeria and Associated Livestock.

S/N	LOCAL NAME	COMMON NAME	SCIENTIFIC NAME	PART EATEN	GOAT	CONSUMER SHEEP	RABBIT	OTHERS
1	Ogbu (tree)		<i>Ficus elasticoides</i>	leaf	✓	✓		
2	Okwe	Nut tree	<i>Ricinodendron heudeloti</i>	✓	✓	✓		
3	Nkwu	Oil palm	<i>Elaeis guineensis</i>	Leaf pericarp, kernel	✓	✓		
4	Ube oyibo	English pear	<i>Persea americana</i>	Leaf, seed, pericarp (fruit)	✓	✓	✓	
5	Ube Igbo	Local pear	<i>Dacryodes edulis</i>	Leaf, fruit, seed	✓	✓		
6	Ji (Stem tuber)	Yam	<i>Dioscoreae species</i>	Tuber peel (rind)	✓	✓		
7	Ede (root tuber)	Cocoyam	<i>Colocasia esculenta</i>	Tuber, peel (rind)	✓	✓		
8	Unere (Giant forb)	Banana	<i>Musa sapientum</i>	Leaf, fruit, peel	✓	✓		Fowl
9	Ogede/ojoko (giant forb)	Plantain	<i>Musa paradisiaca</i>	Leaf, fruit, peel	✓	✓	✓	Fowl
10	Oka	Maize	<i>Zea mays</i>	Entire plant	✓	✓		
11	Mangoro	Mango	<i>Mangifera indica</i>	Leaf, fruit	✓	✓		
12	Gova	Guava	<i>Psidium guajava</i>	Leaf, fruit, seed	✓	✓		
13	Akpu (shrub)	Cassava	<i>Manihot esaulentus</i>	Leaf (preferable dried) tuber	✓	✓		
14	Ugiri	Bushmango	<i>Irvingia gabonensis</i>	Leaf, fruit	✓	✓		
15		Gmelina	<i>Gmelina arborea</i>	Leaf	✓	✓		
16	Icheku	Velvet tamarind	<i>Dialum guinesense</i>	Leaf fruit pulp	✓	✓		
17	Orji	Iroko	<i>Milicia excelsa</i>	leaf	✓	✓		
18	Oji	Kola	<i>Cola nitida, cola acuminata</i>	Leaf seed (preferably dried)	✓	✓		
19	Akuoyibo	Coconut	<i>Cocos nucifera</i>	Leaf, kernel	✓	✓		
20	Oha		<i>Pterocarpus soyauxii</i>	leaf	✓	✓		
21	Udara		<i>Chrysophyllum albidum</i>	Leaf, fruit	✓	✓		
22	Ukwa	African breadfruit	<i>Treculia africana</i>	Leaf, fruit	✓	✓		
23	Uturu		<i>Nauclea diderichi</i>	Leaf fruit	✓	✓		

Table 1: (Continued)

S/N	LOCAL NAME	COMMON NAME	SCIENTIFIC NAME	PART EATEN	GOAT	CONSUMER SHEEP	RABBIT	OTHERS
24	Ahaba		<i>Dactydenia barteri</i>	leaf	✓	✓		
25	Okwurubekee	pawpaw	<i>Carica papaya</i>	Leaf fruit seed	✓	✓		Snail fowl
26		Soursop	<i>Annona muricata</i>	Fruit	✓	✓		
27	Oroma	Orange	<i>Citrus species</i>	Leaf, fruit, seed	✓	✓		
28	Achara (shrub)	Bamboo	<i>Bambusa vulgaris</i>	Leaf	✓	✓		
29		Elephant Grass	<i>Pennisetum purpureum</i>	Leaf	✓	✓		
30		Gamba grass	<i>Andropogon tectorum</i>	Leaf	✓	✓		
31		Guiffinea grass	<i>Panicum maximum</i>	Leaf	✓	✓		
32		Rice	<i>Oryza sativa</i>	Entire plant	✓	✓		
33			<i>Eleusine indica</i>	Leaf	✓	✓		
34			<i>Setaria barbata</i>	leaf	✓	✓	✓	fowl
35			<i>Dactyloctenium aegyptium</i>	Leaf inflorescence	✓	✓		
36		Bahama grass	<i>Cynodon dactylon</i>	leaf	✓	✓		
37		Ginger lily	<i>Costusafer</i>	Leaf	✓	✓		
38		Carrot (stem tuber)	<i>Daucuscarota</i>	Fruit & accessories	✓	✓	✓	
39	Akidi	Climber	<i>Phaseolus vulgaris</i>		✓	✓		
40	Viovio shrub		<i>Cajanus cajan</i>		✓	✓		
41	Anara shrub	Eggplant	<i>Solanum melangena</i>	Leaf, fruit	✓	✓		
42	Ose shrub	Pepper	<i>Capsicum annum</i>	Leaf, fruit	✓	✓		
43	Onugbu shrub		<i>Vernonia amygdalina</i>	leaf	✓	✓		
44	Shrub		<i>Ixora coccinea</i>	leaf	✓	✓		
45	Shrub		<i>Aspilina africana</i>	leaf	✓	✓	✓	
46	Shrub	Groundnut	<i>Arachis hypogea</i>	Entire lea, fruit plant	✓	✓		
47	Shrub	Pineapple	<i>Ananas comosus</i>	fruit	✓	✓		
48	Inine(forb)		<i>Amaranthus species</i>	Leaf stem	✓	✓		
49	Ahihia(forb)		<i>Cochorus olitorius</i>	Leaf stem	✓	✓		
50	Forb		<i>Tridax procumbens</i>	Leaf	✓	✓	✓	Fowl
51	Egwusi shrub melon		<i>Cucumeropsis manii</i>	Whole fruit	✓	✓		
52	Ugu climber		<i>Telfairia occidentalis</i>	Lea, seed	✓	✓		
53	Shrub		<i>Hibiscus rosinensis</i>	Leaf	✓	✓		
54	Runner		<i>Ipomoea species</i>	Leaf, tuber	✓	✓	✓	
55	Forn		<i>Alternanthera species</i>	Leaf, stem	✓	✓	✓	
56	Climber		<i>Desmodium scorpiurus</i>	Leaf stem	✓	✓	✓	
57	Shrub	Beans	<i>Vigna unguiculata</i>	Entire plant	✓	✓		
58	Shrub	Broomweed	<i>Sida species</i>	Leaf	✓	✓		
59		Water leaf	<i>Talinum triangulare</i>	Entire plant	✓	✓	✓	
60		Okro	<i>Abelmoscus esculentus</i>	Fruit	✓	✓		
61	Sugar cane	Cane sugar	<i>Saccharum officinarum</i>	Leaf, stem	✓	✓	✓	
62	Ukpodu		<i>Napoleana imperialis</i>	Leaf, stem	✓	✓		
63	ububo		<i>Alchornea cordifolia</i>	Leaf, stem	✓	✓		
64			<i>Terminalia catappa</i>	Fruit tree				

From Table 1 above, one very significant feature of all the plant fodder species highlighted is that more than half of the total number also represent sources of human food delicacies.

It is also pertinent to note that while most of these plants are consumed raw preferably, a few are more palatable to the animals when sundried (*Colocasia*, *Manihot et cetera*). It is

not advisable to give the leaves of Manihot and Cola species when fresh to the pregnant females. Rabbits being very fragile animals prefer the tenderest plant parts and it is important to note that what these animals eat is not restricted

only to the ones highlighted, again animals from different localities may show varying degrees of preferences for each plant mentioned above.

Table 2: Family, Habit, Growth Form, Life Span and Percentage Preference of Fodder to Livestock.

S/N	SCIENTIFIC NAME	FAMILY	GROWTH FORM	LIFE SPAN	OTHER ECONOMIC VALUE	PERCENTAGE PREFERENCE BY LIVESTOCK
1	<i>Ficus elasticoides</i>	Moraceae	Tree	Perennial H	Domestic	A
2	<i>Riciodendron heudeloti</i>	Euphorbiaceae	Tree	Perennial W	Domestic	A
3	<i>Elaeis guineensis</i>	Arecaceae	Tree	Perennial W	Food, cash, industrial domestic	A
4	<i>Persea americana</i>	Lauraceae	Tree	Perennial W	Food, cash domestic	A
5	<i>Dacryodes edulis</i>	Burseraceae	Tree	Perennial W	Food, cash, industrial	A
6	<i>Dioscorea sp. galata</i>	Dioscoreaceae	Stem tuber	Annual SW	Food, cash, industrial	A
7	<i>Colocasia esculenta</i>	Araceae	Corm	Annual H	Food, cash, industrial	A
8	<i>Musa sapientum</i>	Musaceae	Giant forb	Biennial H	Food, cash, industrial	A
9	<i>Musa paradisiaca</i>	Musaceae	Giant forb	Biennial H	Food, cash, industrial	A
10	<i>Zea mays</i>	Poaceae	Grass	Annual H	Food, cash, industrial	A
11	<i>Mangifera indica</i>	Anacardiaceae	Tree	Perennial W	Food, cash, industrial	A
12	<i>Psidium guajava</i>	Myrtaceae	Tree	Perennial W	Food, cash, industrial	B
13	<i>Manihot esculenta</i>	Euphorbiaceae	Root tuber	Perennial W	Food, cash, industrial	A
14	<i>Invingiabonensis</i>	Ixonanthaceae	Tree	Perennial W	Food, cash, domestic	A
15	<i>Gmelina arborea</i>	Verbenaceae	Tree	Perennial W	Timber (3) domestic	A
16	<i>Dialium guineense</i>	Caesalpiniaceae	Tree	Perennial W	Food, cash, industrial domestic	A
17	<i>Milicia excelsa</i>	Moraceae	Tree	Perennial W	Timber (5) domestic	A
18	<i>Cola species</i>	Sterculiaceae	Tree	Perennial W	Cash, domestic	B
19	<i>Cocos nucifera</i>	Arecaceae	Tree	Perennial W	Food, cash, domestic	B
20	<i>Pterocarpus soyaxica</i>	Fabaceae	Tree	Perennial W	Food, cash, domestic	B
21	<i>Chrysophyllum albidum</i>	Sapotaceae	Tree	Perennial W	Food, cash, domestic	B
22	<i>Treculia africana</i>	Moraceae	Tree	Perennial W	Food, cash, industrial domestic	B
23	<i>Nauclea diderichii</i>	Rubiaceae	Tree	Perennial W	Timber (5) Food, domestic	B
24	<i>Dactyloctenium aegyptium</i>	Sterculiaceae	Tree	Perennial W	Domestic	B
25	<i>Carica papaya</i>	Caricaceae	Tree	Perennial SW	Food, cash, domestic	A
26	<i>Citrus species</i>	Rutaceae	Tree	Perennial W	Food, cash, industrial domestic	B
27	<i>Annona muricata</i>	Annonaceae	Tree	Perennial W	Food, cash	B
28	<i>Bambusa vulgaris</i>	Poaceae	Shrub	Perennial W	Cash, industrial, Domestic	A
29	<i>Pennisetum purpureum</i>	Poaceae	Grass	Perennial H	Domestic	B
30	<i>Andropogon tectorum</i>	Poaceae	Grass	Perennial H	Domestic	A
31	<i>Panicum maximum</i>	Poaceae	Grass	Perennial H	Domestic	B
32	<i>Oryza sativa</i>	Poaceae	Grass	Annual H	Domestic	A
33	<i>Eleusine indica</i>	Poaceae	Grass	Annual H	Food, cash industrial(5) domestic	A
34	<i>Setaria barbata</i>	Poaceae	Grass	Annual H	Domestic (2)	A
35	<i>Cynodon dactylon</i>	Poaceae	Grass	Annual H	Domestic (2)	B
36	<i>Costus afer</i>	Poaceae	Grass	Annual H	Domestic (2)	B
37	<i>Daucus carota</i>	Apiaceae		Biannual H	Food, cash Domestic (2), medicinal	A
38	<i>Phaseolus vulgaris</i>	Fabaceae	Climber	Annual SW	Food, cash Domestic (2), medicinal	A
39	<i>Cajanus cajan</i>	Fabaceae	Shrub	Biannual SW	Food, cash Domestic (2), medicinal	B
40	<i>Solanum melangona</i>	Solanaceae	Shrub	Annual SW	Food, cash Domestic (2), medicinal	A
41	<i>Capsicum annuum</i>	Solanaceae	Shrub	Annual W	Food, cash, domestic medicinal	A
42	<i>Vernonia amygdalina</i>	Asteraceae	Shrub	Perennial W	Food, cash, domestic medicinal	A
43	<i>Ixora coccinea</i>	Rubiaceae	Shrub	Perennial W	Ornamental domestic	B
44	<i>Aspilota africana</i>	Asteraceae	Shrub	Annual SW	Domestic medicinal	B

Table 2: (Continued)

45	<i>Arachis hypogea</i>	Fabaceae	Shrub	Biannual SW	Food, cash, domestic, industrial	A
46	<i>Amaranthus species</i>	Amaranthaceae	Forb	Annual H	Food, domestic	B
47	<i>Cochorus olitorius</i>	Tiliaceae	Forb	Annual H	Food, domestic	A
48	<i>Tridax procumbrens</i>	Asteraceae	Forb	Annual H	Domestic	A
49	<i>Cucumeropsis manii</i>	Cucurbitaceae	Climber	Annual H	Food, cash, domestic, industrial	B
50	<i>Telfaria occidentalis</i>	Cucurbitaceae	Climber	Annual H	Food, cash, domestic, industrial	A
51	<i>Hibiscus rosasinensis</i>	Malvaceae	Shrub	Perennial W	Ornamental Domestic	B
52	<i>Ipomoea species</i>	Convolvulaceae	Runner	Annual H	Domestic	B
53	<i>Alternanthera species</i>	Amaranthaceae	Shrub	Perennial SW	Domestic	A
54	<i>Desmodium scorpiurus</i>	Fabaceae	Climber	Annual H	Domestic	A
55	<i>Vigna unguiculata</i>	Fabaceae	Shrub	Biannual SW	Food, cash, Domestic	A
56	<i>Sida species</i>	Malvaceae	Shrub	Perennial W	Domestic	B
57	<i>Talinum triangulare (water leaf)</i>	Portulacaceae	Forb	Annual H	Food, Domestic	B
58	<i>Abelmoscus esculentus</i>	Malvaceae	Shrub	Biannual SW	Food, cash, Domestic	B
59	<i>Sugar cane</i>	Cane sugar	Grass	Perennial H	Food, industrial cash,	A
60	<i>Pterocarpus soyauxii</i>				Food, Domestic	B
61	<i>Alchornea cordifolia</i>				Domestic	A
62	<i>Napoleonia imperialis</i>				Domestic	C
63	<i>Terminalia catappa</i>				Food, Domestic	B

KEY: A – 70 – 100%, B – 40 – 70%, C – 10 – 40%, D – 0 – 10%, W – Woody, SW – Semiwoody, H – Herbaceous.

From Table 2 above, with plants from about 30 families and with species per family ranging from 1-10, for this work alone, the range of plant biodiversity (fodder species) at the disposal of common livestock is large. The implication is that with effective biodiversity conservation, sources of livestock food and by extension the farmer's income and profit is assured. This translates also to a veritable source of protein for the overall good health of the human population. Plant

fodder species cut across trees, shrubs, climbers, grasses, forbs *et cetera* even plants that are termed unwanted. Therefore, biodiversity conservation through reforestation, flooding, erosion control, controlled grazing/wildfires is imperative for sustainability – without which all will be lost. Again, a little over 30 species are perennial – this will ensure year round availability of most fodder species both for the rainy and dry seasons.

Table 3: Potential/possible sources of fodder species for the future.

S/N	LOCAL NAME	FAMILY	SCIENTIFIC NAME	PART EATEN	GROWTH FORM	CONSUMER	Other ECONOMIC VALUE
1	Ijikere	Anacardaceae	<i>Spondias mombin</i>	Tender leaves		Goat, sheep, Rabbit	Domestic
2	Osi	Bombacaceae	<i>Ceiba pentandra</i>	Tender leaves	Tree	✓	Timber
3	Akpu	Verbenaceae	<i>Vitex doniana</i>	Tender leaves	Tree	✓	Industrial, Domestic
4	Mbembe	Malvaceae	<i>Malvastrum coromandelianum</i>	Fruits	Tree	✓	Food, cash, domestic
5		Poaceae	<i>Dactyloctenium aegyptium</i>	Entire plant	Forb	✓	Domestic
6		Acanthaceae	<i>Justicia flava</i>	Entire plant	forb	✓	Domestic
7		Verbaceae	<i>Duranta repens/erecta</i>	Leaf	Shrub	✓	Ornamental domestic
8		Poaceae	<i>Paspalum scrobiculatum</i>	Meat		✓	
9		Commelinaceae	<i>Commelina diffusa</i>	Entire plant	Forb	✓	Domestic
10		Cyperaceae	<i>Mariscus alternifolias</i>	Entire plant	Sedge	✓	Domestic
11		Cucurbitaceae				✓	
12			<i>Newbouldia laevis</i>			✓	Domestic
13			<i>Annona senegalensis</i>			✓	Domestic

From table 3 above, there are 4 tree, 2 shrubs and 2 forb species mentioned. Goats and sheep in one locality in the

south east may savour what is taboo to Goats and sheep in another locality in the same Southeast.

CONCLUSION

Goats, sheep and Rabbits in the South East feed on a wide variety of fodder species particularly Musa, Zea, Ficus, Grass (Pennisetum, Panicum and Andropogon spp), Persea, Elaeis, Manihot, Colocasia and forbs (Alternanthera, Desmodium, Tridax, Aspilina) et cetera. They are easy to manage, a great source of protein, and an alternative source of income particularly now that crude oil need to be augmented by Agriculture for the Nigerian Economy to become more stable. There are other overlooked sources of fodder spp that need to be revisited: Vitex, Ceiba, Newbouldia, Pterocarpus, Spondias, Terminalia, Moringa, and many other grass and forb species. It is very pertinent to note that most of these fodder species are easily available forest species but presently the forest ecosystem of South East Nigeria is 'threatened' to 'extinction' by powerful negative influence, like serious cattle grazing, incessant forest fire, Erosion and unsustainable Agricultural activities on marginal lands. Saving our forest is synonymous to our survival.

REFERENCES

- Abbasi, A. M., Khan M.A., Ahmad, M and Zafar, M (2012). Medicinal plant Biodiversity of lesser Himalayas-Pakistan. Springer Science. 1-4614-1575-6.
- Akobundu, I. O. and Agyakwa, C. W. (1998). *A handbook of West African Weeds*. International Institute of Tropical Agriculture, Ibadan, Nigeria. 565 pp.
- FAO (1966). "Food and Agriculture Organization of the United Nations" Agricultural development in Nigeria 1980. Rome, FAO.
- FAO (1973). "Food and Agriculture Organization of the United Nations" Production Yearbook, Rome, FAO.
- Nyananyo, B. L. (2006). *Plants from the Niger Delta*. Onyoma Research publications, Port Harcourt, Nigeria. 403pp.
- Otegbeye, G. O. and Onyeausi, A. O. (2006): In: Ivbijaro, M. F. A. Akintola F. and Okechukwu, R. U. E (Eds). Sustainable Environmental Management in Nigeria. Mathivi Production, Ibadan. Nigeria 465 pp.

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