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DIVERSITY OF INDIGENOUS WILD FRUIT TREES IN SELECTED FLOODPLAINS OF ADAMAWA STATE

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ABSTRACT: The research was conducted to assess the diversity of wild fruit trees in floodplains of Adamawa State, Nigeria. Three floodplains in Adamawa State (Demsa, Song and Mubi South Local Government Areas) were selected for the study. One hectare sample plots were marked out in each of the floodplains and all matured wild fruit trees within the plots were identified, counted and their girths at breast height measured. Abundance, frequency, relative frequency, density, relative density, dominance, relative dominance and important value index were determined using relevant formulae. Simpson's Diversity Index was used in determining the species diversity in each of the plots. Comparison of the diversity index of Demsa and Song study sites using t-test at 0.05% level of probability showed no significant difference. The same was for Song and Mubi; Mubi and Demsa respectively. Results showed that twelve species of trees belonging to ten families were identified in the floodplains. The species diversity indices of the three sites were 0.2319, 0.2310 and 0.1549 for Demsa, Song and Mubi South respectively indicating that the floodplains had high diversity of wild fruit trees.

Key Words: Diversity, Wild Fruit Trees, Adamawa, Floodplains.

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1. INTRODUCTION

Through the ages, people dwelling in rural tropical countries have depended on forests for food and other livelihoods need through the gathering and processing of produce from trees. In rural countryside of many developing nations, wild fruits are often the only fruits consumed as people cannot afford cultivated commercial fruits such as apple, grapes, avocados, oranges or bananas (Makurji 2005). As a result, Nazarudden (2010) reported that in recent years, a growing concern has emerged to evaluate various wild edible plants for their nutritional features. Indeed, inventory of wild food resources, ethno-botanical information on their adaptability coupled with nutritional evaluation can only establish the non cultivated variety as a real substitute for domesticated or cultivated species (Mahapatra *et al.* 2012).

There are about 3000 species of wild fruit trees in Africa representing an enormously important, and largely untapped, natural resource (Pye-smith 2010). For proof of the difference that these fruits can make to health and welfare of rural communities, you need look no further than the participatory tree domestication programme managed by the World Agroforestry Centre in West and Central Africa (Pye-Smith 2010). In the 1990s, Scientists from the World Agroforestry Centre conducted surveys in West Africa, Southern Africa and the Sahel to establish which indigenous trees were most valued by local people. Of the 6000 farmers that responded in Cameroun, Gabon, Ghana and Nigeria, Pye-Smith (2010) observed that contrary to the expectation that the farmers would point to commercially important timber species, what they valued most were indigenous fruit trees.

According to National Academy of Science (2008), fruit product in Africa of present has been dominated by such species introduced from tropical Americas and Asia. Consequently, most of these introduced fruit species rather than the indigenous species were grown and established in orchards and plantations for large scale production and distribution. Thus, the indigenous fruit trees known to the local people continued their downward spiral of dwindling cultivation and knowledge without research investment and improvement (National Academy of Science 2008). Awodoyin *et al.* (2015) reported that until recently, most of the researchers in

horticultural crops production in Nigeria still inadvertently show preferences for detailed research work on introduced fruit species over the indigenous species.

Adamawa plains are extensively flooded periodically, thus subject to intermittent leaching, siltation, nutrient flux and probably species loss. The role of tree diversity in rural nutrition/and health is significant and could be at risk in areas highly prone to extensive and recurrent flooding. Large populations of people in Adamawa State live in floodplains and are heavily dependent on natural food resources for both subsistence and cottage industrial needs. Vital aspects of rural livelihood; food security, nutrition, health and commerce are linked to diverse wildly growing fruit trees and are thus probably affected by incessant flooding.

The study was conducted to assess the diversity (abundance, relative density, relative frequency, relative dominance and importance value) of edible indigenous wild fruit tree species in Adamawa floodplains.

2. MATERIALS AND METHODS

2.1 The Study Area

Adamawa State is located at the North-Eastern part of Nigeria. It is lies between latitude 7º and 11º N of the equator and between longitude 11º and 14º E of the Greenwich meridian. It shares boundary with Taraba State in the South and West, Gombe State in its Northwest and Borno State to the North. Adamawa State has an international boundary with the Cameroon Republic along its eastern border. The State covers a land area of about 38,741 km^2. It is divided into 21 local Government Areas (Figure 1) (Adebayo 1999). It has a population of 3,168,101 (National Bureau for Statistics 2007).

The mean annual rainfall pattern in the state shows that the amounts range from 700 mm in the north – west part to 1600 mm in the southern part. Generally, mean annual rainfall is less than 1000 mm in the central and north – western part of the state including Song, Gombi, Shelleng, Guyuk, Numan, Demsa, Yola and part of Fufore local government areas. On the other hand the north – eastern strip and the southern part have over 1000 mm. The mean length of rainy season ranges from 120 – 210 days in the state. The lowest Relative Humidity in the state (20 – 30%) is recorded between January and March. It starts increasing as from April and reaches its peak (about 80%) in August and September (Adebayo 1999). Maximum temperature in the state can reach 40ºC particularly in April while minimum temperature can be as low as 18º C between December and January. Mean monthly temperature in the state ranges from 26.7ºC in the south to 27.8ºC in the north – eastern part (Adebayo 1999).

The major vegetation formations in the state are the southern Guinea savannah, Northern Guinea Savannah, and the Sudan Savannah (Figure 2). Within each formation is an interspersion of thickets, tree savannah, open grass savannah and fringing forests in the river valleys. However large scale deforestation resulting from indiscriminate extraction of wood for fuel and expansion of agricultural land areas has left large areas within each vegetation type with few indigenous woody plant species (Adebayo 1999).

The abundant woody species in the southern guinea savannah vegetation are *Daniellia oliveri, Diospryos ellioti, Ceiba pentandra, Nauclea latifolia, Bombax costatum, Parkia biglobosa, Drypetes floribunda, Brachystegia eurycoma, Brysocarpus coccineus, Zanthoxylum zanthoxyloides, Vitex doniana, Piliostigma thonningii,* and *Entada abyssinica.* Species of the Northern guinea and Sudan savanna zones also occur in this zone. The most abundant grasses are species of *Andropogon, Hyparrhenia, panicum and Ctenium* (Adebayo 1999).

The following are the abundant woody species in the northern guinea savannah vegetation: *Afzelia africana, Vitellaria paradoxa, Terminalia laxiflora, Terminalia glaucescens, Annona senegalensis, Burkea africana, Prosopis africana, Albizia zygia, Ficus exasperata, Pterocarpus lucens, Detarium microcarpum, Anogeissus leiocarpus, Balanites aegyptica, Tamarindus indica, Sclerocarya birrea, Khaya senegalensis, Ficus syncomorous, Borassus aethiopum, Boswellia dalzielii* and *Ziziphus spina-christi.* The abundant grass species include *Pennisetum, Andropogon, Hyparrhenia, Bracharia* and *Aristida* (Adebayo 1999).

The dominant woody species in Sudan savannah vegetation are: *Acacia senegal, Acacia nilotica, Adonsonia digitata, Borassus aethiopum, Ziziphus spina-christi, Slerocarya birrea,* and *Terminalia avicennioides.* Grass species include *Aristida longiflora, Cenchrus biflorus, Pennisetum pedicellatum* and *Eragrostis spp* (Adebayo 1999). Fringing forests exist in the river valleys across the vegetation zones. Woody species in the Fringing forests include: *Pterocarpus spp, Vitex doniana, Khaya senegalensis, Ficus spp, Syzygium guineense, Brachystegia eurycoma* and *Albizia zygia* (Adebayo 1999).

2.2 *Adamawa Flood Plains*

Adamawa flood plains span two Nigeria agroecological zones. Dry sub-humid Chibok-Biu Mubi-Song high plain and dry sub-humid Azare-Gombe-Yola plain (Ojanuga 2006).

2.3 Site Selection

Since large portion of the flood plains had been converted to either farmlands or settlements areas, three sites were purposively sampled for data collection. Demsa Local Government Area (9° 25′N, 12° 8′E), Song Local Government Area (9° 49′N, 12° 37′E) and Mubi South Local Government Area (10° 26′N, 13° 27′E), representing the southern, central and northern parts of Adamawa State respectively (Figure 1).

2.4 Assessment of species of edible wild fruit trees

Assessment of the edible wild fruit tree species was done in 2014. In each of the selected sites, a plot of one hectare was marked out. All matured fruit trees within the plots were identified and a total count of them was conducted. The girth at breast height of all the trees were also measured using a measuring tape. These figures were used for the determination of species relative dominance, importance value and diversity index.

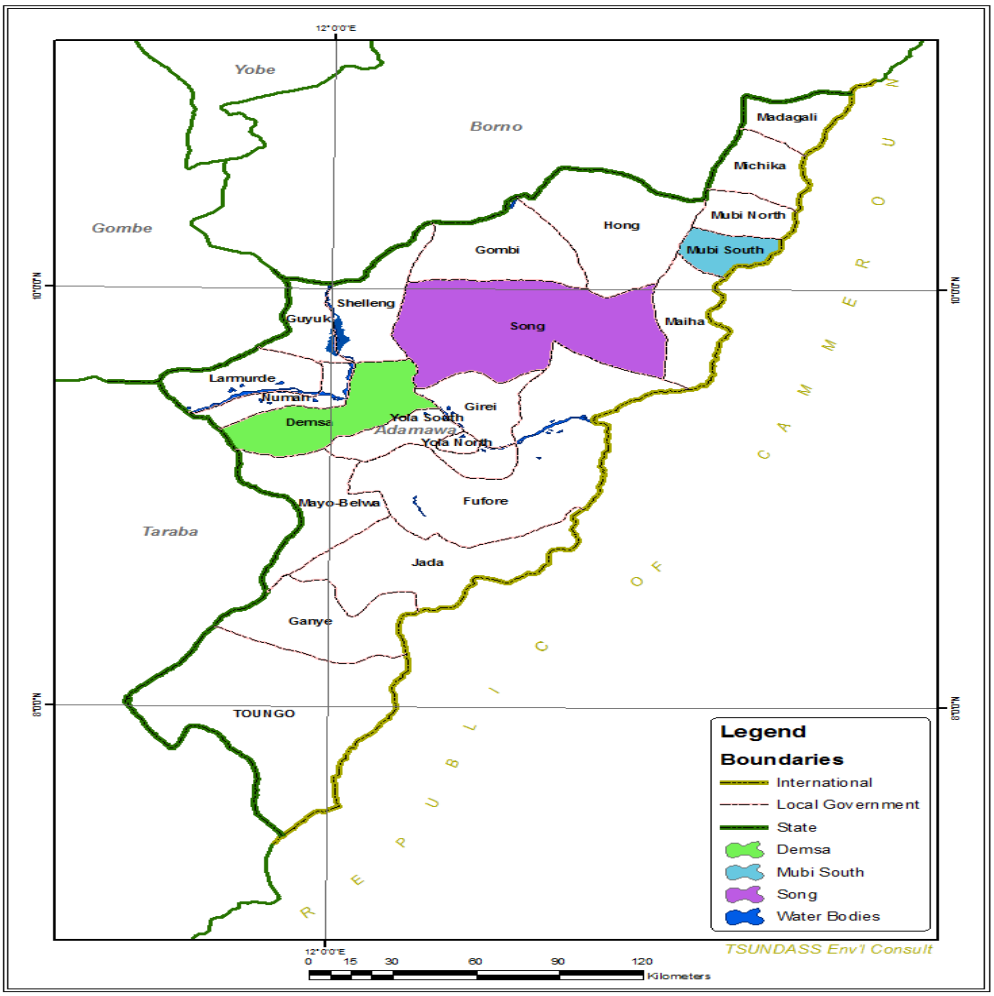

Figure 1: Map of Adamawa State showing the Study Sites
Source: Adebayo (1999)

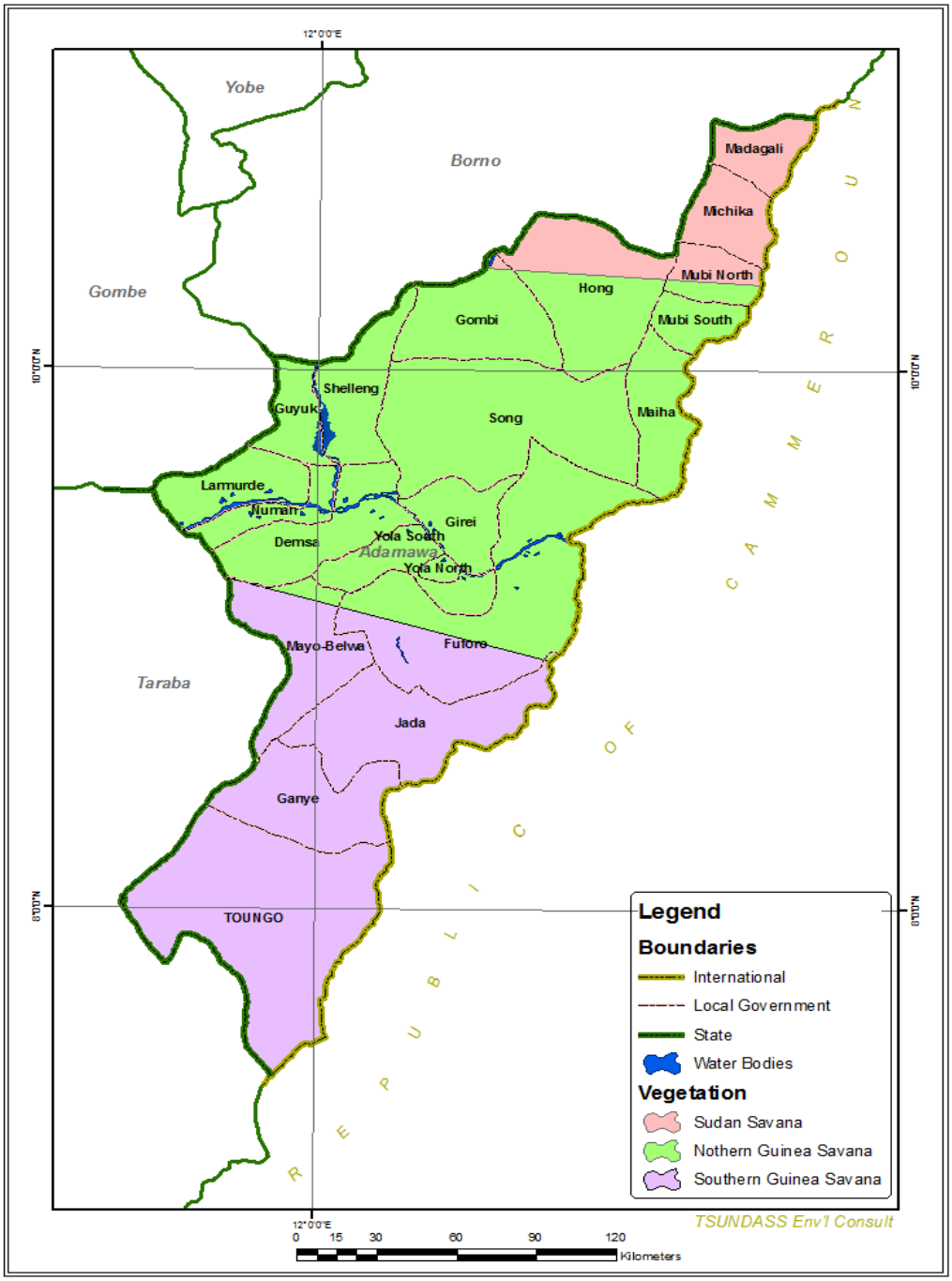

Figure 2: Vegetation Zones of Adamawa State
Source: Adebayo (1999)

2.5 Data Analysis

The following indices were determined:

$$Density = \frac{Number\ of\ individuals}{Are\ sampled}$$

$$Rd = \frac{Density\ of\ a\ species}{Total\ density\ for\ all\ species} x \frac{100}{1}$$

$$Dominance = \frac{Total\ basal\ areas}{Area\ sampled} x \frac{100}{1}$$

$$RD = \frac{Dominance\ of\ a\ species}{Total\ number\ of\ plot\ sampled} x \frac{100}{1}$$

$$F = \frac{Number\ of\ plots\ which\ species\ occurs}{Total\ plots\ sampled} x \frac{100}{1}$$

$$RF = \frac{Frequency\ values\ of\ a\ species}{Total\ frequency\ of\ all\ species} x \frac{100}{1}$$

$$Importance\ value = Rd\ density + RD + \text{RF}$$

Where; Rd: Relative density, RD: Relative dominance, RF: Relative frequency, F: frequency

The importance value ranges from 0 – 300 (Goldsmith *et al.* 1986)

The species Diversity was determined Simpson's index:

$$D = \sum_{i=1}^{s} P_i^2$$

Where; P_i is the proportion of i^{th} species in the sample; i.e. n_i/N.

3. RESULTS AND DISCUSSIONS

3.1 Checklist of species of wild fruit trees in the Study Sites

Table 1 outlines the various wild fruit tree species as they occurred in the one hectare plots in the three study sites. A checklist of the species found in the tree floodplains reveal twelve different species belonging to ten families. These are species found in the Northern Guinea Savannah and Sudan Savannah vegetation zones of the state as reported by Adebayo (1999). The occurrence of species in both flooded and non-flooded areas indicates that some of the wild fruit trees species that are indigenous to the vegetation zones of the state have the ability to grow in floodplains. This, notwithstanding, the species abundance in all the study sites, appears low, with Mubi study site, having the lowest. The exclusion of some wild fruit tree species commonly found in the State from the floodplains may not be unconnected with the fact that not all tree species are adapted to flooding. Results indicate that *Tamarindus indica* and *Vitellaria paradoxa* were common to the three sites. *Detarium microcarpum* and *Sclerocarya birrea* were common to Demsa and Song study sites while *Balanites aegytiaca* was found in Demsa and Mubi South study sites. *Prosopis africana* and *Santaloides afzelii* were species found only in Demsa study site, while *Bombax costatum*, *Ficus cordata*, *Flacourtia indica* and *Ziziphus mauritiana* occurred only in Mubi study site.

3.2 Diversity Indices of wild fruit tree species in Demsa study site

Table 2 shows that *Prosopis africana* occurred most abundantly in the study site, followed by *Sclerocraya birrea* and *Santaloides afzelii*. These were followed by *Tamarindus indica*, *Vitellaria paradoxa*, *Balanites aegyptiaca* and *Detarium microcarpium*, which was the least abundant. Since Dominance and Relative Dominance are a function of Basal Area, *Prosopis africana* appeared to have dominated the area most and had the highest Importance Value Index. *Sclerocarya birrea* and *Tamarudus indica* had the same Dominance values though *Sclerocarya birrea* had a higher Importance Value Index than *Tamarindus indica*. *Detarium microcarpum* had the least Dominance and Relative Dominance values indicating that it was the least dominating species in the study site. In between these extremes were *Vitellaria paradoxa*, *Balanites aegyptiaca* and *Santaloides afzelii*.

Table 1: Checklist of Species of Wild Fruit Trees in the Study Sites

Species Name	Hausa name	Family	Demsa	Mubi	Song
Balanites aegyptiaca	Aduwa'a	Balanitaceae	*	-	*
Bombax costatum	Kurya	Bombacaceae	-	-	*
Detarium microcarpu	Tauraa	Caesalpinaceae	*	*	-
Ficus cordata		Moraceae	-	-	*
Flacourtia indica		Flacourtiaceae	-	-	*
Parkia biglobosa	Dorowa	Mimosoideae	-	*	*
Prosopis Africana	Kiriya	Mimosoideae	*	-	-
Santaloides afzelii		Connaraceae	*	-	-
Sclerocarya birrea	Danya	Anacardiaceae	*	*	-
Tamaridus indica	Tsamiya	Caesalpiniodideae	*	*	*
Vitellaria paradoxa	Kadanya	Sapotaceae	*	*	*
Ziziphus mauritiana	Magarya	Niamnaceae	-	-	*

*Present, – Absent

Source: Field Survey (2014)

3.3 Diversity indices of wild fruit tree species in Song study site

Detarium microcarpum appeared to be the most abundant species in Song study site as shown in Table 3. This is followed by *Santaloides afzelii*, *Parkia biglobosa*, *Sclerocarya birrea*, *Vitellaria paradoxa* and *Tamarindus indica* in that order. Similarly, *Detarium microcarpium* had the highest Dominance and Relative Dominance values indicating that it was not just the most abundant species, but the most dominating species as well. It is followed by *Parkia biglobosa*, *Santaloides afzelii*, *Tamarindus indica*, *Sclerocarya birrea* and *Vitellaria paradoxa* as the least dominating species.

Detarium microcarpum maintains the lead with the highest Importance Value Index. This time, it is followed by *Santaloides afzellii*, *Parkia biglobosa*, *Sclerocarya birrea*, *Tamarindus indica* and *Vitellaria paradoxa*. The change in the trend may perhaps be attributed to the contribution of relative frequency to the computation of importance value (Table 3).

3.4 Diversity Indices of Wild Fruit Tree Species in Mubi South Study Site

Table 4 shows that *Ficus cordata* is the most abundant species in Mubi South study site, followed by *Tamarindus indica* and *Balanites aegyptiaca*. *Ziziphus mauritiana* and *Bombax costatum* have the same abundance figures and are the fourth most abundant species while *Vitellaria paradoxa* and *Flacourtia indica* are the least abundant species.

Bombax costatum however has the highest Dominance and Relative Dominance Values, making it the most dominating species in the study site. This is followed by *Ficus cordata*, *Vitellaria paradoxa*, *Tamarindus indica*, *Balanites aegyptiaca*, *Ziziphus mauritiana* and lastly *Flacourtia indica*. *Ficus cordata* however, has the highest important value figure followed by *Tararindus indica*, *Bombax costatum*, *Balanites aegyptiaca*, *Ziziphus mauritiana*, *Vitellaria paradoxa* and *Flacourtia indica* in that order (Table 4).

3.5 Simpson's species diversity index in the study sites

Adopting Simpson's Diversity Index Formula in comparing the species Diversity of the three study sites as shown in Table 5, Demsa study site has the highest species diversity of 0.2319, followed by Song, with 0.2310 and lastly Mubi South Site which has 0.1549. A comparison of the diversity indices of wild fruit trees species in the three study sites of Demsa and Song, Song and Mubi and Mubi and Demsa using Usher (1992) method, showed no significance difference at (P = 0.05) level of probability since the t-calculated are 0.538, 1.115, and 0.577, while the t-tabulated are 2.45, 2.57, and 2.45 for Demsa, Song and Mubi South respectively.

The species diversity in the floodplains using Simpson's diversity index formula reveal a great diversity 'D' values for Demsa, Song, and Mubi study sites indicating a great diversity of wild fruit trees in the three floodplains. Comparing the species diversity of the three sites using t-test shows that there is no significant difference between any two of the sites since the t-calculated of all the sites are less than t-tabulated. The proximity of Mubi study site, to the Sudan vegetation zone of the state, which does not support tree growth, may perhaps account for the low abundance of the tree species in the study site.

Table 2: Diversity Indices of Wild Fruit Tree Species in Demsa Study Site

Name of species	Abundance	Relative frequency	Density	Relative density	Dominance	Relative dominance	IVI
Prosopis Africana	30	41.09	0.003	41.09	0.0373	47.15	129.33
Sclerocarya birrea	10	13.69	0.001	13.69	0.0120	15.17	42.55
Santaloides afzelii	10	13.69	0.001	13.69	0.0025	3.16	30.54
Detarium microcarpum	4	5.47	0.0004	5.47	0.0011	1.39	13.33
Balanites aegyptiaca	5	6.84	0.0005	6.84	0.0068	8.59	22.27
Tamarindus indica	8	10.95	0.0008	10.95	0.0123	15.54	37.44
Vitellaria paradoxa	6	8.21	0.0006	8.21	0.0071	8.97	25.39
Total	73	99.94	0.00073	99.94	0.0791	99.97	300.85

Source: Field Survey (2014)

Table 3: Diversity Indices of Wild Fruit Tree Species in Song Study Site

Name of species	Abundance	Relative frequency	Density	Relative density	Dominance	Relative dominance	Importance value
Detarium microcarpum	29	34.11	0.0029	34.11	0.010	34.72	102.94
Santaloides afzelii	21	24.70	0.0021	24.70	0.0040	13.88	82.28
Parkia biglobosa	12	14.11	0.0012	14.11	0.0062	21.52	49.74
Tamarindus indica	6	7.05	0.0006	7.05	0.0035	12.15	26.25
Sclerocarya birrea	10	11.76	0.0010	11.76	0.0030	10.41	33.66
Vitellaria paradoxa	7	8.23	0.0007	8.23	0.0021	7.29	23.75
Total	85	99.96	0.0085	99.96	0.0288	99.97	288.62

Source: Field Survey (2014)

Table 4: Diversity of Wild Fruit Tree Species in Mubi South Study Site

Name of species	Abundance	Relative frequency	Density	Relative density	Dominance	Relative dominance	Importance value
Balanites aegyptiaca	6	15.00	0.0006	15	0.00018	0.21	30.21
Ficus cordata	9	22.50	0.0009	22.5	0.0219	25.97	70.97
Tamarindus indica	7	17.50	0.0007	17.5	0.0049	5.81	40.81
Ziziphus mauritania	5	12.50	0.0005	12.5	0.00037	0.43	25.43
Bombax costatum	5	12.50	0.0005	12.5	0.0438	51.95	76.95
Flacourtia indica	4	10.00	0.0004	10.00	0.00034	0.40	40.40
Vitellaria paradoxa	4	10.00	0.0004	10.00	0.0129	0.15	20.15
Total	40	100.00	0.0004	100.00	0.0843	84.92	284.52

Source: Field Survey (2014)

Table 5: Simpson's Species Diversity Index in the Study Site

Species Name	Demsa			Song			Mubi		
	(n_i)	Proportion (P_i)	S. index (P_i^2)	(n_i)	Proportion (P_i)	S. index (P_i^2)	(n_i)	Proportion (P_i)	S. index (P_i^2)
Prosopis africana	30	0.41	0.168	-	-	-	-	-	-
Sclerocarya birrea	10	0.41	0.019	10	0.1124	0.013	-	-	-
Santaloides afzelii	10	0.41	0.019	22	0.2472	0.061	-	-	-
Detarium microcarpum	4	0.05	0.0025	32	0.3595	0.129	-	-	-
Balanites aegyptiaca	5	0.07	0.0049	-	-	-	6	0.15	0.225
Tamarindus indica	8	0.11	0.0121	6	0.0674	0.004	7	0.175	0.0306
Vitellaria paradoxa	6	0.08	0.0064	7	0.0787	0.006	4	0.1000	0.1000
Parkia biglobosa	-	-	-	12	0.1348	0.018	-	-	-
Ficus cordata	-	-	-	-	-	-	9	0.225	0.0506
Ziziphus mauritania	-	-	-	-	-	-	5	0.125	0.0156
Bombax costatum	-	-	-	-	-	-	5	0.125	0.0156
Flacourtia indica	-	-	-	-	-	-	4	0.1000	0.1000
Total	73	1.00	0.2319	89	1.00	0.2310	40	0.1000	0.1549

Source: Field Survey (2014)

4. CONCLUSION

From the findings of this study it can be concluded made:

1. The floodplains of Adamawa State contain a significantly high diversity of wild fruit trees although some of the wild fruit trees that are characteristically indigenous to these vegetation zones as revealed by previous studies were absent; probably because not all trees do well in flooded areas.
2. Since the floodplains do not support arable farming but appear to support tree growth, though selectively, the floodplains could be converted to wild fruit tree plantations by government. These could improve the revenue base of government while ensuring balanced nutrition to the people.
3. Deliberate tree improvement programmes (involving specific domestication interventions) for useful characters for highly promising indigenous fruit trees of Sub-Saharan sub-regions in general and Nigeria in particular is advocated.

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