



Floristic Composition and Life Forms Study of Woody Plants in Magama Local Government Area, Niger State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. All authors contributed significantly in the design, experiment and analysis. Authors HS and BLA designed the study, performed the statistical analysis, author AAA wrote the protocol, and wrote the first draft of the manuscript. Authors BLA, AAA and HGA managed the analyses of the study. Author HS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The floristic composition and life forms analysis was conducted in Magama local government area of Niger state, Guinea Savanna of Northern Nigeria to generate a baseline data for the woody plants genetic resources.

Study Design: Sampling method was done in Auna, Ibeto, Nasko and Salka.

Place and Duration of Study: Magama local government area of Niger State for 2 years.

Methodology: Point-centered quarter method was used in data collection. Data generated was analysed using quantitative method.

Results: A total of 56 woody species from 45 genera and 28 families of angiosperms were encountered. The species *Detarium microcarpum* had the highest density of 1.7 per hectare, with dominance of 1.22 m² ha⁻¹ and relative dominance of 13.9% followed by *Piliostigma thonningii* with density of 1.5 per hectare, dominance of 1.04 m² ha⁻¹ with relative dominance of 10.2%. The species with least density and dominance was *Ximania americana*. The family Caesalpiniaceae had the highest dominance followed by Combretaceae, Mimosaceae and Sapotaceae. Mimosaceae had the highest species composition with nine species from five genera. Caesalpiniaceae and Combretaceae had

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seven and six species from seven genera and three genera respectively. The families Ochnaceae and Olacaceae had the least species composition. The dominant life form spectrums of woody species were dominated by microphanerophytes (53%), nanophanerophytes (39%) and mesophanerophytes (8%). The presence of 56 species, 45 genera in 28 families indicates a fairly diverse vegetation resource that should be given some level of protection for sustainability.

Conclusion: The study revealed that the vegetation of Magama Local Government is diverse and requires forest management practices by the local community in the conservation and sustainable exploitation of plant resources in the area.

Keywords: Floristic composition; life forms; microphanerophytes; nanophanerophytes.

1. INTRODUCTION

There is a global concern about loss of valuable genetic resources which promoted international action programmes for the conservation of plant genetic resources and establishment of gene banks in many countries. In most tropical areas, forest resources are destroyed indiscriminately to the extent that many species are either threatened, endangered or extant. The rate of plant species destruction especially in Nigeria is increasing. Plant genetic resources for food and agriculture are the basis for global food security and provide recreational, psychological, emotional and spiritual fulfilment [1]. Vegetation cover is recognised as element of biodiversity, which needs to be identified and monitored. Vegetation analysis using internationally standardised methods has been recognised as an essential tool for identification, monitoring and conservation of ecosystems [2]. In recent times, overgrazing and changes in land use pattern are taking heavy toll on diversity available in wild species especially in Nigeria. Urbanization and changing life styles, globalization and market economies are also contributing indirectly to the loss of diversity which has serious implications for food security in long term [3].

According to Akinsoji [4] inhabitants living in their environments are able to survive by using the vegetation components to serve their needs. Plant materials are used for making agricultural tools, timber for constructions, and fuel wood for household energy fodder and forage for livestock among others. Apart from providing subsistence, woody plants are increasingly recognized for their role in improving the economic status of rural people who sell products of these plants in markets worldwide [5]. It is a common knowledge that a plant with economic importance to a region is often not easily destroyed when clearing for agricultural and construction purposes [6,7]. Considering the unprecedented influence of human interference on the plant world at both global and local levels, the need to conserve plant genetic resources cannot be overemphasized. The destruction of natural ecosystems as a result of excessive bush burning, shifting cultivation and over grazing, is having widespread effects upon the woody plant species by limiting their distributions [8]. The negative effects on plants distribution are large due to the promotion of desert conditions, erratic rainfall and low humidity which threaten to erode genetic biodiversity [9]. Information on species composition and abundance allows for monitoring changes in vegetation and conservation of indigenous germplasm [10]. Information on floristic composition of an area could be vital in the conservation and management of plant species in the area. Ecological studies on the vegetation structure, species composition and dominance in Magama Local Government Area have not been carried out. This study was conducted to generate baseline

data that could be useful for the conservation of woody plant species through a floristic survey and life form study of woody plant species using a quantitative method.

2. MATERIALS AND METHODS

The study area is in Magama Local Government Area of Niger State lies between latitude $09^{\circ} 45'N$ and $10^{\circ}05'N$ and longitude $04^{\circ}03'E$ and $05^{\circ}25'E$ (Fig. 1). It covers an area of approximately 5,334 square kilometers with a population of 18163 [NPC, 2006]. Agriculture is the main occupation of the people of the area. Besides farming, some people of the area engage in fishing and livestock production. The Local Government has two distinct seasons; wet and dry seasons. The wet season starts from April to October with the heaviest rainfall is in August. The dry season lasts for 5-6 months starting November to March. The mean relative humidity is about 90% in August and 54% from December to February. The mean minimum temperature is about $30^{\circ}C$ to $35^{\circ}C$ and the mean annual rainfall varies from 1,100 mm to 1,600 mm [11]. Magama Local Government has diverse soil types including loamy, loamy sand and sand in the uplands and clayey, clayey loam in Fadama. The soils are predominantly acidic and some areas are affected by soil erosion which resulted to the formation of deep gullies [12]. Magama Local Government lies within Guinea savannah zone. The natural vegetation of the area is dominated by trees and shrubs.

The point – centered quarter method of Muller-Dombois and Ellenberg [13] was used in data collection. Four sampling sites were selected in the study area. These are Auna, Ibeta, Nasko and Salka (Fig. 1). Plots of $10,000m^2$ were demarcated using measuring tape in each site and within each demarcated plots. Four quadrants were drawn at 90° from the centre in each throw. In each quadrant the nearest woody species to the centre was identified and the distance between nearest woody plants to the centre was measured for trees more than 3 cm in diameter. The diameter at breadth height of the individual species was measured; the height of the perennating bud was also measured. This method was used repeatedly for 50 sampling locations in each site.

Data generated was analysed using descriptive statistics in accordance with the methods of Hopkins [14] to determine density and dominance of woody species in the area.

a. Density

- i. Mean Distance (D) = $\frac{\text{Total distance}}{\text{Number of trees}}$
- ii. Absolute Density (AD) = $\frac{\text{Size of study}}{D^2}$
- iii. D (species) = $\frac{NI}{\text{Number of trees}} \times AD$

Where; D (species) is Density of any given species, and
NI is Number of individuals of the species in the quarters.

b. Dominance

- i. Basal Area = $\left(\frac{1}{2}d\right)^2 \times \pi$

Where d = tree diameter and $\pi = 3.142$

- ii. Mean Basal Area (MBA) = $\frac{\text{Total Basal Area of Trees}}{\text{Number of trees}}$

- iii. Dominance of species = MB of tree species × density of species
- iv.
$$\text{Relative dominance} = \frac{\text{Dominance of the species}}{\text{Total dominance of all the species}} \times 100$$
- v. Family dominance – The family dominance of all species was assessed by summing up the dominance values of the species that belongs to the same family.
- vi. Life forms: Life form spectrum was determined by measuring the heights of the woody species, species that have the same height were assigned in groups and the percentage of the total flora belonging to each category was calculated.

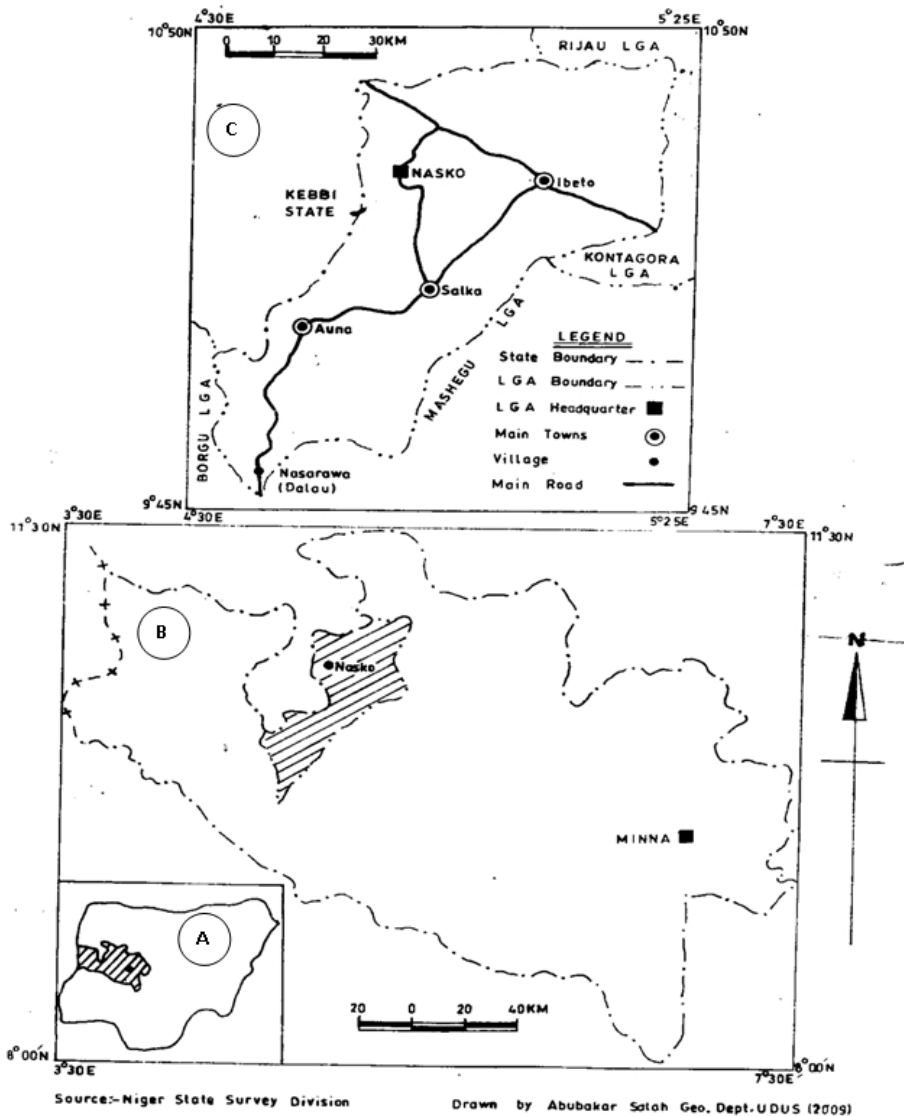


Fig. 1. (A) Map of Nigeria Showing Niger State;(B) Niger State showing Magama Local Government and(C) Map of Magama Local Government

3. RESULTS AND DISCUSSION

Results of woody species composition, density, dominance, cover value and Life form in Magama Local Government of Niger State are presented in Tables 1 to 3. Family and species composition is presented in Table 1. The result revealed 56 species belonging to 45 genera 28 families, and Mimosaceae had the highest composition of nine species distributed in five genera. The genus *Acacia* consisted of five species and the remaining four genera consist of one species each. Caesalpiniaceae consisted of seven species in seven genera followed by Combretaceae with six species in three genera. The genus *Combretum* comprised of three species and the remaining genera had one each. The family Bombacaceae is represented by three genera, Meliaceae and Moraceae comprises of three species each. In Bombacaceae, the genera (*Adansonia*, *Bombax* and *Ceiba*) and each genus has only one species each- *Adansonia digitata*, *Bombax costatum* and *Ceiba pentandra*. Similarly, in Meliaceae, *Azadirachta*, *Khaya* and *Pseudocedrela* consisted of one species each. But in Moraceae, the only *Ficus* genus consisted of three species. In Rhamnaceae and Rubiaceae there are two species each in one genus namely *Ziziphus* and *Gardenia* respectively. In Verbenaceae there are two species in two genera *Parkia* and *Vitex*. Each of the remaining families consisted of one species in one genus.

Table 1. Families and woody species composition in Magama Local Government area, Niger State, Nigeria

Family	Species	Hausa Name
1. Mimosaceae	<i>Acacia polyacantha</i> Willd.	Kumbar Shaho
	<i>Acacia siebieriana</i> DC.	Farar Kaya
	<i>Acacia gourmaensis</i> A. Chev.	Kama Muraba
	<i>Acacia gerrardii</i> Harms	Bakar Kaya
	<i>Acacia nilotica</i> (L.) Willd ex Dalile	Bagaruwa
	<i>Dichrotachys cinerea</i> (L) Wight & Am.	Dundu
	<i>Prosopis africana</i> (Guill & Perr)	Kiriya
	<i>Entada africana</i> Guill & Perr.	Tawatsa
	<i>Sarcocephalis latifolus</i> Sm.	Tuwon Biri
2. Caesalpiniaceae	<i>Daniellia oliveri</i> Hutch & Dalziel	Maje
	<i>Azalia africana</i> Sm. ex Pers.	Kawo
	<i>Isobernia doka</i> Craib & Stapf	Doka
	<i>Detarium microcarpum</i> Guill & Perr.	Taura
	<i>Tamarindus indica</i> L.	Tsamiya
	<i>Piliostigma thonningii</i> (DC) Hochst	Kalgo
3. Combretaceae	<i>Burkea africana</i> Hook	Kolo
	<i>Combretum collinum</i> Fresen.	Jan Tarauniya
	<i>Combretum molle</i> R. Br. ex G. Don.	Wuyan Damo
	<i>Anogeissus leiocarpus</i> (DC) Guill & Perr.	Marke
	<i>Terminalia schimperiana</i> Hochst	Baushe
4. Moraceae	<i>Terminalia laxiflora</i> Engl. & Diels	Farin Baushe
	<i>Combretum glutinosum</i> Perr.	Farar Tarauniya
	<i>Ficus platyphylla</i> Delile	Gamji
	<i>Ficus sycomorus</i> L.	Baure
	<i>Ficus iteophylla</i> Miq.	Shiriya

5. Meliaceae	<i>Azadirachta indica</i> A. Juss. <i>Khaya senegalensis</i> (Desr) A. Juss. <i>Pseudocedrela kotschy</i> (Schweinf.) Harms	Dogon yaro Madaci Tuna
6. Bombacaceae	<i>Adansonia digitata</i> L. <i>Ceiba pentadra</i> (L.) Gaertn. <i>Bombax costatum</i> Pellgr. & Vuillet	Kuka Rimi Kurya
7. Rubiaceae	<i>Gardenia aqualla</i> Stapf & Hutch. <i>Gardenia sokotensis</i> Hutch.	Gaude Gauden Kura
8. Verbenaceae	<i>Vitex doniana</i> Sweet <i>Parkia biglobosa</i> (Jacq.) R. Br. ex G. Don.	Dunya Dorowa
9. Rhamnaceae	<i>Ziziphus abyssinica</i> A. Rich <i>Ziziphus spina</i> – <i>Christi</i> (L.) Desf.	Magaryar Kura Kurna
10. Arecaceae	<i>Borassus aethiopum</i> Mart.	Giginya
11. Annonaceae	<i>Annona senegalensis</i> Pers	Gwandan Daji
12. Ebenaceae	<i>Diospyros mespiliformis</i> Hotcht ex A. DC	Kanya
13. Tiliaceae	<i>Grewia mollis</i> Juss.	Dargaji
14. Euphobiaceae	<i>Hymenocardia acida</i> Tul	Jan Yaro
16. Anacardiaceae	<i>Lannea acida</i> A. Rich.	Faru
17. Polygalaceae	<i>Securidaca longepedunculata</i> Fresen.	Uwar Magunguna
18. Sapotaceae	<i>Vitellaria paradoxa</i> Happer	Kade
19. Araliaceae	<i>Cussonia arborea</i> Hochst ex. A. Rich	Takandar Giwa
20. Umbelliferae	<i>Steganotaenia araliacea</i> Hochst.	Hano
21. Sterculiaceae	<i>Sterculia setigera</i> Delile	Kukuki
22. Papilionaceae	<i>Pterocarpus erinaceus</i> Poir .	Madobiya
23. Balanitaceae	<i>Balanites aegyptiaca</i> (L.) Delile	Aduwa
24. Celastraceae	<i>Maytenus senegalensis</i> (Lam.) Exell	Namijin Tsada
25. Cochlospermaceae	<i>Cochlospermum planchonii</i> Hook F.	Balge
26. Loganiaceae	<i>Strychnos spinosa</i> Lam.	Kokiya
27. Asclepiadaceae	<i>Calotropis procera</i> (Aiton) R. Br.	Tumfafiya
28. Ochnaceae	<i>Lophira lanceolata</i> Tiegh. ex Keay	Namijin Kade
29. Olacaceae	<i>Ximenia americana</i> L.	Tsada

The density, dominance, relative dominance and cover value of species found in the study area is presented in Table 2. *Detarium microcarpum* had the highest density, dominance and relative dominance and cover value, followed by *Piliostigma thonningii*, *Vitellaria paradoxa*, *Terminalia schimperiana*, *Combretum glutinosum*, *Combretum collinum* and *Ximenia americana* had the least value. The life form spectrum of woody plants indicated that, Microphanerophytes had the highest dominance value of 53%, followed by Nanophanerophytes and Mesophanerophytes with 39 and 8% respectively (Table 3). The presence of Microphanerophyte have been reported as colonizers of abandoned farmlands at Isiala Mbano, Imo State, Nigeria [15].)

The presence of 56 species, 45 genera in 28 families indicates a fairly diverse vegetation resource that should be given some level of protection for sustainability. The report of Mbaekwe and Isichie [16] on the ecology of *Piliostigma thonningii* on early successional plots in Northern Nigeria, observed that *Detarium microcarpum* was the dominant species in Kainji and Yawuri areas which fall within the same geographical location with the study area. Similarly, Oteng-Yeboah [17] reported the dominance of Combretaceae and Rubiaceae families in Sokoto vegetation. The dominance of Mimosaceae and Caesalpiniaceae in the vegetation of Sokoto have been reported [18,19]. The species encountered in the study area were more diverse from that of Sokoto which could largely be related to the climatic

conditions of the area with high rainfall distribution and intensity. The density and dominance of *Detarium microcarpum* and *Piliostigma thonningii* can be related to soils. These species can grow on different soils; Fine gravel silt, Silt – clayey, Silt – sandy, Silty – clayey, Fine gravel – sandy, Fine gravel and Sandy [20]. *Piliostigma* have very hard seed coats making them impermeable to water and therefore fail to germinate even in favourable environmental conditions. The seeds can remain in the soil and can germinate in varying depth of soil and can remain in the soil provided with moisture up to three months. This species also adapt, before the soil dries out they have already established themselves. The vegetation of this area is comparatively higher than that of Sokoto and Zamfara States

Table 2. Species Density, Dominance, Relative Dominance and cover value of woody Plants in Magama Local Government Area, Niger State, Nigeria

S/No	Species	Density (ha ⁻¹)	Dominance (m ² ha ⁻¹)	Relative Density (%)	Relative dominance (%)	Cover value
1.	<i>Detarium microcarpum</i>	1.7	1.22	11.3	13.9	25.221.
2.	<i>Piliostigma thonningii</i>	1.5	1.04	9.5	10.2	19.716
3.	<i>Vitellaria paradoxa</i>	1.4	0.98	9.3	9.7	19.0.
4.	<i>Terminalia schimperiana</i>	0.8	0.61	6.2	6.5	12.70.
5.	<i>Combretum collinum</i>	0.8	0.61	5.8	6.5	12.39.
6.	<i>Combretum glutinosum</i>	0.7	0.61	5.7	4.6	10.39.
7.	<i>Parkia biglobosa</i>	0.7	0.51	5.4	4.3	9.78.9
8.	<i>Annona senegalensis</i>	0.7	0.48	5.2	3.9	9.18.4
9.	<i>Combretum molle</i>	0.6	0.43	3.7	3.7	7.47.1
10.	<i>Acacia siebieriana</i>	0.6	0.43	3.2	3.7	6.95.9
11.	<i>Daniellia oliveri</i>	0.5	0.37	2.9	3.7	6.65.5
12.	<i>Acacia polyacantha</i>	0.4	0.27	2.7	3.3	6.04.8
13.	<i>Burkea africana</i>	0.4	0.27	2.3	2.4	4.7
14.	<i>Diospyros mespiliformis</i>	0.4	0.27	2.3	2.4	4.74.2
15.	<i>Lannea acida</i>	0.3	0.26	2.2	2.4	4.6
16.	<i>Prosopis africana</i>	0.3	0.26	2.2	2.4	4.6
17.	<i>Sterculia setigera</i>	0.3	0.23	2.2	2.1	4.3
18.	<i>Entada africana</i>	0.3	0.20	2.2	1.8	4.0
19.	<i>Hymenocardia acida</i>	0.3	0.20	2.2	1.8	4.0
20.	<i>Strychnos spinosa</i>	0.2	0.18	1.5	1.8	3.3
21.	<i>Tamarindus indica</i>	0.2	0.18	1.5	1.8	3.3
22.	<i>Gardenia aqualla</i>	0.2	0.13	1.5	1.2	2.7
23.	<i>Terminalia laxifora</i>	0.2	0.13	1.5	1.2	2.7
24.	<i>Steganotaenia araliaceae</i>	0.04	0.003	0.2	0.2	0.4
25.	<i>Acacia gourmaensis</i>	0.03	0.02	0.1	0.2	0.3
26.	<i>Azelia africana</i>	0.03	0.02	0.1	0.2	0.3
27.	<i>Cussonia arborea</i>	0.03	0.02	0.1	0.2	0.3
28.	<i>Gardenia sokotensis</i>	0.03	0.02	0.1	0.2	0.3
29.	<i>Grewia mollis</i>	0.03	0.02	0.1	0.2	0.3
30.	<i>Maytenus senegalensis</i>	0.03	0.02	0.1	0.2	0.3

31. <i>Sarcocephalis latifolus</i>	0.03	0.02	0.1	0.2	0.3
32. <i>Vitex doniana</i>	0.1	0.06	0.1	0.2	0.3
33. <i>Balanites aegyptiaca</i>	0.06	0.04	0.1	0.2	0.3
34. <i>Dichrotachys cinerea</i>	0.04	0.02	0.2	0.1	0.3
35. <i>Isoberlinia doka</i>	0.04	0.02	0.2	0.1	0.3
36. <i>Ziziphus spina-christi</i>	0.04	0.02	0.2	0.1	0.3
37. <i>Khaya senegalensis</i>	0.04	0.02	0.2	0.1	0.3
38. <i>Pterocarpus eranaceus</i>	0.04	0.02	0.2	0.1	0.3
39. <i>Azadirachta indica</i>	0.04	0.02	0.2	0.1	0.3
40. <i>Bombax costatum</i>	0.04	0.02	0.2	0.1	0.3
41. <i>Ceiba pentandra</i>	0.005	0.003	0.1	0.02	0.1
42. <i>Ficus sycomorus</i>	0.005	0.003	0.1	0.02	0.1
43. <i>Securidaca longepedunculata</i>	0.005	0.003	0.1	0.02	0.10.1
44. <i>Acacia gerrardii</i>	0.005	0.003	0.1	0.02	0.1
45. <i>Adansonia digitata</i>	0.005	0.003	0.1	0.02	0.1
46. <i>Calotropis procera</i>	0.005	0.003	0.1	0.02	0.1
47. <i>Ficus iteophylla</i>	0.1	0.06	0.05	0.05	0.1
48. <i>Ficus platyphylla</i>	0.1	0.06	0.05	0.05	.1
49. <i>Lophira lanceolata</i>	0.1	0.06	0.05	0.05	0.1
50. <i>Ziziphus abyssinica</i>	0.1	0.06	0.05	0.05	0.1
51. <i>Acacia nilotica</i>	0.08	0.05	0.04	0.04	0.08
52. <i>Anogeissus leiocarpus</i>	0.08	0.05	0.04	0.04	0.08
53. <i>Borassus aethiopum</i>	0.06	0.04	0.03	0.03	0.06
54. <i>Cochlospermum planchonii</i>	0.06	0.04	0.3	0.3	0.06
55. <i>Pseudocedrela kotschyi</i>	0.06	0.04	0.3	0.3	0.06
56. <i>Ximenia americana</i>	0.06	0.04	0.3	0.3	0.06

Table 3. Life form spectrum of woody plants in Magama Local Government Area, Niger State, Nigeria

Life form	Frequency	Percentage (%)
Nanophanerophyte	78	39
Microphanerophyte	106	53
Mesophanerophyte	16	8

From the result obtained in this study, it was observed that grazing animals especially cattle and movement of sand which cause seed abrasion due to their hard texture they are able to withstand digestion by animals which forage on the fruits and the seed were passed through cow dung [21,22]. The fruits of *Detarium* and *Piliostigma* are highly palatable not only to human for their seeds but also the cattle for pulp. Cattle eat the fruits when dried; therefore seeds have to withstand digestion which provides opportunity for colonizing new habitats. The hard seeds also resist fires for these reasons, *Detarium* and *Piliostigma* often occur in colony where few other species are found. The most prominent species were *Isoberlinia doka*, *Prosopis africana* and *Anogeissus leiocarpus*. Most of the species encountered have thick fissured bark which is an adaptive feature against drought and fire. For example, *Vitellaria*, some have thin flaking bark and dropping branches and *Anogeissus*.

Cussonia have leaves glabrous, shiny pointed at both ends to minimize loss of water through transpiration. *Combretum*, *Anogeissus* and *Terminalia* carry winged seeds that are easily dispersed by wind. Some have leaves with hairs, waxy surfaces, and thick cuticles and of small size that regulate transpiration. Dispersal by explosive mechanism is common among leguminous species like *Acacia* species. Species like *Lophira* and *Daniellia* are deciduous and shed their leaves before the onset of bush fire during dry season.

It was observed that excessive logging, roads, dams constructions, Agriculture, overgrazing, bush burning by game and honey gatherers are so rigorous in the area which resulted in the destruction of many species like *Khaya*. Climatic factors such as drought and erosion also served as a threat to species in the area. Species in the genus *Isoberlinia*, *Daniellia*, *Parkia* and *Vitellaria* are now being cut down for timber production and their barks, roots, fruits, and leaves are over harvested for medicinal and other purposes. Generally, all the plants identified in the study area are naturally adapted to the area. Species of *Khaya* are now being grown because many species are becoming vulnerable due to human factors. Generally, it was observed that plantation of *Azadirachta* are increasing in the area as shelter belts as wind breaks. This species has the potential to displace some indigenous ones because of its fast growth and drought resistance. Selective fodder browsing by increasingly large number of cattle coming to the area profoundly influences species distribution. Thorny species and those with tall canopy are usually avoided to the detriment of shorter more palatable ones, hence, the dominance of Caesalpiniaceae, Combretaceae and Mimosaceae become apparent as observed in this study. Families Caesalpiniaceae, Combretaceae, Mimosaceae and Sapotaceae are the dominant families in the vegetation. Although, the study area is different from Isiala Mbalo based on climatic and edaphic factors but microphanerophytes dominate the area. In Magama Local Government of Niger State, a similar observation on the dominance of Microphanerophyte was observed. Microphanerophyte dominate the life form because the perennating buds (2-8 m above the ground) tend to escape the effects of seasonal bush fires that kill most grasses and severely damage the nanophanerophytes (<2m in height). However, further growth to mesophanerophytes (8-29m high) and megaphanerophytes (>29 m high) is checked by intervening dry season of about five month when growth activities in the perennating buds is only minimal.

4. CONCLUSION

The study revealed that the vegetation of Magama Local Government is diverse and requires forest management practices by the local community in the conservation and sustainable exploitation of plant resources in the area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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