



Floristic composition and community structure of woody species in a southern guinea savanna in Agbeji and Ajabalaka, Kogi state, Nigeria

Fatimoh Ozavize Ademoh¹, Akinjide Moses Afolabi², Fedelis Ugbede Egwaba³

^{1,3} Department of Biological Sciences, Kogi State University, Anyigba, Kogi State, Nigeria

² Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

The study determined the species composition of the study areas. This was with a view to determining some structural characteristics of the vegetation and the dominant tree species. 0.09 ha of two selected sample plot were established in the study area and woody plant species with girth and height of ≥ 1 cm and ≤ 1 m respectively were completely enumerated, identified to species level and their girth size were measured at breast height (gbh). The number of species, genera and families were established for the studied plots. The data collected were used to calculate species diversity index, basal area, species evenness and the stem density of tree species. The result showed that in Plot A, 55 plants (trees and shrubs) representing 25 species, 24 genera and 16 families and in Plot B, 49 plants (trees and shrubs) representing 19 species, 18 genera and 15 families were documented in each 0.09. Stem density was found to be 605 and 539 stem ha⁻¹ respectively. The basal area of the species in the plots were 27.4168 m² h⁻¹ and 12.87 m² h⁻¹ respectively. The dominant tree species in the Agbeji (plot A) were *Acacia senegal*, *Cochlospermum planchonii*, *Elaeis guineensis* and in plot B *Cochlospermum planchonii* and *Irvingia wombolu* were the dominant species. The findings of this study serve as baseline information for monitoring the ecological dynamics of the study areas.

Keywords: diversity, ecosystem dynamics, fire, floristic composition, savanna, evenness

1. Introduction

Savanna biome is depicted by heterogeneity in the physiognomy and spatial structure of the vegetation [1, 2, 3, 4] where a mosaic with high and low-cover patches is invented by the varied proportion of woody plants interspersed in a grass matrix [5].

The savanna is characterized by relatively poor ecosystems which are result of human disturbances such as the cutting down of flora for fuel, construction materials and poles, furniture, the harvesting of non timber forest products, medicines, the overgrazing and bush fires [6, 7]. These factors induce a remarkable degradation of flora, leading to their paucity and the alteration of the ecosystems as well as a significant loss of biodiversity [8, 9].

Noss [10], itemize some measures for monitoring vegetation condition. These are compositional, structural, and functional indicators. Compositional indicators include identity attributes, such as species richness and diversity, vegetation types, presence of threatened species and relative cover of exotic and indigenous species. Structural indicators are measures of the three dimensional arrangement of the vegetation such as the density of different plant forms, density of tree hollows, canopy cover and groundcover components, patch size and landscape context. Functional indicators include ecological processes and vegetation history, such as disturbance history, tree health, and nutrient cycling.

Vegetation structure generally considers the composition of plant community in terms of specific morphological characteristics while composition is the floristic assemblage of

plant species that characterize the vegetation [11]. Information on structural characteristics of vegetation is highly demanded both globally and locally. On the global scale, more detailed and standardized data on biomass and vegetation structure of vegetation units are needed [12, 13] in order to parameterize global vegetation maps [14]. On the local scale, information on structural characteristics of vegetation as well as standardized inventories of these properties are important for detailed structural descriptions of both the tree and the herb layer with respect to the stratified vegetation types, and secondly, to compare the vegetation types in terms of structural parameters [15, 16].

Fire has influenced the nature of the savannas over the course of their evolution. Fire has become more frequent as the continent has dried out. Indigenous people have used fire in the savannas for tens of thousands of years, and people continue to use fire for many types of land management purposes. In most tropical agro-ecosystems where land cover fluxes are rapid than natural restoration, tree species composition, distribution and diversity are particularly susceptible to change from continuous stress factors such as bushfires, logging and cultivation [17, 18]. With the reoccurrence of savanna fire, the tree component of vegetation must therefore be constantly monitored and managed in order to direct successional processes towards maintaining species and habitat diversity [19, 20]. Hence, this study investigate the woody species in the southern Guinea savanna at Agbeji and Ajabalaka, Nigeria.

2. Materials and Methods

2.1 Study area

This study was conducted in the eastern part of Kogi, Nigeria. Two sample plots, one at Agbeji (Dekina Local Government Area) and the other at Ajabalaka (Igalamela-Odolu Local Government Area) were used for this study. The latitude and longitude of Agbeji and Ajabalaka are 7° 30' N longitude 7° 10' E and 7° 10' 16" N, 6° 49' 35" E respectively.

2.1.1 Vegetation

The vegetation consists of rain forest on the eastern and typical wood land savanna and grassland to the western part. This vegetation is as a result of heavy rainfall incidence which is usually prolonged [21]. White [22] described this type of vegetation as the mosaic of Lowland Rainforest and secondary Grassland.

There are two prominent seasons in these areas, the rainy season and the dry season. The dry season begins in November, ends in February and a lengthy rainy season from March to October. The mean annual rainfall of this area is 1,808 mm [23]. The temperature varies throughout the year, with an average monthly temperature which ranges between 17°C to 36.2°C. Relative humidity is moderately high and varies from an average of 65 - 85% throughout the year [23].

2.2 Data collection

2.2.1 Sampling procedure

Two sample plots, 30×30 m each, were used for this study, plot A (Agbeji in Dekia Local Government Area) and Plot B (Ajabalaka in Igalamela-Odolu Local Government area). Woody species (shrubs and trees) 1 m and above in height, were completely enumerated, identified to species level. Their girth sizes were measured at breast height (gbh 1.3 m or above all buttresses or stem deformities) for the trees that are 3 m and above in height and at midpoint for those less than 3 m in height. Climbers were removed before girth measurements were taken.

2.2.2 Data processing and statistical analyses

Species identification and nomenclature followed the Flora of West Tropical Africa [24] and Trees of Nigeria [25]. For each plot, the number of tree species (species richness), genera and families were established. Tree species diversity was calculated using [26] Formula: $H^1 = -\sum ni/N \ln ni/N$; where ni is the importance value for each species, N is total importance value.

Species evenness was calculated as Pielou's evenness index $J^1 = H^1/\ln S$;

where S is the total number of species. J^1 is constrained between 0 and 1.

The less variation in communities between the species, the higher J^1 is.

Basal area ($m^2 ha^{-1}$) was calculated for each tree species in each plot. The girth measurement for each individual tree was used to calculate the basal area using the formula:

Basal area ($m^2 ha^{-1}$) = $C^2/4 \Pi$, where C = girth size (circumference) in metres. The total basal area for each species was determined by adding the basal areas of

individuals of the species and the total basal area for each plot was calculated by adding the basal areas of all the species in the plot.

Determination of size-class distribution in the plots followed six stem girth size-classes (GBH): (i) 0-20 cm (ii) 21-40 cm (iii) 41-60 cm (iv) 61-80 cm (v) 81-100 (vi) > 100 cm. Frequency distribution of stem density (ha^{-1}) size classes were drawn for the two plots.

3. Result

3.1 Tree species composition of the plots

In plot A, a total of 55 plants (trees and shrubs) were present in the 0.09 ha representing 25 species, 24 general and 16 families (Table 1). In plot B a total of 49 plants (trees and shrubs) representing 20 species, 19 genera and 15 families were documented in 0.09 ha (Table 2).

The most frequent occurring families in plot A were Anacardiaceae (18.8%), Ephorbiaceae (18.8%) and mimosoidaea (25%) (Table 1) while plot B had Euphorbiaceae (35.7%) as the only dominant plant families.

The most abundant plant species within plot A were *Acacia senegal* (66), *Cochlospermum planchonii* (99) and *Elaeis guineensis* (88) while plot B had *Cochlospermum planchonii* (111) and *Irvingia wombolu* (55) most abundant plant species (Table 1, 2).

The rare species which are species having only one individual each in plot A include *Albezia lebeck*, *Cruetis ferruginea*, *Daniellia oliveri*, *Ficus sur*, *Hippocratea indica*, *Hymenocardia acida*, *Khaya senegalensis*, *Manihot esculentum*, *Mangifera indica*, *Melicia excelsia*, *Parkia biglobosa*, *Paulina pinnata*, *Prosopis africana*, *Reissantia indica*, *Waltheria indica*. While in plot B *Alchornea cordifolia*, *Anacardium occidentale*, *Combretum spp*, *Indigofera macrophylla*, *Mallotus subulatus* *Prosopis africana*, *Spathodea campanulata*, *Waltheria indica*, *Zanthoxylum rubescens* were the rare species.

3.2 Structural characteristics of the savanna.

The total stem density in Plot A was 605 stem ha^{-1} and 539 stem ha^{-1} in plot B (Table 3). The Shannon weiner index of diversity (H^1) were 2.79 (Plot A) and 2.65 (plot B) (Table 3). The basal area of the tree species were 27.41 $m^2 ha^{-1}$ (plot A) and 12.38 (Plot B). In plot A the species that contributed to the basal area were *Acacia senegal* (9.76), *Elaeis guineensis* (14.92) and (Table 1).

Species density in plot A (605 ha^{-1}) was higher than that of the plot B (539 ha^{-1}) (Table 3). The basal area of the plants in plot A 27.41 $m^2 ha^{-1}$ is higher than 12.87 $m^2 ha^{-1}$ in plot B (Table 3). There were differences in the plant species in the two plots contributing to highest proportion of the basal area. In plot A the plant species that contributed to the basal area were *Elaeis guineensis* (14.92 $m^2 ha^{-1}$, 54.43%) been the highest followed by *Acacia senegal* (9.76 $m^2 ha^{-1}$, 35.61%) *Khaya senegalensis* (1.14 $m^2 ha^{-1}$, 4.2 %) (Table 1) while plot B *Prosopis africana* (28.83 $m^2 ha^{-1}$, 9.1%) had the highest basal area followed by *Azadirachta indica* (2.77 $m^2 ha^{-1}$, 21.52%), *Securinega virosa* (1.94 $m^2 ha^{-1}$, 15.07%) and *Irvingia wombulu* (1.26 $m^2 ha^{-1}$, 9.79%) (Table 2).

Table 1: Species composition, Density (ha^{-1}) and total basal area ($\text{m}^2 \text{ha}^{-1}$) of tree species in a southern Guinea savanna, plot A, Agbeji, Nigeria.

	Species	Family	Density (ha^{-1})	Basal Area ($\text{m}^2 \text{ha}^{-1}$)
1	<i>Acacia senegal</i> (L.)	MIM	66	9.7635
2	<i>Albizia lebbek</i> (L.) Benth	MIM	11	0.007
3	<i>Alchornea cordifolia</i> (Schum. & Thonn.) Mull. Arg.	EUP	22	0.0087
4	<i>Anacardium occidentale</i> L.	ANA	22	0.0224
5	<i>Anthoclesita djalensis</i> A. Chev.	LON	22	0.2885
6	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	AST	33	0.0032
7	<i>Cochlospermum planchonii</i> Hook.f.	COC	99	0.2183
8	<i>Cnestis ferruginea</i> Vahl ex DC.	CON	11	0.0042
9	<i>Daniellia oliveri</i> (Rolfe) Hutch. & Dalz.	CAE	11	0.0087
10	<i>Dialium guineensis</i> Willd.	LEG	22	0.2844
11	<i>Elaeis guineensis</i> Jacq.	ARE	88	14.9232
12	<i>Ficus sur</i> Forssk.	MOR	11	0.0088
13	<i>Harungana madagascariensis</i> Lam. ex Poir.	HYP	22	0.0651
14	<i>Hippocratea indica</i> (Willd.)	CEL	11	0.0004
15	<i>Hymenocardia acida</i> Tul.	EUP	11	0.0056
16	<i>Irvingia gabonensis</i> (Aubry-Lecomte ex O'Rorke) Baill.	IRV	33	0.0186
17	<i>Khaya senegalensis</i> Desr. (A. Juss.)	MEL	11	1.14116
18	<i>Lannea barteri</i> (Oliv.) Engl.	ANA	22	0.249
19	<i>Mangifera indica</i> L.	ANA	11	0.0179
20	<i>Manihot esculenta</i> Crantz	EUP	11	0.0022
21	<i>Milicia excelsa</i> (Welw.) C.C.Berg	MOR	11	0.0787
22	<i>Parkia biglobosa</i> Jacq Benth	MIM	11	0.2188
23	<i>Prosopis Africana</i> (Guill., Perrott. and Rich.) Taubert	MIM	11	0.0787
24	<i>Reissantia indica</i> (Willd.) N.Hallé	CEL	11	0.0014
25	<i>Waltheria indica</i> L.	STR	11	0.0008
	Total		605	27.4193

Note: Families are given as mnemonic three letter acronym following Weber ^[27].

Girth size class distribution of all plant species (≥ 1 cm gbh, ≥ 10 cm dbh) in plot A showed that there were greater number of individuals in the girth size classes 0–20 cm and ≥ 100 cm whereas 81–100 cm had no individual at all (Figure 1). In plot B girth size classes 0–20 cm and ≥ 100 had the greater individuals and lowest number of individuals in the girth size classes of 61–80 cm. The two plots had equal number of individual in girth size classes 0–20 cm, 21–40cm and 61–80

cm while the number of individual in girth size classes 41–60 cm and >100 cm varies (Figure 3).

The girth size-class distribution of stems shows that plant species which fall within 0-20 cm girth size-class in the plots constitute the largest part of the population (60.0 - 67.3 %) (Table 4, Figure 3). In plot A girth size-class of 81-100 cm had the lowest proportion while in plot B girth size-class of 61- 80 cm had the lowest (2.0 %) (Table 4, Figure 3).

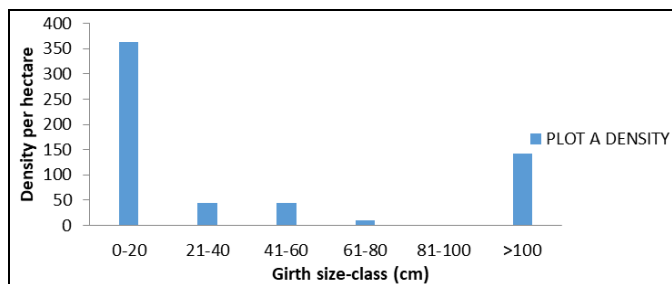
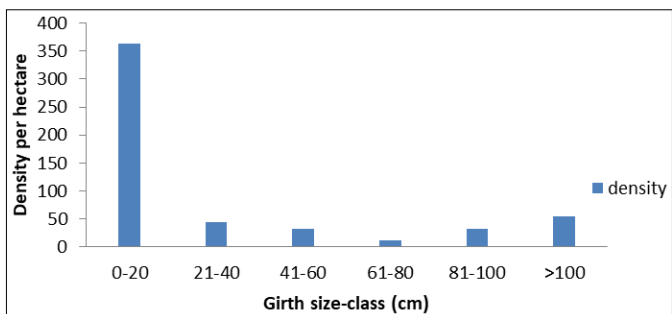
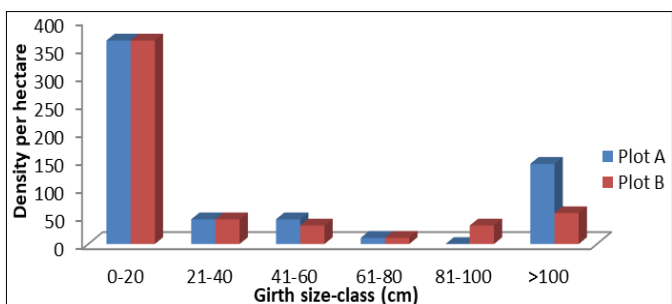
Table 2: Species composition, density (ha^{-1}) and total basal area ($\text{m}^2 \text{ha}^{-1}$) of tree species in a southern Guinea savanna in Plot B Ajabalaka, Nigeria

S/N	Species	Family	Density (ha^{-1})	Basal Area ($\text{m}^2 \text{ha}^{-1}$)
1	<i>Alchornea cordifolia</i> Schum. & Thonn.) Mull. Arg.	EUP	11	0.638
2	<i>Alchornea laxiflora</i> (Benth.) Pax & K. Hoffin.	EUP	33	0.527
3	<i>Anacardium occidentale</i> L.	ANA	11	0.617
4	<i>Anthonatha microphylla</i> P. Beauv.	EUP	33	0.111
5	<i>Azadirachta indica</i> A.Juss.	MAL	22	2.769
6	<i>Cnestis ferruginea</i> Vahl ex DC	CON	22	0.004
7	<i>Cochlospermum planchonii</i> Hook.f.	COC	110	0.377
8	<i>Combretum spp</i>	COM	11	0.022
9	<i>Elaeis guineensis</i> Jacq.	PAL	33	0.308
10	<i>Indigofera macrophylla</i> Schum and Thonn.	LEG	11	0.009
11	<i>Irvingia wombolu</i> Vermoesen	IRV	55	1.257
12	<i>Isoberlina doka</i> Craib & Stapf lerhwi	FAB	33	0.075
13	<i>Mallotus subulatus</i> Mull. Arg.	EUP	11	0.035
14	<i>Newbouldia laevis</i> (P.Beauv.) Seem.	BIG	55	0.071
15	<i>Prosopis africana</i> (Guill., Perrott. and Rich.) Taubert	MIM	11	3.714
16	<i>Securinega virosa</i> (Roxb. ex Willd.) Baill.	EUP	44	1.94
17	<i>Spathodea campanulata</i> P. Beauv.	BIG	11	0.028
18	<i>Waltheria indica</i> L.	STR	11	0.035
19	<i>Zanthoxylum rubescens</i> (Planch ex. Hook. F.) Engl. Ex Watterm.	RUT	11	0.336
	Total		539	12.873

Note: Families are given as mnemonic three letter acronym following Weber ^[27].

Table 3: Some Structural and Diversity Parameters of the southern Guinea Savanna in Plot A and Plot B.

Vegetation Parameter	Plot A	Plot B
Stem density (stem ha ⁻¹)	605	539
Basal area (m ² ha ⁻¹)	27.41	12.87
Species richness (0.09ha ⁻¹)	25	19
Number of genera	24	19
Number of family	16	15
Shannon – Weiner index (H ⁻¹)	2.79	2.65
Pielou's evenness index	0.698	0.682

**Fig 1:** Girth size-class distribution of woody species in the southern Guinea savanna at Agbeji, Nigeria**Fig 2:** Girth size-class distribution of woody species in the southern Guinea savanna at Ajabalaka, Nigeria**Fig 3:** Girth size-class distribution of woody species in the southern Guinea savanna at Agbeji and Ajabalaka, Nigeria.**Table 4:** Density per girth size-classes at Agbeji and Ajabalaka in Nigerian southern Guinea savanna.

Girth size-class distribution cm	Density ha ⁻¹	
	Plot A	Plot B
0-20	363	363
21-40	44	44
41-60	44	33
61-80	11	11
81-100	-	33
>100	143	55
Total	605	539

4. Discussion

The result of this study showed the floristic composition and structural characteristic of the vegetation. Some of the species encountered in this study (*Prosopis africana*, *Khaya senegalensis*, *Parkia biglobosa*, *Daniella oliveri*, *Dialium guineense*, *Albizia lebbek*) corroborated with the report of [28] who reported similar species when evaluating the phytoecological indicator species in the airborne palynomorphs in Anyigba Kogi State. The differences in the species composition that is species, genera and families observed in this study agree with the observation of [30] who reported differences in the structural composition of the communities in kashimi forest reserve Nigeria when studying its savanna woodland. The differences may be due to the level of disturbance such as logging, grazing, clearing of vegetation for agricultural purpose e.t.c. Hence, the more disturbed a vegetation is the more trees are likely to differ in number of species, genera and family. The total stem density recorded in this study, 605 ha⁻¹ and 539 stem ha⁻¹ were lower than the range of 700-1038 reported by [31] and [32] in their study of the Miombo woodlands. The value of stem density might be as a result of land use practices and disturbance.

The diversity index 2.79 (plot A) and 2.65 (plot B) recorded in this study fall within the range (1-2.85) recorded in Miombo woodland [33, 31, 34] and 2.24- 3.39 reported by [35] at federal university of agriculture Makurdi, Nigeria. The total basal area of 27.41 m² ha⁻¹ recorded in plot A is higher than 20.7 m² ha⁻¹ basal area reported by [30] in their study in Nigeria. This is also higher than the range 8-16.7 m² ha⁻¹ reported in other studies in Tanzania [36, 32]. Basal area of 12.87 m² ha⁻¹ recorded in plot B falls within the range 8-16.7 m² ha⁻¹ reported in other studies in Tanzania [36, 31]. The result of basal area in plot A could be due to the large girth sizes of some species that were not so much disturbed in the vegetation.

The highest proportion of plant species of girth size-class distribution of 0 -20 cm observed in the two plots studied is similar to the observation of many researchers in secondary rain forest [37, 38] that the lower girth size-class has more stems than the higher girth size-class. This might be due to less disturbance from natural and anthropogenic sources.

5. Conclusion

This study revealed the floristic composition of the study area. Furthermore, total stem density, basal area, species diversity index and species evenness index of the woody species were also revealed. Information on the rare species and the abundant species in the plots were documented. Nevertheless, there is a short coming to the findings, which is paucity of information on the evenness, basal area, species diversity of this areas in the past for proper comparison.

6. References

1. Amhakhian SO, Osemwota IO. Physical and chemical properties of soil in Kogi State, Guinea Savanna of Nigeria. *Journal of Soil Science*. 2012; 22(1):44-52.
2. Ratter JA, Ribeiro JF, Bridgewater S. The Brazilian cerrado vegetation and threats to its biodiversity. *Annals of Botany*. 1997; 80:223-230.
3. Augustine DJ. Spatial heterogeneity in the herbaceous layer of a semi-arid savannah ecosystem. *Plant Ecology*. 2003; 167:319-332.
4. Bucini G, Hanan NP. A continental-scale analysis of tree cover in African savannahs. - *Global Ecology and Biogeography*. 2007; 16:593-605.
5. Levick SR, Asner GP, Kennedy-Bowdoin T, Knapp DE. The relative influence of fire and herbivory on savannah three dimensional vegetation structure. *Biological Conservation*. 2009; 142:1693-1700.
6. Sarmiento G. The ecology of Neotropical savannahs. Cambridge. University Press, Harvard, 1984, 235.
7. Wafo TG, Huynh F. Caractérisation etsuividerecul des ligneuxdans les aires protégéesdunord Cameroun analyse par télédétection spatiale dans la réserve de Kalfou. Journéed' animationscientifique (JAS09) de l'AUF Alger, 2009, 7.
8. Madi A, Huub P, Sali B. La demandeurbaine en bois énergie et nécessité' unegestionrationnelle des ressourcesnaturelles: le cas de la ville de Maroua à l'Extrême Nord du Cameroun. The urban need in firewood and the necessity of a rational management of natural resources. *African savanna landscapes in mutation*, 2003, 9.
9. Khresat SA, Rawajfih Z, Mohammad M. Land degradation in north-Hadande Jordan: causes and processes. *Journal Arid Environment*, 1998; 39: 623-629.
10. Darkoh MBK. Regional perspectives on agriculture and biodiversity in the drylands of Africa. *Journal of Arid Environment*. 2003; 54:261-279.
11. Noss RF. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Conservation Biology*. 1990; 4(4):355-364.
12. Martin GJ. *Ethnobotany: A method manual*. Botanic Garden, Kew. Chapman and Hall press, United Kingdom, 1996.
13. Brown S, Gaston G. Estimates of Biomass Density for Tropical Forests. In: Levine J. S. (ed.), *Biomass Burning and Global Change* Cambridge, The MIT Press, 1996, 133-139.
14. Food and Agricultural Organization – FAO. *Global forest resources assessment*, 2001.
15. Loveland TR, Zhu Z, Ohlen DO, Brown JF, Reed BC, Yang L. An analysis of the IGBP global land-cover characterization process. *Phytogrammetric Engineering and Remote Sensing*. 1999; 65:1021-1032.
16. Hahn K. Die Pflanzengesellschaften der Savannen im Südosten Burkina Fasos (West afrika). Ihre Beeinflussung durch den Menschen und die Naturräumlichen Gegebenheiten, Diss. JWG. Universität, Frankfurt a. Main, 1996, 208.
17. Devineau JL, Fournier A, Kalog B. Les sols et la végétation de la région de Bondoukui (Ouestburkinabé). - ORSTOM, Paris, 1997.
18. Uhi C. Factors controlling succession following slash-and-burn agriculture in Amazonia. *Journal of Ecology*, 1987; 75:377-407.
19. Lykke MA. Assessment of species composition change in savanna vegetation by means of woody plants' size class distributions and local information. *Biodiversity and Conservation*. 1998; 7:1261-1275.
20. Pickett STA, White SP. *The theory of natural disturbance and patch dynamics*. Academic press Inc. New York, 1985, 472.
21. Turner MG. *landscape heterogeneity and disturbance*. Springer-Verlag, New York, 1987.
22. Frank OO, Paul OJ. Assessment of soil fertility status in some areas of kogi east agroecological zone of kogi state. *Journal of Agriculture and Rural Research*, 2017; 1(2):56-62
23. White F. *The Vegetation of West Africa*. UNESCO, Paris, 1983, 356.
24. Amhakhian SO, Oyewole CI, Isitekhale HH. Effect of different levels of phosphorus on the growth and yield of maize (*Zea mays l.*) in Ofere (Basement Complex) soils Kogi State, north central ecological zone. *Nigeria Continental Journal of Agricultural Science*. 2010; 4:20-28.
25. Hutchinson J, Dalziel JM. *Flora of West Tropical Africa*. (Revised by Keay RWJ, Hepper FM.) Crown Agents for Overseas Governments, London, 1954-1972.
26. Keay RWJ. *An Outline of Nigerian Vegetation*, third ed. - Government Printer, Lagos, Nigeria, 1959.
27. Shannon CE, Weiner W. *The Mathematical Theory of Communication*. University of Illinois Press, Urbana, 1949, 117.
28. Weber WA. Mnemonic three letter acronym for the families of vascular plants: A device for more effective herbarium curation. *Taxonomy*. 1982; 31:74-82.
29. Essiem BC, Nkang AE. Evaluation of the phytocological indicator species in the airborne palynomorphs from Anyigba, Kogi State, Nigeria. *Standard Scientific Research and Essays*. 2013; 1(14):398-402.
30. Agwu Jibrin A, Jaiyeoba IA. Characterization of structural composition and diversity of vegetation in the Kpashimi forest reserve, Niger state, Nigeria. *Journal of Geography and Geology*. 2013; 5(3):75-87.
31. Isango JA. Monitoring growth and impact of harvesting options, shifting cultivation and grazing on vegetation growth in miombo woodlands of Iringa District, Tanzania. A collaborative report submitted to Mema/DaniaIringa, tafari, 2004.
32. Backeus I, Pettersson B, Ruffo C. Tree communities and structural dynamics in miombo (*Brachystegia-Julbernadia*) woodlands, Tanzania. *Forest Ecology and Management*. 2006; 230:171-178.
33. Tuite P. The ecological status of miombo woodlands in Southern Tanzania. Ph.D. thesis. University College Dublin, 1992.

34. Malimbwi RE, Kielland-Lund J, Nduwanungu J. Species diversity and standing crop development in four miombo vegetation communities. Faculty of forestry, Sokoine University of Agriculture, Morogoro, Tanzania, 1998.
35. Ikyagba TE, Tee TN, Dagba BI, Ancha UP, Ngibo KD, Tume C. Tree composition and distribution in federal university of agriculture Makurdi, Nigeria. *Journal of research in forestry, wildlife and environment*. 2015; 7(2):147-157.
36. Boaler SB, Sciwale KC. Ecology of miombo site, Lupa north forest reserve, Tanzania: Effects on vegetation of local cultivation practices. *Journal of Ecology*. 1966; 54:577-578.
37. Ademoh OF, Muoghalu JI, Onwumere B. Temporal pattern of tree community dynamics in a secondary forest in southwestern Nigeria, 29 years after a ground fire. *Global Ecology and Conservation*. 2017; 9:148-170.
38. Muoghalu JI. Tree species population dynamics in a secondary forest at Ile-Ife, Nigeria after a ground fire. *African Journal of Ecology*. 2006; 45:62-71.