ISSN 2349-7823

International Journal of Recent Research in Life Sciences (IJRRLS)
Vol. 10, Issue 1, pp: (41-50), Month: January - March 2023, Available at: www.paperpublications.org

TREES SPECIES DIVERSITY AND SOIL PHYSIOCHEMICAL PROPERTIES IN UKPON FOREST RESERVE, CROSS RIVER STATE, NIGERIA

[1]Esor .P.E., [2]Iwara, I.O., [3]Omini, D.I

[1]Lead Environmental Consultant, Zero Handle Limited Bristol UK.

[2,3] Department of Forestry and Wildlife Management, Cross River University of Technology Calabar

DOI: https://doi.org/10.5281/zenodo.7728375

Published Date: 13-March-2023

***Abstract*: In Okpon river forest reserve, soil nutrients play an important role in the formation of plant communities. In this study, trees species diversity and soil physiochemical properties in Ukpon river forest reserve cross River State, Nigeria was assessed using Systematic line transects and purposive sampling techniques for plots demarcation and data collection. Data were analyzed using descriptive statistics such as tables, frequencies and diversity indices were analyzed using 'R' soft wear. 65 tree species in 32 families and 10 genera were identified. Meliaceae, (6) Caesalpiniceae and Moraceae (5) families each were the most abundant families individuals population.). The highest relative frequency (2.256%) and (2.241%) were recorded in *Melicia excelsa*. Relative dominance (4.970%) was highest in *Bianella toxisperma*. IVI recorded the highest value (4.970%) in *Melicia excelsa* . The highest dbh and tree height were (80.5cm) and (68.3m). Shannon wiener index was (5.058), Margelef index (36. 097) and species richness (68). However, it is necessary to understand the phenology of the forest reserve, to study whether seeds or fruits produced are adequate, physiological conditions to germinate and growth into wildlings for regeneration purpose.**

***Keywords:* Trees, Species, Soil, Ukpon River.**

1. INTRODUCTION

Forest is an important earth 's natural resources and a driver of several ecosystem processes including nutrient storage and recycling, air purification and wildlife habitats. Information on forest structure is an essential component for sustainable forest management and planning. The value and importance of forest structure is very crucial especially when considering tropical rainforests which contain trees with reasonable height and diameters (Onyekwelu *et al*,. 2003). Different researchers have shown that the forests together with the biotic and abiotic community support structure and play several roles in the ecosystem functioning. This become necessary to investigate the influence of different plant communities on soil because it will provide the necessary ecological data which will be used to generate better conservation work and resources management decision. In previous studies, have shown that there is inevitable relationship existing between plant species abundance and the physicochemical properties of soil in many areas (Adekunle, 2004).

The growth and geographic distribution of flora are greatly affected by the environment. This is because if any environmental factor is less than ideal, it limits plant's growth and distribution. Soil and vegetation exhibit and form an integral relationship. On the one hand, soil gives support (moisture, nutrient, and Anchorage) to vegetation to grow effectively; while on the other hand, vegetation provides protective cover for the soil, reduces/prevents soil erosion, and

ISSN 2349-7823

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helps to maintain soil nutrient through litter accumulation and subsequent decay (nutrient cycling). Hence, vegetation and soil are interconnected and offer reciprocal effects to each other. According to Brant *et al*, (2006), soil characteristics are strongly affected by the vegetation of an ecosystem, including soil volume, structure, texture, P^H productivity, and the floristic composition. Plants are mostly attracted to locations where site conditions are favorable to them. As such, any modification in species distribution and abundance in any environment may be indication of the variation in soil properties (Engler and Guisan, 2009). In addition, the improvement of soil nutrient status under their canopies are attributes of tree species of the habitat (Gedda, 2003).

Investigation on abiotic factors of an ecosystem such as the Ukpon River Forest reserve is therefore important because it will elucidate the possible limiting factors in the soil controlling species diversity and abundance . Specifically, it is worth to know which soil properties presently are consistent with the tree species diversity and distribution found in Ukpon River Forest reserve.

2. MATERIALS AND METHODS

2.1 study area

Okpon River forest reserve was Gazetted by Cross River State in 1930.The reserve occupied a land mass of 31,300 hectares of land, covering two Local Government Areas, Obubra and Yakurr respectively. The Reserve lies between Latitudes 5^0 . 40^1 ,$5^0.50^1$ and $6^0.00^1$, 6^0 .10^1 North of the Equator and Longitude 8^0. 10^1 ,8^0. 20^1 and $8^0.30^1$, 8^0. 40^1 East of the Greenwich Meridian · The reserve is bounded in the North by Etung and Ikom LGA, South Baise, LGA, West Abi LGA to the East Eboyi State.

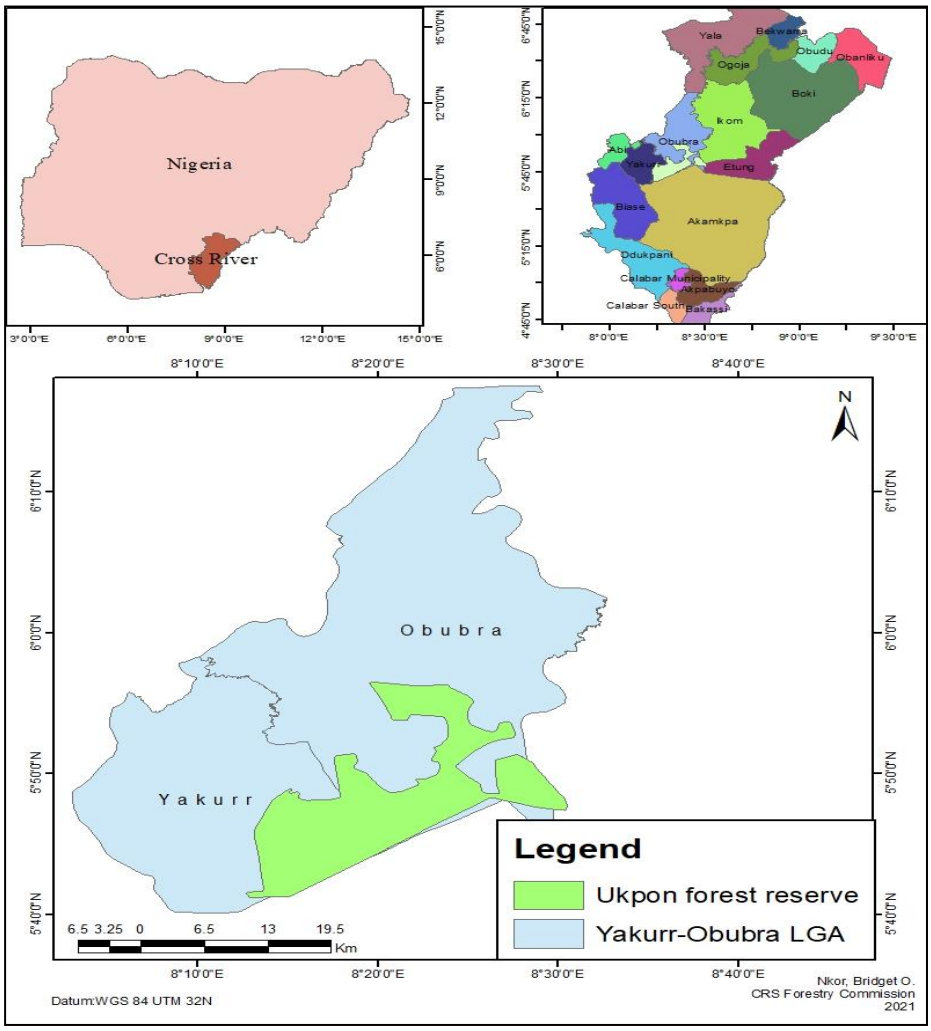

Figure 1: Map of Okpon River Forest Reserve

ISSN 2349-7823

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2.2 Tree sampling Techniques/Procedure

Systematic and purposive sampling techniques was adopted to established transects and plots selection. (8) transects were laid for plants species enumeration. Transects were peg at 100m apart. 4 plots were laid along the transects alternately position at a distance of 250m interval. Within each plots, diameter at breast height (dbh at >10cm) 50m x50m of tree species were enumerated and counted. (Akinyemi, 2017)

2.3 Soils sampling procedure

3m x 3m Subplot were laid out for soil samples collection (Onyekwelu,*et al*., 2008. Five soil samples were taken at the four corners and Centre of each sub-plots. Soils from five point layers were collected at three fixed depth of 0-15cm, 15-30cm, 30-45cm using soil Auger (Suleiman, *et al*.,2017). The soil from the same depth and five fixed point were homogeneously mixed to form a composite sample per-subplots . Hence five (5) bulk sample per-sub plot. Thus there were 32 soil samples in total. (32 plots x 3 sub-plots x 3 soil layers).

The soils samples were carefully collected in a black polythene bags labeled according to the various plots and investigate some selected soil physical. Analysis of soil samples were carried out in the Soil Science Laboratory, Department of Soil Science University of Calabar, Nigeria.

2.4 Data Collection

Tree species encountered were assigned as class based on (>10cm dbh) Diameters of tree species, Density, relative frequency, relative dominant, IVI were all computed including soil phytochemical analysis.

2.5 Soil physiochemical parameters

pH: The soil samples was determined by the methods describe by (Edori *et al*., 2017). **Moisture Content (MC):** was determined according to (Nounamo *et al*., 2000).

$$\% MC = \frac{\text{Loss in weight}}{} \times 100 \quad \text{.....(eqn 1)}$$

Cation Exchange Capacity (CEC) was determined using the ammonium acetate methods (Reeuwijk, 2002).

Available Phosphorus (p), potassium (K^+) and sodium (Na^+) in the soil was determined using the HCL Solution and their levels determine by flame photometry , (Olurumfemi *et al.*, 2016).

Exchangeable Bases Calcium (ca^{2+}) Magnesium (mg^{2+}) in the soil was determined using atomic absorption spectrometer. Exchangeable bases (Calcium, Magnesium, Potassium and Sodium) in the soil was determine using the ammonium acetate extract method from the CEC determination.

$$\text{Exchangeable base} = \frac{\text{Base saturation}}{\text{CEC}} \times 100 \quad \text{.....(eqn2)}$$

Organic Carbon was determined by the Dichromate wet oxidation methods of (Nelson and Sommers 1996).

Total Nitrogen:

Was measured using the Kjeldhl methods (Halvin *et al*, 1990). The soil samples analyzed for total N was dried, ground and sieve before distillation of the digest with strong alkali, before storing them for analysis in a paper bag or other containers that are not air tight.

Bulk Density: is defined as the dry weight of soil per unit volume of soil. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g/cm3.

Bulk density was determined by obtaining the Gravimetric soil core methods, described by Black and Hartage, (1986).The samples was allowed to oven dried at 105^0C until reaching constant weight.

$$\text{Bulk Density} = \frac{\text{Mass of dry soil}}{\text{Total volume of soil}} \quad \text{.....(eqn3)}$$

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Particle Size Determination

Particle size analysis was carried out using the hydrometer method, with sodium hexametaphosphate (Calgon) as a dispersing agent (Black *et al.*, 1965).

Weight of Soil

%Sand = 100 – (%Silt + Clay)

$$\%Clay = R2hrs + \frac{(T_1\text{-}20^0C \times 0\text{-}.36)}{\text{Weight of Soil}} \times 100 \quad \text{……(equ 4)}$$

% Silt = 100 – (%Sand + % Clay)

Where:

R40secs = hydrometer reading after 40 seconds

T_1 = Temperature after 40 seconds

R2hrs = hydrometer reading after 2 hours

T_2 = temperature after 2 hours

Organic Matter Determination

Organic matter was also obtained by multiplying organic carbon content by a conversion factor (1.724), (Walkley and Black, 1934) as shown in (equation 5):

% Organic matter = % Organic carbon x 1.724……..(eqn. 5)

2.6 Data analysis

Data collected were imputed into Microsoft word Excel package 2017 version. , Density, RF, RD, and tree species were computed using Diversity indices. Statistical significance were accepted (P< 0.005%). Soil correlation Matrix and tree species were performed using Pearson Correlation analysis in 'R' soft wear.

Basal areas of all trees in the samples plots was calculated using the formula (eqn)..1,

$$BA = \frac{\pi D^2}{4} \quad \text{..... (1)}$$

Species Relative density (RD %): It was computed using the following equation

$$RD = \frac{ni \times 100}{N} \quad \text{……..(2)}$$

Where;

RD = Relative density of the species

ni = Number of individuals per species and

N = Total number of all individual tree of all species in the entire population.

Relative Dominance (%) was estimated using the following equation

$$RD_0 = \frac{\sum Ba_1 \times 100}{\sum Ba_n} \quad \text{……..(3)}$$

Where;

Ba_1 = Basal area of individual tree belonging to the i^{th} species and

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Ba_n = Stand basal area.

Shannon – wiener diversity index was calculated using equation

$H = -\sum P_1 \text{ In } (P_1)$…….. (4)

Where; $1 = 1$

H' = Shannon diversity index,

S = The total number of species in the community,

P_1 = Proportion S (species in the family) made *u* to the i^{th} spp and

In = natural logarithm.

Species Evenness:

Where;

H' = Evenness I Species in each plot will be determined by using

Shannon's equitability (EH), which was obtains using (equ 5).

$$E_H = H = \sum P_1 \text{ In } (P_1)$$

$$H_{max} \quad \text{In}(S) \quad \overline{\qquad} \quad \overline{\qquad\qquad} \quad s$$

Species Richness (d) was calculated using the Margalef index (d) (equ.6)

Species Richness (d) = S – 1/1Nn (2) …… (6)

Where;

S = Total number of spp,

N = Total numbers of individuals of all species.

Important Value Index:

IVI =RF+RD+RD…… …….. (eqn7)

Where;

RD = Relative density of the species;

RD_O = The relative dominance of species.

3. RESULTS AND DISCUSSION

Table 1. Maximum and minimum diameters were recorded as 80.5cm and 10.1cm. Mean dbh was 25.1cm, height was 28.6m standard deviation for dbh and height were 13.2cm and 14.1m. minimum and maximum height were 5.2m and 68.3m Table1.

Table 1: Diameter at breast height and tree growth at Okpon River Forest Reserve

	Dbh (cm)	**Ht (m)**
Minimum	10.1	5.2
Max	80.5	68.3
Mean	25.1	28.6
Standard deviation	13.2	14.1
Sample Size	939	937

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68 tree species belonging to 34 families were recorded. Abundance species were, Meliaceae (6 tree / ha) followed by Caesalpiniceae and Moraceae (5 trees / ha) each. Relatives frequency was highest in *Melicia excelsa* 2.256%, followed by *Khaya irvorensis* 1.933% , *Ceiba pentadra* 1.826% .65 species recorded relative frequencies less than 0.001%. Relative density was highest in *Milicia excelsa* 2. 241% followed by *Khaya irvorensis* 2.028% . 66 tree species observed RD less than 0.001%. Table 2 *Melicia excelsa* obtained relative dominance 4.970% followed by *Biallonella toxisperma* 3.672. IVI was highest in *Melicia excelsa* 9.4675, followed by *Khaya irvorensis* 6.865% *Biallonella toxisperma 6.670% Ceiba pentadra* 6.865%. 64 tree species recorded IVI ranged from 0. 231% to 4. 758% Table 2.

Table 2: Tree species composition and abundance

S/No	Species	Family	RF(%)	RD(%)	RDo(%)	IVI
1	*Antidesma laciniatum*	Euphorbiaceae	0.215	0.213	0.097	0.525
2	*Antrocaryon micraster*	Anacardiaceae	0.107	0.107	0.017	0.231
3	*Aubregrinia taiensis*	Mimosaceae	0.215	0.213	0.037	0.466
4	*Avicennia africana*	Avienniaceae	0.430	0.427	0.209	1.066
5	*Azadirachta indica*	Meliaceae	0.322	0.320	0.192	0.835
6	*Baillonella toxisperma*	Sapotaceae	1.504	1.494	3.672	6.670
7	*Balanites wilsoniana*	Balanitaceae	0.322	0.320	0.147	0.789
8	*Baphia maxima*	Papiloniaceae	0.537	0.534	0.200	1.271
9	*Baphia nitida*	Papiloniaceae	0.537	0.534	0.247	1.318
10	*Barteria fistulosa*	Passifloraceae	0.215	0.213	0.036	0.464
11	*Carpolobia lutea*	Apocynaceae	0.107	0.107	0.049	0.263
12	*Casearia barteri*	Salicaceae	0.107	0.107	0.053	0.267
13	*Cassipourea congoensis*	Rphizophoraceae	0.107	0.107	0.024	0.238
14	*Ceiba pentandra*	Bombaceae	1.826	1.814	2.635	6.275
15	*Dialium dinklagei*	Caesalpinaceae	0.107	0.107	0.132	0.346
16	*Dialium guineense*	Caesalpinaceae	1.611	1.708	1.439	4.758
17	*Dichaetanthera africana*	Melastomataceae	0.215	0.213	0.064	0.492
18	*Dichapetalum spp*	Melastomataceae	0.107	0.107	0.026	0.240
19	*Entandrophragma utile*	Meliaceae	0.537	0.534	0.774	1.845
20	*Eribroma oblonga*	Malvaceae	0.215	0.213	0.082	0.510
21	*Eriocoelum macrocarpum*	Sapindaceae	0.215	0.213	0.212	0.641
22	*Erythrina vogelii*	Caesalpinaceae	0.322	0.320	0.257	0.899
23	*Erythrophelum suaveolens*	Caesalpinaceae	0.107	0.107	0.090	0.304
24	*Erythroxylum mannii*	Erthroxylaceae	0.215	0.213	0.124	0.552
25	*Ficus capensis*	Moracaae	0.752	0.747	0.157	1.656
26	*Ficus congensis*	Moraceae	0.537	0.534	0.149	1.220
27	*Ficus exasperate*	Moraceae	1.182	1.174	0.431	2.786
28	*Ficus mucuso*	Moraceae	0.107	0.107	0.014	0.228
29	*Ficus vogeliana*	Moraceae	0.430	0.427	0.091	0.947
30	*Funtumia elastica*	Apocynaceae	1.826	1.814	0.789	4.430
31	*Garcinia kola*	Moraceae	1.074	1.067	0.359	2.501
32	*Garcinia livingstonei*	Moraceae	0.215	0.213	0.047	0.475
33	*Garcinia manii*	Apocynaceae	0.859	0.854	0.446	2.160
34	*Gilbertiodendron dewevrei*	Caesalpinaceae	0.215	0.213	0.180	0.608
35	*Gmelina arborea*	Verbenaceae	1.182	1.174	1.948	4.303
36	*Grewia coriacea*	Tillaceae	0.215	0.213	0.077	0.505

37	*Guarea glomerulata*	Meliaceae	0.430	0.427	0.172	1.028
38	*Hannoa klaineana*	Simaroubaceae	0.752	0.747	0.474	1.973
39	*Harungana madagascariensis*	Guttiferae	0.322	0.320	0.182	0.824
40	*Heinsia crinata*	Myristicaceae	0.107	0.107	0.019	0.233
41	*Hevea brasiliensis*	Euphorbiaceae	0.537	0.534	0.136	1.207
42	*Hexalobus crispiflorus*	Annonaceae	0.107	0.107	0.027	0.241
43	*Hymenostegia afzelia*	Caesalpinaceae	0.107	0.107	0.213	0.427
44	*Irvingia gabonensis*	Irvingiaceae	1.504	1.494	2.669	5.667
45	*Irvingia grandifolia*	Meliaceae	0.107	0.107	0.059	0.273
46	*Irvingia wombolu*	Irvingiaceae	0.859	0.854	1.320	3.033
47	*Khaya grandifoliola*	Meliaceae	0.967	0.961	1.142	3.069
48	*Khaya ivorensis*	Meliaceae	1.933	2.028	2.903	6.865
49	*Kigelia africana*	Bignoniaceae	0.107	0.107	0.016	0.230
50	*Klainedoxa gabonensis*	Irvingiaceae	0.322	0.320	0.873	1.515
51	*Lepidobotrys staudtii*	Linaceae	0.215	0.213	0.119	0.547
52	*Leptonychia pallida*	Sterculiaceae	0.215	0.213	0.041	0.469
53	*Lophira alata*	Ochnaceae	1.826	1.814	1.657	5.297
54	*Lovoa trichilioides*	Meliaceae	1.504	1.601	1.902	5.006
55	*Milicia excels*	Moraceae	2.256	2.241	4.970	9.467
56	*Millettia macrophylla*	Papiloniaceae	0.215	0.213	0.075	0.503
57	*Mitragyna ledermannii*	Rubiaceae	0.107	0.107	0.181	0.396
58	*Moringa oleifera*	Moringarceae	0.430	0.427	0.705	1.562
59	*Randia longiflora*	Rubiaceae	0.430	0.427	0.186	1.043
60	*Raphia hookeri*	Arecaceae	0.215	0.213	0.109	0.537
61	*Rauvolfia vomitoria*	Apocynaceae	0.107	0.107	0.087	0.301
62	*Rhaptopetalum beguei*	Scytopetalaceae	0.107	0.107	0.019	0.234
63	*Ricinodendron heudelotii*	Euphorbiaceae	0.967	0.961	0.437	2.364
64	*Tectona grandis*	Verbenaceae	0.322	0.320	0.631	1.274
65	*Thecacoris leptobotrya*	Euphorbiaceae	0.107	0.107	0.119	0.333

Where RF=relative frequency; RD= relative density; RDo=relative dominance; IVI – importance value index

3.1 Correlation between soil physicochemical properties and tree species in Okpon River Forest Reserve

The results of Pearson Correlation between soil physicochemical properties presented in Table 3 shows that pH had non-significant and negative correlation with organic carbon (-0.110), total N (- 0.086), aluminum (-0.406), hydrogen (-0.352), ECEC (-0.172), clay (-0.463) and sand (-0.084) and had negative and significant correlation with available phosphorus. With this negative correlation, increase in the soil pH will result in decrease of these properties. pH had positive and significant correlation Na^+, Mg^{2+}, K^+, Ca^{2+} and B.S which means increase in pH leads to the increase in concentrations of these elements in soil solution. Organic carbon correlated positively and non-significantly with phosphorus, aluminum, hydrogen, ECEC, clay, silt and bulk density but significantly with total N (- 0.983. Table 4.

Available P correlated negatively and non-significantly with Ca^{2+} (-0.370), Mg^{2+} (-0.369), silt (-0.089), sand (-0.016), and significantly with K^+ (-0.051), and Na^+ (-0.516), while it correlated positively and non-significantly with Al^{3+}, ECEC, clay and bulk density (Table 10). Calcium correlated had positive and significant relationship with Mg^{2+} (0.507), K^+ (0.721), Na^+ (0.719) and BS (0.836) and also had negative and non-significant relationship with Al^{3+}, H^+, clay and sand. Magnesium K^+ and Na^+ had relationship with other soil properties just the same way Ca^{2+} had, probably because they all bases. Table 3,

ISSN 2349-7823

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Table 3: Pearson Correlation Matrix between soil physicochemical properties and tree species in Okpon River Forest Reserve

	pH	OC	TN	P	Ca	Mg	K	Na	AL	H	ECEC	BS	Clay	Silt	Sand	BD
Ph	1	-0.110	-0.086	-0.595	0.710	0.618	0.873	0.859	-0.406	-0.352	-0.172	0.880	-0.463	0.124	-0.084	0.007
OC	-0.110	1	0.983	0.166	-0.107	-0.016	-0.271	-0.208	0.041	0.327	0.331	-0.252	0.221	0.188	-0.298	0.018
TN	-0.086	0.983	1	0.114	-0.095	-0.005	-0.278	-0.211	0.066	0.309	0.337	-0.242	0.220	0.214	-0.320	-0.004
P	-0.595	0.166	0.114	1	-0.370	-0.269	-0.521	-0.516	0.367	0.476	0.395	-0.560	0.444	-0.089	-0.016	0.415
Ca	0.710	-0.107	-0.095	-0.370	1	0.507	0.721	0.719	-0.456	-0.141	0.336	0.836	-0.312	0.260	-0.002	0.063
Mg	0.618	-0.016	-0.005	-0.269	0.507	1	0.679	0.676	-0.296	-0.322	0.034	0.687	-0.195	0.338	-0.001	0.011
K	0.873	-0.271	-0.278	-0.521	0.721	0.679	1	0.954	-0.425	-0.469	-0.227	0.919	-0.476	0.044	0.157	-0.019
Na	0.859	-0.208	-0.211	-0.516	0.719	0.676	0.954	1	-0.427	-0.439	-0.229	0.911	-0.520	0.042	0.192	-0.036
AL	-0.406	0.041	0.066	0.367	-0.456	-0.296	-0.425	-0.427	1	0.115	0.093	-0.425	0.130	-0.023	0.116	-0.240
H	-0.352	0.327	0.309	0.476	-0.141	-0.322	-0.469	-0.439	0.115	1	0.542	-0.428	0.273	0.116	-0.239	0.217
ECEC	-0.172	0.331	0.337	0.395	0.336	0.034	-0.227	-0.229	0.093	0.542	1	-0.128	0.313	0.328	-0.186	0.238
BS	0.880	-0.252	-0.242	-0.560	0.836	0.687	0.919	0.911	-0.425	-0.428	-0.128	1	-0.529	0.156	0.082	-0.091
Clay	-0.463	0.221	0.220	0.444	-0.312	-0.195	-0.476	-0.520	0.130	0.273	0.313	-0.529	1	-0.023	-0.476	0.324
Silt	0.124	0.188	0.214	-0.089	0.260	0.338	0.044	0.042	-0.023	0.116	0.328	0.156	-0.023	1	-0.313	0.094
Sand	-0.084	-0.298	-0.320	-0.016	-0.002	-0.001	0.157	0.192	0.116	-0.239	-0.186	0.082	-0.476	-0.313	1	-0.257
BD	0.007	0.018	-0.004	0.415	0.063	0.011	-0.019	-0.036	-0.240	0.217	0.238	-0.091	0.324	0.094	-0.257	1

3.2 Discussion

The results of this study recorded 68 tree species belonging to 34 families. *Caesalpinceae, , Moraceae and Meliaceae* were the most abundance families. The area is rich in terms of tree species composition but lower when compared with 99 tree species belonging to 36 families recorded in Takamanda Rainforest of Southwest, Cameroon by (Egbe *et al.*, 2012). In the same vain, it is lower than 118 tree species reported by Adeyemi *et al.,* (2013) for the Oban Division of the Cross River National Park in Nigeria. Comparing the results of this study to a similar study by Oluwatosin and Jimoh (2016), in Onigambari forest reserve Ondo State, Nigeria, obtained a higher number of families (54) tree species, while, Muazu (2010), reported four families in Kuyambana forest reserve, Zamfara State, Nigeria, even lower than the presence study of 34 families recorded in Okpon river forest reserve. He reported the dominance of *Caesalpinaceae, Mimosaceae* and *Combretaceae* families. This finding corroborated the works of Adekunle (2013) who found that tropical rainforest ecosystems of Southwest Nigeria are dominated by some specific families such as the *Sterculiaceae, Meliaceae, Moraceae,*. In this present study, Okpon River Forest reserve were dominated by *Caesalpinceae, Meliacea and Moracea.*

Fabaceae, meliceae, and *caesalpiniaceae* have been consistently reported as dominant plant families in Nigeria tropical forest (Adekunle *et al*., 2013). The effect of anthropogenic activities on growth and distribution of tree species may have played a role in the status of these species in the ecosystem, threatening the occurrence and development of certain species while favoring others. The *Caesalpinaceae, , Meliacea , Moraceae and euhporbiacea* were observed to be the most prevalent families in this presence study. This may be due to their fast regeneration ability associated with symbiotic properties, which may have enabled the species to easily established within habitat types.

The positive correlation between tree species diversity with K, Na and ECEC (sum of basic cations Ca^{2+},Mg^{2+}, Na^{+} and K^{+}) in this present study is similar to those reported by Tuomisto *et al*, (2014), who found a substantial increase in species diversity with increasing soil cation concentration in non-inundated rain forest in lowland Amazonia. *Fu, et al*, (2004*)* and Long *et al* (2018) also found a positive significant correlation between tree species diversity and K contents in tropical forest. A study by Ali *et al* (2019),don in tropical forest of Southern China found that BS and tree species diversity were significantly positive correlated. In addition, *kumar et al* (2011) found a significant positive relationship between tree species diversity and soil available P, exchange able K and Ca in a tropical dry deciduous forest of Rajasthan, India. Ecological processes and functions occur differently in various micro-habitats within the ecosystem. As a result, their soil nutrient status and tree species nutrient uptake also differ and finally lead into species diversity. Soil nutrients are considered as one of the factors limiting tropical forest structure, *(*Vitousek *et al.*,2010*)*, primary productivity and other biological processes such as plant root allocation and growth *(*Zhang *et al.*,2015*).*

4. CONCLUSION AND RECOMMENDATION

Assessment of tree species diversity and soil phytochemical properties was documented in Okpon river forest reserve. *Caesalpiniaceae, Leguminosae, Meliaceae Apocynaceae* were the dominant families in the forest reserve. The density value of 21%, RF 5.279%, and RD 4.536% was indication that forest reserve is moderate and intake. The research has

proven that, there is make differences in the vegetation species composition. Also, majority of the species occupying the forest reserve were found to have a lower importance value index as a poor representation amongst the samplings population of the forests. This could be achieve with the adoption and appropriate Silvicultural measures that can enhance the, survival and growth of tree species in the reserve

From the study, the most valuable factors affecting tree species distribution are soil PH which was generally acidic, Organic carbon was high, Total nitrogen, available phosphorus, Effective cation exchange capacity (ECEC), were low. Whereas Exchangeable bases, calcium, Magnesium, potassium, Sodium, Clay and Silt were low. Sand, Bulk density, and hydrogen were high in the study area. The analysis revealed that Total Nitrogen, Bulk density and Organic Carbon content are the most influential variables responsible for tree species diversity in the study site. Sodium, Sand, Clay content and Magnesium were the fundamental properties that represented what determine the unique characteristics of Okpon river forest reserve. Trees below diameter at breast height should be conserve to protects vulnerable tree species in the study area to avoid the risk of extinction. Addition of relative higher plant residue should be adopted to enhance the Total Nitrogen contents of the reserve which will in turn improve soil conditions. Logging activities in the reserve should be restricted so that the nutrient can replenished as it shows the tendency to support tree growth.

REFERENCES

[1] Adekunle , VAJ. Olagoke A.O., Akindele, S.O. (2013) Tree Species Diversity and Structure of a Nigeria strict Nature Reserve. *Tropical Ecology.54: (3) 275-289*

[2] Adenkunle V.A .J, Akindele S.O, Fuwape J.A.(2004).Structure and Yield Models of Tropical lowland rain Forest Ecosystem of South West Nigeria. Food Agriculture and Environment. 395-399.

[3] Ali, A., Lin, S., He, J., Kong, F., Yu, J. and Jiang, H. (2019). Climate and Soil Determine Above Ground Biomass indirectly Via Species diversity and Stand Structural Complexity in Tropical Forest. *Forest Ecology and Management* 432:823-831.

[4] Adeyemi, A.A.,Jimoh, S.O., and Adesoye, P.O, (2013).Assessment of Tree Diversities in Oban Division of the Cross River Nation park (CRNP), *Nigeria Journal of Agriculture, Forestry and the Social Sciences* 11(1): 216-230

[5] Egbe, E.A., Chuyong, G. B., Fonge, B.A and Namuere, K.S. (2012). Forest Disturbance at Korup National park. Cameroon. *International Journal of Biodiversity conservation*. 4 (11) : 377 – 384.

[6] Black G.R, Hartge. K.H (1986). Bulk Density. In: Klute. A (Ed). Methods of Soil Analysis. Physical and Mineralogical Methods. Vol .1. *American Society of Agronomy*. Madison. Pp. 363-375.

[7] Black,C,A., Evans, D.D., White,J.L., Ensminger, L, E., and Clack, F.E. (1965). Methods of Soils Analysis part 2, Chemical and Microbiological properties. Agronomy 9. ASA, Madison, Wiscosin, 1573pp.

[8] Brant V., Pivec., J., Venclov A.V., Soukup, J. and Holec, J. (2006).The influence of different soil vegetation covers onto the volumetric water content in upper soil layers. Plant soil and Environment, vol. 52(6) : 275-281.

[9] Gedda, A.E., (2003).Range evaluation in relation to pastoralist's perception in the Middle Awash valley of Ethiopia. Ph.D. Thesis, University of the Free State, Bloemfontein, South Africa, 297pp.

[10] Engler, R and Guisan, A. (2009). MIGCLIM: Predicting plant Distribution and dispersal in changing climate. Diversity and Distributions, 15 (4): 590-601.

[11] Fu, B.J., Liu, S.L., Ma, K.M., and Zhu, Y.G., (2004). Relationship between Soil Characteristics, Topography and plant Diversity in a Heterogeneous Deciduous Broad-leaved Forest near Beijing, China, plant and Soil 261(1-2):47-54.

[12] Kumar, S., lyer A., A., Agrarian s. (2011).Catton yield in relation to physicochemical properties of Cultivated soil of Rajkot region. Int. j. of adv. Eng Teach., 2(3)52-55.

[13] Long, W.X.., Yang, X..B and Li, D.H. (2018). Pattern of Species Diversity and Soil Nutrients along a Chronosequence of VegetationRecovery in Haman Island, South China, *Ecological Research* 27:561-568..

[14] Ma'azu, A. (2010). Woody plants Genetics Resources of Kuyambana Forest Reserve, Mara Zamfara State. Unpublished M.Sc Dissertation on Department of Biological Sciences, Usman Danfodiyo University , Sokoto. 64pp.

[15] Nelson D. W., Sommer L.E (1996) .Total Carbon and Soil Organic Matter. In Methods of soil Analysis. Part 3 – Chemical Methods.M. D (Ed).ASA –SSSA,Madison ,Wiscosin,USA.pp 961-1010.

[16] Nounamo, L., Yemifaah, M., Techienkwa, M,.and Njom Gang, R.(2000). Impact of Natural Fallow Duration in Cameron. *Nig. J. soil Res*. 3:52-57.

[17] Osamionayi, R.A., Ufuoma, N.U., Kehinde, O (2020). Regeneration Potentials of Tree Species at BC 32/4 in Sakpoba Forest Reservse, Edo State, Nigeria. *Polish Journal of sciences, Vol 35(2): 165-182.*

[18] Oluwatosin, B and Jimoh, S.O (2016): Pattern of Plant Species Diversity in a dry Forest Ecosystem of Nigeria. *Journal of Ecology Research and Management* 11:21-47.

[19] Olurunfemi I.E., Fasinmman, J.T., Ojo, A.S., (2016). Modeling of Cation Exchange Capacity and soil water Holding Capacity from basic soil properties*: Eurasian Journal of soil science* 5 (4) : 266- 274.

[20] Onyekwelu, J.C., Mosandi, R, and Stimm, B. (2008). Tree Species Diversity and Soil Status of Primary and Degraded Tropical Rainforest Ecosystem in South-Western Nigeria. *Journal of Tropical Forest Science. 20 (3) : 193-204.*

[21] Onyekwelu J.C,Biber P, Stimin, B. (2003). Thinning Scenarios for Gmelina arborea Plantations in South-West Nigeria Using density Management Diagrams. *Food Agriculture and Environment Journal* 320- 325.

[22] Salami, K. D., Akinyemi A.O., Adekola P.J and Odewale, M.A (2016). Tree species Composition and Regeneration potentials of Onigabari Forest Reserve, Oyo State, Nigeria. *Research Journal of Agriculture and Food Science* Vol 4 (3) pp 39-47.

[23] Suleiman, R., Jimoh, I.A. and Aliyu, J. (2017). Assessment of Soil Physical and Chemical properties under Vegetable Cultivation in Abuja Metropolitan Area, Nigeria. Zaria *Geographer Vol. 24, No. 1.*

[24] Tumisto, H., Zugum, G. and Candenas, G. (2014). Species Richness and Diversity along Edaphic and Climatic gradients in Amozonia..*Ecology* 37(11):1034-1046.

[25] Reeuwijk L.P, (2002). Procedure for Soil Analysis .Technical Paper 9.6th edition. International soil Reference and Information Centre and Food and Agricultural Organization of the United Nation Waegningen ,The Nether land.

[26] Walkley, A, and Black, I.A. (1939). An Examination methods for determining Soil Organic Matter and a proposed Modification of the Chronic Acid Titration Methods, soil Sci, 37: 29-38.

[27] Vistousek, P.M. and Sanford, R.l. (2010). Nutrient Cycling in Moist Tropical Forest Annual Review of Ecology and Systematic 17:137-167.

[28] Zang, W., Zhao, J., Pan, F.J., Li., D.J., Chan, H.S. and Wang, K.L., (2015). Changes in Nitrogen and Phosphorus Limitation during Secondary Succession in a Karst region in South West China. *Plant and soil* 391:77-91.