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PLANT SPECIES COMPOSITION AND NUMBER OF INDIVIDUALS PER SPECIES OF UNDERSTOREY VEGETATION IN DIFFERENT LAND USE IN ETCHE REGION OF RIVERS STATE, NIGERIA

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ABSTRACT

Species composition helps to conserve, maintain and regulate the environment. Although, plant biodiversity has been extensively studied, there is paucity of knowledge on the relationship of its different categories. Thus, the study examined analysis of plant biodiversity in Etche Region, Rivers State, Nigeria. A quantitative research design was used and this involved comparison of tree growth and understorey parameters in the built up area (BUA), natural forest (NF), fallow land, farmland and riparian vegetation. Five quadrats of 20 x 25m^2 were laid randomly in each of the study area for data collection. Descriptive and inferential statistics were used for data analysis. Results showed that 58 different understorey and 35 different overstorey species were found in the entire study area. The species diversity and richness of the understorey and overstorey were higher in the NF and fallowland. It was also found that the combination of tree growth characteristics (girth, diameter at breast height, basal area, crown diameter) were significantly related to species diversity, richness, evenness and number of individual understorey species at $p<0.05$. It is concluded that human activities has reduced the species richness of plant biodiversity in the study area. The study recommended that good laws/policy should be enacted in order to help deduce the trend of deforestation and loss of plant biodiversity in the study area.

Keywords: Plant Species, Understorey Vegetation, Etche Region, Rivers State.

Introduction

Biodiversity otherwise biological diversity refers to the wealth of life on earth, the millions of plants and animal species including micro-organisms, the genes they contain, and the intricate but fragile ecosystems they help to build into the living environment. Chima, Ezekwem Ogbonna and Inya 2009) refers to variety and variability from place to place of plant and animal genes, species and ecosystems found on earth, including the intricate relationship which binds them as the source of life and which enables them to function and resist environmental stress. In otherwise, biodiversity is about all existing life on the earth's surface seen from the biogeographical perspective as the very stuff of life. Spatial analysis of landuse effects on plant biodiversity is quite obvious to some extent in human environment. Beyond the intrinsic value we ascribe to living organisms and assemblages that biodiversity contributes to numerous ecosystem processes that support ecological, economic and social wellbeing sources. Again, biodiversity enhances the ability of ecosystem including those found in farms, gardens, cities and towns to cope with climatic and environmental shocks.

In Nigeria, deforestation of the rainforest and loss of biodiversity occur in the Niger Delta which include lack of protection of some areas of species richness coupled with increasing population and growth in economic activities (Mmom and Arokoyu 2010). The excessive exploitation of the forest resources is a source of concern and threat to the economic, social and environmental importance (Aigbe and Oluku, 2012).

On other studies on land use change, Abah (2013) mentioned that land use patterns, driven by variety of social causes, result in land cover changes that affect biodiversity, water, and radiation budget. Iqbal and Khan (2014) revealed a decrease in forest cover and low vegetation cover at a change rate of 2.70% and 2.60% respectively. On the other hand, built up and bare soil have increased at a rate of 1.00% and 4.20% respectively. Disregarding future changes in land use or land cover when developing biodiversity scenarios assumes that their effects on biodiversity will be negligible compared to the impacts of climate change. Stanton et al (2012) and Abbas (2012) reported that two main reasons are frequently brought forward when omitting to include the effects of land use/cover change in biodiversity scenarios. Some studies looked at the effects of landuse on vegetation richness in the urban areas and these include the works of Daye et al (2015) which involved the diversity of flora and vegetation in European cities as a potential for nature conservation in urban-industrial areas of Berlin and Potsdam (Germany) while Eludoyin, Aiyeloja and Ndife (2015) considered spatial analysis of trees composition, diversity and richnesss in the built up areas of University of Port Harcourt, Nigeria. None of these studies considered the effect of landuse proper on plant biodiversity appropriately especially in Etche LGA of Rivers State. Thus, the present study focuses on the effect landuse on plant biodiversity in Etche LGA of Rivers State, Nigeria.

Statement of the Problem

Plant diversity is globally threatened by anthropogenic land use including management and modification of the natural environment. At regional and local scales, numerous studies world-wide have examined land use and its effects on plant diversity, but evidence for declining species diversity is mixed (Gerstner, Dormann, Stein, Manceur and Seppelt, 2014). Unsustainable use of forest resources, for example, through logging and shifting cultivation, has potential impact on its ecological functioning due to sudden changes on their structure and composition. Emergence of invasive species and loss of ecosystem services resulting from the occurrence of many woody pioneers and herbaceous species have been observed in several disturbed forest ecosystems. Opening of forest canopies in the logged or burnt forests increases light levels which in some cases positively influences diversity indices although loss of tree species could occur through other causes like direct destruction, the most important single factor affecting the fate of tree species population on earth is the accelerated rate of habitat destruction (Harris, 2004). The different farming system such as shifting cultivation and monoculture and activities like tillage, fertilizer and pesticide applications, disturbs the balance of the ecosystem. The annual burning of trees, shrubs and herbs during the shifting cultivation kills off the seeding of this plants and the soil microorganisms, thus leading to extinction. Conservative estimates of tree species loss rate suggest that unless current trends are reversed, more than one quarter of the earth's tree species may vanish in the next fifty years (Eludoyin, Utang and Obafemi 2012). Hence man needs to change his behavior and activities that cause environmental degradation and tree species loss. Such change in behaviour will to large extent be aided by an understanding of different land use practices on tree populations.

Understanding the factors related to human disturbance that affect the tree biodiversity and forest vegetation structure can help conservation managers to suggest best forest management practices in ways that can best protect these values. Deforestation and degradation of wooded habitats due to anthropogenic activities (especially land-use change) are among the major contributors to current global climate change and biodiversity reduction (Zanella, Sakomura, Silverside 1999).

Plant diversity is instrumental to ecosystem health and human well-being (Daily 1997; Quijas, Schmid & Balva-nera, 2010; DeMazancourt et al., 2013). In part, land use directly changes ecosystems via land modification, fragmentation and intensification (Lambin & Geist, 2006), but land use also indirectly affects habitat characteristics linked to species diversity, such as area, edges and age, not only of the managed land but also of remaining natural land within the same matrix (Gerstner et al., 2014). Sustainable land use is required to sustain ecosystem health in the long term, balancing human needs and ecosystem functioning but it has been revealed that this kind of land management style is hard to maintain in an area such as Etche Region of Rivers State and as a result, the plant biodiversity is found to be reducing with respect to their physical abundance without any form of quantification. Therefore, quantitative knowledge about the effects of land use on ecosystem responses such as plant species diversity and richness is highly relevant (DeFries, Foley & Asner, 2004) in the recent times. However, the following research questions are to be answered by this study.

1. What are the different plant species in different in Etche Region of Rivers State, Nigeria?
2. What are the plant species composition (individual plants) and richness of plant species (understorey and overstorey) in the study area?

Aim and Objectives of the Study

The broad aim of the study is to examine the effects of landuse types on plant biodiversity in Etche Region of Rivers State, Nigeria. The following objectives were considered to:

i) Identify and enumerate the plant species in different Etche Region of Rivers State, Nigeria.
ii) Describe the species composition (individual plants) and richness of plant species (understorey and overstorey) in the study area.

The Study Area

Location and Extent

The study shall be carried out in the different landuse in Etche and Omuma LGAs of Rivers State, Nigeria. Etche LGA is one of the twenty-three local government areas of Rivers State. It is situated at the northeast part of the state lies within latitude 4° 50' and 5° 5' north and longitudes 6° 55' and 7° 12' east (Figure 1.1 and Figure 1.2). Imo State bound Etche Local Government Area in the north, Omuma Local Government Area in the east, Obio/Akpor and Oyigbo Local Government Areas in the south; and Ikwerre Local Government Area of Rivers State in the west (Figure 1.1). According to 1991-population census, Etche has total number of 197561 persons (Ministry of Local Government Affairs, Rivers State).

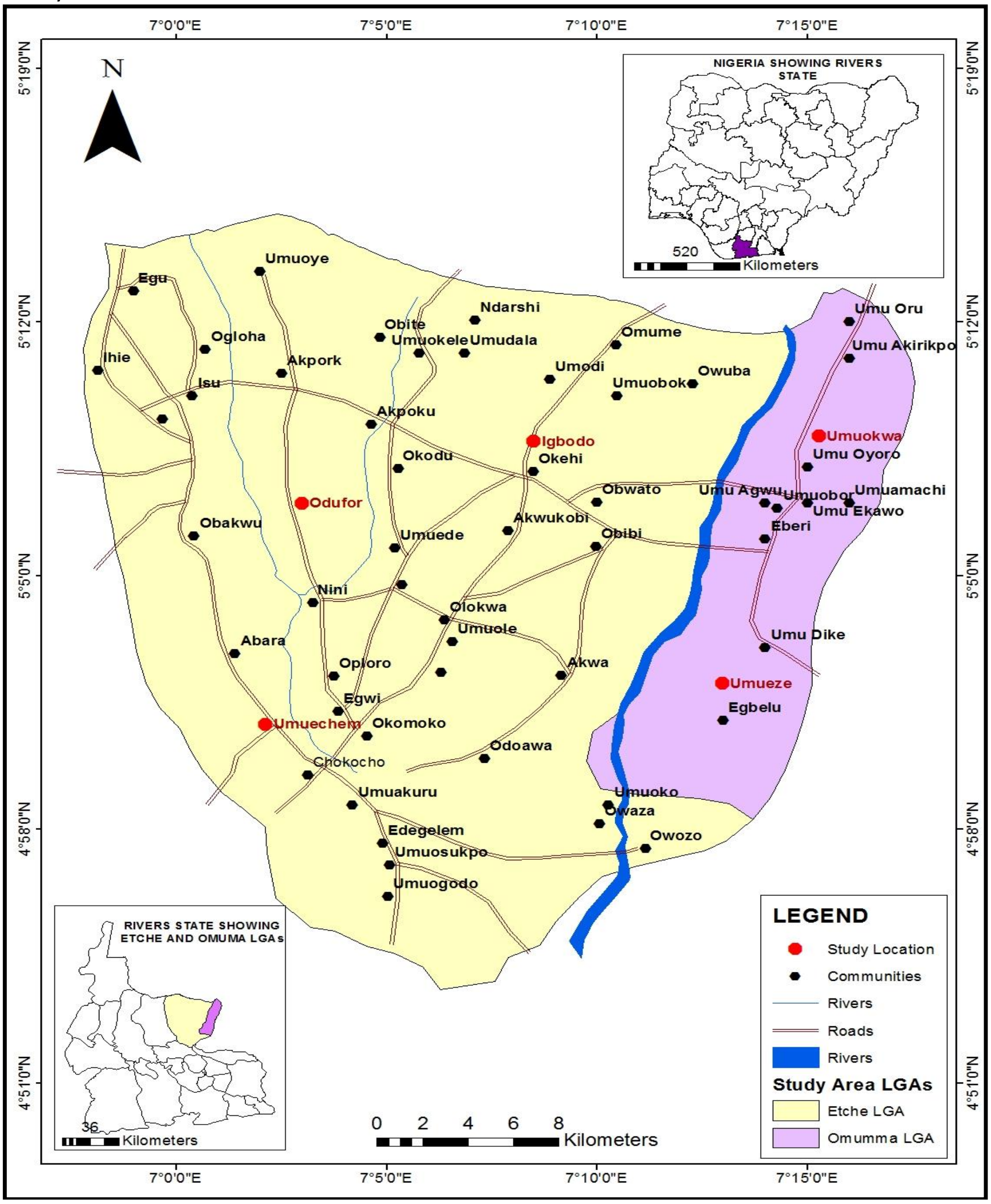

Figure 1: Study Locations in Etche and Omuma LGAs

Inset: Etche and Omuma LGAs in Rivers State

Methodology

Research Design

The research design adopted for this study is quasi experimental research design. It is a survey that intends to provide data for identifying a representative reserve network which ensures that the range of vegetation communities is sampled (Austin & Heyligers, 1989).

Nature and Sources of Data

Data for this study were both primary and secondary data. Primary data involved fieldwork whereby the plants were identified and enumerated. This involved the use of quadrat, tape rule and field assistants for the collection of the data. The secondary data involved the use of previous studies through magazines, journals, bulletin and newspapers.

Sample Frame

The sample frame of the study was in form of the use of quadrat of 20m x 25m in different landuse identified in the study area for the higher vascular plant data collection. For the forest floor vegetation or the understorey, 1m x 1m quadrat was established.

Method of Data Analysis

Descriptive statistics were used to describe the mean values of each vegetation parameters of trees such as tree height, basal area, DBH, and crown diameter for overstorey only and species composition, species density, species diversity, species richness, species evenness, similarity index, frequency, relative frequency, relative density and abundance for both understorey and overstorey. Formulated research hypotheses were tested with inferential statistics. Hypothesis 1 which states there is no significant relationship between species diversity, richness and density of undergrowth vegetation with the overstorey growth parameters in the study area was tested using Pearson's correlation statistics (Lambin & Geist 2006).

The multiple regression analysis was thereafter employed to compute the trend analysis of the relationships (Musa et al., 2009). The multiple regression is expressed as:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + … + bnXn + e$ ……………………………….. Eqn 1

where,

Y is the dependent variable, a is the slope, b is the regression coefficient of the independent variables, X is the independent variable, e is the residual error.

Hypothesis 2 which states that there is no significant difference in the overstorey and understorey parameters in the different landuse in the study area and hypothesis 3 which states that there is no significant variation in the number of individual plants among the different landuse types in the study area were tested using analysis of variance (ANOVA). All statistical analyses were computed using Statistical Package for Social Scientists (SPSS) Version 20.0 and Microsoft Excel 2007 Version. The results of the analysis were presented using tables, charts, and graphs.

Results and Discussion

Species Composition and Number of Individuals per Species of Understorey and Overstorey Vegetation in the Study Area

In the riparian vegetation landuse type, it was discovered that Alchornea cordifolia was extremely the highest; and then followed by Caesalpinia pulcherrima. In total, it is presented that understorey species in the study area was dominated mostly by Ageratum conyzoides (36), Alchornea cordifloia (29), Caesalpinia pulcherrima (26), Cocos nucifera (21), Manihot esculenta, Moringa olivera (21), Persea Americana (36), Sida acuta (34), Tridax procumbens (21) and Spondia cythera (24); while understorey vegetation like Treculia africana (6) and Palisota hirsute were very low in abundance.

Table 1: Species composition and number of individuals per species of understorey vegetation in different land use in the study area

S/N	*Species*	*English Name*		*BUA*	*NF*	*Fallow Land*	*Farml and*	*Riparian Vegetation*	*Total*
1	Ageratum conyzoides	*Goat weed*		*8*	*9*	*12*	*6*	*1*	*36*
2	Alchornea cordifolia	*Christmas bush*		*1*	*5*	*2*	*1*	*20*	*29*
3	Artocarpus incise	*Breadfruit*		*1*	*3*	*3*	*1*	*0*	*8*
4	Bridelia micrantha	*Coast Gold leaf.*		*0*	*4*	*2*	*1*	*0*	*7*
5	Caesalpinia pulcherrima	*Pride-of-barbados*		*7*	*2*	*6*	*1*	*10*	*26*
6	Cassuarina equisetifolia	*Australian Pine Tree*		*2*	*1*	*0*	*0*	*0*	*3*
7	Centrosema pubescence	*Fodder pea*		*2*	*6*	*3*	*2*	*0*	*13*
8	Chromolaena odorata	*Siam weed*		*0*	*5*	*7*	*1*	*1*	*14*
9	Chrysophyllum albidum	*African star apple*		*3*	*8*	*2*	*0*	*0*	*13*
10	Cocos nucifera	*Coconut*		*3*	*9*	*7*	*1*	*1*	*21*
11	Colocasia esculenta	*Cocoyam*		*2*	*10*	*2*	*1*	*1*	*16*
12	Combretum racemosa	*Bush willow*		*0*	*7*	*5*	*1*	*0*	*13*
13	Costus afer	*Spiral ginger*		*0*	*0*	*3*	*2*	*1*	*6*
14	Crescentia cujete	*Calabash tree*		*1*	*2*	*2*	*1*	*0*	*6*
15	Croton zambesicus	*Lavender croton*		*2*	*1*	*1*	*2*	*0*	*6*
16	Cyclosorus afer	*Fern*		*0*	*2*	*3*	*1*	*1*	*7*
17	Dary odesedulis	*African Pear*		*0*	*1*	*2*	*1*	*1*	*5*
18	Dioscorea bulbifera	*Air potato*		*6*	*0*	*1*	*8*	*1*	*16*
19	Dioscorea mangenotiana	*Elephant's yam*		*2*	*1*	*1*	*3*	*0*	*7*
20	Dioscorea alata	*White Yam*		*2*	*1*	*1*	*2*	*0*	*6*
21	Delonix regia	*Flame Tree*		*2*	*5*	*3*	*2*	*1*	*13*
22	Dialium guineense	*Velvet tamarind*		*0*	*3*	*1*	*0*	*0*	*4*
23	Elaeis guineensis	*Oil Palm tree*		*2*	*7*	*3*	*1*	*1*	*14*
24	Ficus benjamina	*Weeping Fig*		*2*	*5*	*3*	*1*	*1*	*12*
25	Ficus exasperate	*Sand paper tree*		*1*	*8*	*1*	*0*	*0*	*10*
26	Gmelina arborea	*Gmelina/ Beechwood*		*3*	*6*	*3*	*1*	*0*	*13*
27	Hura crepitans	*Sandbox Tree*		*5*	*3*	*1*	*1*	*0*	*10*
28	Icacina trichanta	*Icacina*		*1*	*5*	*4*	*1*	*0*	*11*
29	Irvingia gabonensis	*Bush Mango*		*3*	*4*	*2*	*1*	*0*	*10*
30	Mangifera indica	*Mango Tree*		*5*	*6*	*3*	*2*	*1*	*17*

31	Manihot esculenta	*Cassava*		*13*	*2*	*3*	*17*	*1*	*36*
32	Morinda lucida	*Brimstone tree*		*2*	*9*	*1*	*1*	*0*	*13*
33	Moringa olivera	*Drumstick tree*		*5*	*10*	*2*	*1*	*0*	*18*
34	Nauclea latifolia	*African Peach*		*1*	*11*	*2*	*2*	*0*	*16*
35	Newbouldia laevis	*Boundary tree*		*1*	*5*	*1*	*1*	*1*	*9*
36	Palisota hirsute	*Palisota*		*1*	*1*	*2*	*1*	*0*	*5*
37	Panicum maximum	*Guinea grass*		*2*	*5*	*1*	*1*	*0*	*9*
38	Pentaclethra macrophylla	*African Oil Bean*		*1*	*4*	*2*	*1*	*0*	*8*
39	Persea americana	Temple tree		*4*	*7*	*5*	*3*	*0*	*19*
40	Phimeria spp	*Avocado*		*2*	*1*	*6*	*2*	*1*	*12*
41	Phoenix dactyliflera	*Date Palm*		*1*	*3*	*4*	*1*	*0*	*9*
42	Polyalthia longifolia	*Mast Tree*		*5*	*1*	*3*	*1*	*0*	*10*
43	Psidium guajava	*Guava*		*6*	*4*	*4*	*2*	*1*	*17*
44	Rauvolfia vomitoria	*Poison devil's pepper*		*9*	*15*	*2*	*1*	*1*	*28*
45	Senna fistula	*Avocado Pear*		*3*	*8*	*12*	*2*	*0*	*25*
46	Senna siamea	*Golden Shower*		*2*	*5*	*9*	*0*	*0*	*16*
47	Sida acuta	*Cassod tree*		*6*	*9*	*8*	*10*	*1*	*34*
48	Smilax anceps	*Broom weed*		*2*	*19*	*11*	*10*	*2*	*44*
49	Spondias cythera	*Cat briers*		*1*	*12*	*5*	*5*	*1*	*24*
50	Spondias mombins	*Golden Apple*		*2*	*5*	*4*	*1*	*0*	*12*
51	Terminalia catappa	*Hog Plum*		*3*	*5*	*1*	*1*	*0*	*10*
52	Terminalia ivorensis	*Almond*		*1*	*6*	*4*	*1*	*0*	*12*
53	Terminalia mantaly	*Black Afara*		*2*	*5*	*5*	*2*	*1*	*15*
54	Terminalia superba	*Umbrella Tree/Madagascar Almond*		*0*	*8*	*6*	*0*	*0*	*14*
55	Theretiape ruviana	*African limba wood*		*1*	*7*	*2*	*0*	*0*	*10*
56	Tragia benthami	*African joker*		*2*	*5*	*3*	*1*	*0*	*11*
57	Treculia africana	*African breadfrui*		*1*	*3*	*1*	*1*	*0*	*6*
58	Tridax procumbens	*Tridax*		*5*	*6*	*5*	*5*	*0*	*21*
	Total			***150***	***310***	***203***	***120***	***52***	***835***
	Percentage (%)			***17.96***	***37.13***	***24.31***	***14.37***	***6.23***	***100***

Source: Researcher's Analysis, 2020

The percentage of individual understorey vegetation in different landuse Etche Region is presented in Table 4.2 whereby in the BUA, Casuarina equisetifolia was the highest (66.67%). Plants like Hura crepitance (50%) and Polyathia longifolia (50%). In the NF, Bridelia michrantha (57.14%), Chrysophylum albudium (61.54%), Combretum racemosa (53.85%), Ficus exasperate (80%), Dialium guineensis (75%), Colocasia esculenta (62.50%), and Thretiape ruuviana (70%) were the higher among others found in that plot. In the fallow land, it was found that Senna stamea was the highest (56.25%), followed by plants like Phimera spp (50%), Chromoleana odorata (50%), and Phimeria spp (50%). In the farmland, Dioscorea bulbifera (50%) and followed by Manihot esculenta (47.22%). In the riparian vegetation, Alchornea cordifolia was the highest (68.97%) and followed by Caesalpinia pulcherrima (38.46%).

Talikg about the total percentage of understorey vegetation Iin the entire as displayed in Table 4.3. The analysis revealed that Smilax anceps was the highest with 5.27%, followed by Manihot esculenta (4.31%) and Ageratum conozoides (4.31%). Sida acuta, Alchornea cordifolia and Rauvolfia vomitoria had 4.07%, 3.47%, and 3.35% respectively. With the total percentage, Dialium guineense and Cassuarina equisetifolia were the lowest with 0.48% and 0.36% respectively.

Discussion of Findings

The low number of understorey vegetation in the built up area, farmlands and riparian vegetation may be attributed to the developments in the built up area and regular weeding in the farmland. However, the forest floor and the fallow land floor were seeing to be recording higher number of understorey vegetation in the study area. This negated the submission of (Daily 1997) that canopy trees may influence understorey species composition in an individual or collective manner. Similarly Eludoyin, Utang, & Obafemi, (2012) reported that higher canopy cover of plantation might not be favourable to the growth of understorey species because of low light availability that can inhibit seedling emergence. Lu, Yin, & Tang, (2010) added that site scale canopy openness should favour the germination and growth of herbaceous species and at the landscape scale the presence of open canopy should increase the seed rain and therefore the colonization rate of forest sites by herbaceous species. In addition, the variation in the species composition of understorey vegetation may be due to overstorey structure and composition, soil nutrient and moisture availability, succession history, forest management strategies, throughfall light and fragamentation Harris, Alma, & Christopher, (2004). Musa, Musa, & Ogidiolu (2009) reported that tree plantations improve the microclimate for the establishment of native species in the understorey. The total composition between natural forest and fallow land was a slight variation and this is possible because of the relative space that may give room for sunlight to reach the forest floor in the fallow land than the natural forest which would be affected because of the closeness of the canopy.

Talking about the total percentage of understorey vegetation in the entire study area; the analysis revealed that Smilax anceps was the highest with 5.27%, followed by Manihot esculenta (4.31%) and Ageratum conozoides (4.31%). Sida acuta, Alchornea cordifolia and Rauvolfia vomitoria had 4.07%, 3.47%, and 3.35% respectively. With the total percentage, Dialium guineense and Cassuarina equisetifolia were the lowest with 0.48% and 0.36% respectively. Manihot esculaenta was higher in the entire study area because of its roles in sustaining food production in the area as it is processed in many forms especially Gaari which is a staple food in the study area. In terms of the life forms of understorey vegetation, trees were found to be the highest (67.24%) among them across the entire study area. This shows that the entire study area has a potential of having many trees in future if properly managed. The herbs and shrubs also have the potential to survive relatively in the study area. Among the families of understorey vegetation, Euphobiaceae and Combretaceae were the highest. This is in line with the study of Elands, & Wiersum (2013) in which Euphobiaceae was found as one of the highest families in the Gmelina Plantation in Omo Forest Reserve, Southwestern Nigeria.

The overstorey was highest in the natural forest and the least was found in the farmland. The least in the farmland could be attributed to the farming system in the area which is supported with the belief of total clearance of the wooded trees for the survival of the annual crops. Those left behind which are scattered around are used to support crops like melon, Pumpkin and Yam. In the overstorey, Elaeis guineesis was highest in the natural forest, while Raphia hookeri and Bambusa vulgaris were highest in the riparian vegetation. This is possible because individual plants survive mostly in its natural habitat. Mangifera indica was highest in the built up area. This is an ornamental tree which is grown in the built up area to serve the full ecosystem services like food production, shade and climate control.

Summarily, the mean tree composition in the natural forest remains the highest by having mean of 42.6 and fallow land had 24.6. From the list of the families present in the overstorey in the study area, Anacardiaceae was the highest with 14.6% of the total families. The diversity, richness and abundance of understorey and overstorey were higher in the natural forest and fallow land than that of the built up area, farmland and riparian vegetation. The issue still boils down to human activities which are responsible for the lower composition, diversity and richness of understorey and overstorey vegetation in the built up area and farmland. The species density of plants was highest in the natural forest and followed by the fallow land but the least was found in the riparian vegetation. The growth parameter analysis reveals that the crown diameter of tree was highest in the natural forest while the total height was highest in the fallow land. The crown diameter is possible to be highest in the natural forest because of the age of the trees which would be relatively higher than that in the fallow land.

Conclusion

The study has revealed the status of the plant biodiversity (overstorey and understorey) in Etche region of Rivers State across different landuse types; whereby it has been vividly found out that the natural forest and fallow land remained to be higher in terms of the species richness, diversity, density, relative density, number of individual trees, the girth, DBH, height and crown diameter of trees than other landuse types considered in this study. This shows that human activities have degraded the status of different plant biodiversity in the study area; which invariably would have affected the habitat sustainability of fauna especially mammals, soil macro and micro-organisms, soil physical and chemical properties and general environmental liability level of the entire study area.

Recommendations

Based on the findings of this study, the following recommendations were suggested

1. Government policy should be promulgated to reduce the rate at which virgin lands is opened in the study area.
2. The understorey species and overstorey species that were found less in terms of species diversity and richness can be monitored and discover the possible reasons attached to pit, and if possibly they can be domesticated either by budding or grafting methods.
3. More periodical studies should be done in other regions of the State to secure and ensure the livelihood realized from these plant biodiversity by the residents.

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