

E-ISSN: 2346-7290

Ethno-medicinal values and diversity of understory plants in two forest plantations in Abeokuta, Ogun State, Nigeria

Fadun, O.O., Soaga, J.A., Adedokun, M.O., and Oladoye, A.O.

Department of Forestry and Wildlife Management,
Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

Corresponding author (Email: soagaj@yahoo.com)

ABSTRACT

Twenty years old plantations of Teak and Gmelina were used to examine the diversity and ethno-medicinal values of understory plants in Abeokuta, Nigeria. Twenty sample plots of 5m x 5m were established per hectare for data collection. Also fifty respondents were randomly selected from nearby settlements for anthropocentric value of the species and their contribution to livelihoods. The result showed variation in under-storey species diversity in Gmelina and Teak plantations. In Gmelina plantation, 1561 understory plant species were identified in all the plots consisting of 114 species of trees, 651 shrubs and 796 herbs. Significant differences were observed in the relative density of herbs, shrubs and trees found in the Gmelina Plantation. Teak plantation had 656 individuals of understory plant species in all the sample plots consisting of 86 species of trees, 328 shrubs and 242 herbs were observed. Significant differences were also observed in the relative density of shrubs and trees found in the Teak Plantation but there was no significant difference among the herbs. All respondents indicated medicinal uses of the understory plants with attached cash benefits (N50-N200) if the plants were brought by vendors to the community. Consequently, the plantation serves as indirect reservoir of genetic and plant diversity and if natural succession is allowed, indigenous species diversity will be enhanced with native flora of medicinal value to rural inhabitants. Suggestions include policy statement on forest plantations should allow understory species with minimal cultural operation to reduce cost of plantation development while contributing to rural livelihoods through adequate utilization of the understory species.

Keywords: Artificial forest, understory species, utility derived, medicinal uses, rural livelihoods

INTRODUCTION

Tropical rainforests are among the most species rich places on earth. Previous studies demonstrated high tree diversity of tropical rainforest (Proctes, 1983; Vinceti *et al*, 2008), especially economically important trees (Whitemore, 1990; John and Maundu, 2006). However, the studies of under-storey assemblages (Gentry and Dodson, 1987), herbs, shrubs, lianes and epiphytes (Laska, 1997) are limited. Ecologically, under-storey

plant species assemblages play a fundamental role in diversity, structure, and functional aspect of tropical forests (Svenning, 2000). However, there is under valuation of the under-storey species as a result of inappropriate yardstick for recognition of the species as Non Timber Forest Product capable of yielding utility and satisfaction to exploiters and users. Yet there is inadequate information presently to ascertain the total economic value of under-

storey species in plantations to encourage focus on these hidden but important resources in plantation forestry. Overtime, under-storey in plantations may become substantial sources of revenue, income and employment to nearby settlements and therefore indirectly reduce silvicultural cost in plantations. Under-storey species in plantation may show different patterns of diversity than tree species due to different responses to light level, nutrient availability and temperature (Laska, 1997) as an advantage to promote the commercial value of the species.

Under-storey plants provide valuable genetic resources that could be used in scientific and technological applications such as developing new crops or drugs (Seabrook, 1994). Under-storey is the term for the area of a forest growing at the lowest height level below the forest canopy. Under-storey plants are diverse species of plants found under the canopy of the plantation on forest floor. The under-storey is a dark, cool environment that is under canopy but over the ground. Most under-storey of a rainforest has so little light that makes plant growth limited. Young trees often persist as juveniles for decades while they wait for an opening in the forest which will enable their growth into the canopy. On the other hand, under-storey shrubs are able to complete their life cycle in the shade of the forest canopy (Siebert, 2002). Consequently, under-storey plants are shade tolerant and are able to photosynthesize successfully with limited light. The under-storey is important to the stability of the soil surface. Permanently vegetated areas (uncultivated) embedded in a cultivated matrix play a critical role in maintaining diversity and soil properties. The presence of under-storey along with leaf debris softens the impact of rainfall and reduces run off both by acting as a physical barrier to surface water and by contributing

to soil porosity. They are also the source of organic material that sustain living organism in the soil. They also act as a thermal insulator and protect the soil from extremes of heat and cold as well as from strong winds. The addition of organic materials to the soil in the form of humus also provides for a healthier soil. They are often able to use wave length not available to canopy trees (Beckmann, 1990 and D'acunto *et al*, 2016).

Forest under-storey also has humidity than exposed areas. The forest canopy reduces solar radiation, so the ground does not heat up rapidly. Consequently, the under-storey dries out more slowly than the exposed area. The greater humidity allows fungi and other decomposers to flourish. This drives the nutrient recycling and provides favourable micro-climates for many plants and animals. Thus in a recent study, Pfund (2010), incorporated humans into landscapes ecology as part of ecosystem to address issues such as contribution of wild food to local diet, the importance of different land types in the diet of local people and the significance of forest use and tree cover in consumption of wild plant species. This is however with a view to understand the synergies and trade-offs between forest and livelihoods. The recognition of under-storey as valuable resource for utility and satisfaction will therefore contribute to livelihoods. Adebisi (1999) reported that people with simple cultures and those with advanced civilizations have relied on plants to keep them healthy. Infact, people used different combinations of plants to treat different types of ailments which vary from one community to another and in different ecosystems. Consequently, virtually all plant species found in natural ecosystems are of value to man for medicine. In Asia and Africa, over 80% of the populace relied on

traditional medicine for primary healthcare needs.

In view of the above, this study was carried out at the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria with the following objectives:

- Assess the floristic composition, diversity and structure of under-storey plant communities in *Gmelina* and Teak plantations.
- Investigate the frequency, abundance and density of under-storey plant Species in a forest plantation.
- Identify the medicinal value of under-storey plants in artificial plantation and contribution to livelihoods.

METHODOLOGY

Study Area

The study was carried out at the Federal University of Agriculture, Abeokuta, forest plantation of *Gmelina arborea* and *Tectona grandis* in Ogun State, Nigeria. It falls within latitude 7°N and 7°58'N and longitude 3°E and 4°37'E. Generally, the site

is gently undulating with mild slopes. Twenty sample plots of 5m by 5m were randomly established in each plantation (*Gmelina arborea* and *Tectona grandis*) with the size of the plantations estimated at 2 hectares (20,000m²). A sampling intensity of 5% was used for the study with total sampling size put at 1000m²

Materials Used

Materials used include linear meter tape, pegs and line. Others are field book; pen and cutlass were used for the survey.

Method of Analysis

Standard procedures were followed to measure Density, Frequency, Abundance, Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA). Important Value Index (IVI) of the species was also determined. Shannon-Weanner and species Richness indexes were used for diversity studies. Relative Density, Relative Frequency and Important Value Indices were calculated according to the formulae of Dumbois Muller and Ellenberg (Soerianegara and Indrawan, 1998).

(i)	Density	=	$\frac{\text{Total no of plants of a species present in all sample plots}}{\text{Total no of sample plots studied}}$		
(ii)	Abundance	=	$\frac{\text{Total no of plants in all sample plots}}{\text{No of sample plots of occurrence of plant species}}$		
(iii)	Frequency	=	$\frac{\text{No of sample plots in which a species present}}{\text{Total no of sample plots studied}} \times 100$		
(iv)	Relative Density (%)	=	$\frac{\text{Individual density of a family or SPP}}{\text{Total density of all species encountered}} \times 100$	X	100
(v)	Relative Abundance (%)	=	$\frac{\text{Individual abundance of the species}}{\text{Total abundance of all species encountered}} \times 100$	X	100
(vi)	Relative Frequency (%)	=	$\frac{\text{Individual frequency of the species}}{\text{Total frequency of all species encountered}} \times 100$	X	100
(vii)	IVI for a Species Frequency	=	Relative density + Relative Abundance + Relative Frequency		
Taxonomic composition was quantified on a family basis according to Mori <i>et al</i> (1983).					
(i)	Family Relative Density (%)	=	$\frac{\text{No of trees in a family}}{\text{Total no of trees}} \times 100$	X	100

$$(ii) \text{ Family Relative Diversity (\%)} = \frac{\text{No of species in a family}}{\text{Total no of species}} \times 100$$

$$(iii) \text{ Family importance Value (\%)} = \text{Family Relative density} + \text{Family Relative Abundance} + \text{Family Relative Frequency}$$

The medicinal values of the species were identified through the various ailments nearby community residents use the plant species to treat. Questionnaire was administered among 50 respondents randomly selected from the community

RESULTS

***Gmelina arborea* plantation**

Table 1 shows the quantitative structure of herbs and shrubs of the *Gmelina* plantation in the study area. In *Gmelina* plantation, 1561 under-storey plant species were identified in all the plots consisting of 114 species of trees. Also, 651 shrubs and 796 herbs were observed as non-woody species.

Table 2 shows the results on the composition of herbs, shrubs and trees with their medicinal uses and the anthropocentric value attached to the plants in the study area. For the herbs species, it shows that there were five (5) species of four (4) families. Poaceae family dominated with two species followed by other families. For the shrubs, there were eight (8) species of seven (7) families. Euphorbiaceae family dominated with two species. For the trees, there were two species with two families *Azadirachta indica* and *Ficus sur.*

Table 1: Quantitative structure of herbs and shrubs in Gmelina Plantation

Scientific Name	Total Individual	Density/Acre	Frequency	Abundance/Acre	R.D (%)	R.F (%)	R.A (%)	IVI
Herbs								
<i>Commelina benghalensis</i>	253	101.20	100	101.20	31.78	21.05	31.20	84.03
<i>Rottboellia cochinchinensis</i>	188	75.20	100	75.20	23.63	21.05	23.18	67.86
<i>Setaria barbata</i>	180	72.00	100	72.00	22.61	21.05	22.19	65.85
<i>Aspilia africana</i>	130	52.00	100	52.00	16.33	21.05	16.03	53.41
<i>Spigelia anthelmia</i>	45	18.00	75	24.00	5.65	15.80	7.40	28.85
Total Herbs	796	318.40	475	318.40	100	100	100	300
Shrubs								
<i>Chromolaena odorata</i>	193	77.20	100	77.20	29.65	14.29	26.68	70.62
<i>Combretum hispidum</i>	94	37.60	95	39.58	14.44	13.57	13.68	41.69
<i>Cnestis ferruginea</i>	76	30.40	95	32.00	11.68	13.57	11.06	36.31
<i>Reissantia indica</i>	71	28.40	85	33.41	10.91	12.14	11.55	34.60
<i>Annona senegalensis</i>	62	24.80	90	27.56	9.52	12.86	9.53	31.91
<i>Bridellia ferruginea</i>	53	21.20	85	24.94	8.14	12.14	8.62	28.90
<i>Mannoiphyton fulvum</i>	51	20.40	80	25.50	7.83	11.43	8.81	28.07
<i>Triumfetta cordifolia</i>	51	20.40	70	29.14	7.83	10.00	10.07	27.90
Total shrubs	651	260.40	700	289.33	100	100	100	300

Note: R.D = Relative Density; R.F = Relative Frequency; R.A = Relative Abundance; IVI = Important Value Index

Table 2: Composition of herbs, shrubs and trees with medicinal uses and anthropocentric values in the Gmelina Plantation

S/N	Botanical name	Family	Common name	Local name	Parts used	Medicinal uses	Value attached
Herbs							
1.	<i>Aspilia africana</i> (Per) C.D Adams	Asteraceae	Haemorrhage plant, African Marigold	Yunyun, uranjilalu, kalankuwa	Leaves, flower, roots and seeds	Haemostatic, cleaning sores, corneal opacities, stomach disorders, tuberculosis, nervous disorders, guineaworm, gonorrhoea, skin rash.	₦100/Unit sale
2.	<i>Commelina benghalensis</i> (Linn.)	Commelinaceae	Tropical spiderwort, Whiskered commelina	Godogbo	Leaves, whole plant	Febrifuge, diuretic, laxative and anti-inflammatory. To cure leprosy.	₦200/Unit sale
3.	<i>Setaria barbata</i> (Lam.) Kunth	Poaceae	Bristle	Ponipon, Omo-eye	Stem, root	Antipyretic, haemostatic	₦ 50/Unit sale
4.	<i>Spigelia anthelmia</i> (Linn.)	Loganaceae	Worm wood	Aparan	Leaves, stem and root	Intestinal worms, convulsions	₦ 50/Unit sale
5.	<i>Rottboellia cochinchinensis</i> (Lour.)	Poaceae	Itchgrass	Holo	Leaves, root, stem	Edible Leaves	₦ 100/Unit sale
Shrubs							
6.	<i>Mannoiphyton fulvum</i> (Mull.-Arg.)	Euphorbiaceae	Fulvum	Ebumen	Root, shoots	Bronchitis, cough, gonorrhoea, stomach ache, Heart problems, insanity, leprosy, ear treatments	₦100/Unit sale
7.	<i>Bridelia ferruginea</i> (Benth.)	Euphorbiaceae	Bridelia, papery bark tree	Ira, iralodan, ira eju, Kirni, Ola, Ede, okukuu.	Leaves, bark, roots, fruits, stem	Insomnia, antipyretic, general care in children, diabetes, antibacterials, dysentery, mouth wash, gonorrhea	₦100/Unit sale
8.	<i>Combretum hispidum</i> (Laws.)	Combretaceae	Bush willow	Okan	Leaves, stem, roots	Black tongue, appetizer, weakness, antipyretic.	₦100/Unit sale
9.	<i>Annona senegalensis</i> (Pers.)	Annonaceae	African custard apple, Gwanda-daji	Abo, Ibobo, gwandar daji, uburu ocha	Root, bark, leaves, seeds	Dysentery, cough, toothache, anthelmintic, eye drops, and blood purification.	₦100/Unit sale
10.	<i>Reissantia indica</i> (Willd.)	Celastraceae	Velvet bushwillow, Mopane paddle pod	Abodedije (Ayede- Ekiti), Ponju Owiwi	Root, bark, stem, sap	Antibacterial	₦200/Unit sale
11.	<i>Triumfetta cordifolia</i> (A. Rich)	Malvaceae	Burweed, cordleaf burbark	Akeeri (Oyo), Itogbin-in	Flowers, leaves, bark, roots, twigs, stem	Burns, diarrhoea, to ease childbirth, sterility in women. Muscle pain, lung problems, dysentery, liver diseases, laxative. asthenia,	₦200/Unit sale

							marasmus, hepatitis
12.	<i>Cnestis ferruginea</i> (Guan.)	Connaraceae	Short pod, Alum plant	Akaraaje, Omu-aja, elemesan, Eyin akerese (Kaba)	Leaves, stem and bark	Use as an antidote for Snake bite, eye drops, migraine, gonorrhea, mouth odour, laxative and cough	₦ 100/Unit sale
13.	<i>Chromolaena odorata</i> (L.) R. M King & Robinson	Asteraceae	Siam weed	Akintola, Awolowo	Leaves, stem-twigs	Dysentery, malaria fever, leaf sap used for blood clotting.	₦ 50/Unit sale
Trees							
14.	<i>Azadirachta indica</i> (A.Juss)	Meliaceae	Neem tree	Eke-oyibo, Dongo-yaro	Leaves, stem, bark, seeds	Malaria, jaundice, syphilis, skin disease, eczema, ringworm, emetic, laxative, sore throat	₦ 100/Unit sale
15.	<i>Ficus sur</i> (Forrsk)	Moraceae	Cape fig, Broom cluster fig	Opoto	Latex, leaves, bark, roots, twigs	Treating wounds, toothache, eye problems, general body pain, lung and throat problems, hypertension, diarrhoea, peptic ulcers, tonsillitis and stomach pain	₦ 200/Unit sale

Teak Plantation

Table 3 shows the quantitative structure of herbs and shrubs in teak plantation. From the teak plantation, 656 individuals of under-storey plant species were identified in all the sample plots consisting of 86 species of trees, 328 shrubs and 242 herbs were observed.

Table 4 shows the result on the composition of herbs, shrubs and trees with their medicinal uses and anthropocentric value. For herbs, there were five species of five families while for shrubs, there were five species of three families. For the trees, there were three species of trees with three families.

Table 5 shows the quantitative structure of trees in the study area. However, trees showed significant difference. This was observed between *Azadirachta indica* and *Ficus sur*. In Gmelina plantation, *Azadirachta indica* had the highest relative density while *Ficus sur* recorded the lowest density.

In Teak Plantation, trees also showed significant difference. This was observed between *Albizia lebbbeck* and *Azadirachta indica*. *Azadirachta indica* had the highest relative density while the lowest density was obtained in *Albizia lebbbeck*.

Table 3: Structure of herbs and shrubs in Teak Plantation

Scientific Name	Total Individual	Density/Acre	Frequency	Abundance/Acre	R.D (%)	R.F (%)	R.A (%)	IVI
Herbs								
<i>Synedrella nodiflora</i>	62	24.80	95	26.11	25.62	22.35	22.98	70.95
<i>Anchomanes difformis</i>	58	23.20	85	27.29	23.97	20.00	24.01	67.98
<i>Mariscus Alternifolius</i>	51	20.40	95	21.47	21.07	22.35	18.89	62.31
<i>Ipomoea involucrate</i>	37	14.80	65	22.77	15.29	15.30	20.04	50.63
<i>Rottboellia cochinchinesis</i>	34	13.60	85	16.00	14.04	20.00	14.08	48.12
Total	242	96.80	425	113.64	100	100	100	300
Shrubs								
<i>Manniophytum fulvum</i>	133	53.20	100	53.20	40.55	22.99	36.65	100.19
<i>Combretum hispidum</i>	73	29.20	90	32.44	22.26	20.69	22.35	65.30
<i>Reissantia indica</i>	46	18.40	80	23.00	14.02	18.39	15.84	48.25
<i>Combretum zenkeri</i>	45	18.00	90	20.00	13.72	20.69	13.78	48.19
<i>Mallotus oppositifolius</i>	31	12.40	75	16.53	9.45	17.24	11.38	38.07
Total	328	131.20	435	145.17	100	100	100	300

Note: R.D = Relative Density; Freq. = Frequency; Abun = Abundance; R.F = Relative Frequency; R.A. = Relative Abundance Index

TABLE 4: Composition of herbs, shrubs and trees with medicinal uses and anthropocentric values in Teak Plantation

S/N	Botanical name	Family	Common name	Local name	Parts used	Medicinal and other uses	Value attached
Herbs							
1.	<i>Synedrella nodiflora</i> (Gaertn.)	Asteraceae	Node weed	Ewe Olukoti	Leaves	Infusion of leaves, drink as laxative.	₦100/Unit sale
2.	<i>Anchomanes difformis</i> (Engl.)	Araceae	Anchomanes	Abirisoko, oje, langbodo, ogirisako, Isu-igo	Roots	Diuretics, purgative, gonorrhoea	₦200/Unit sale
3.	<i>Mariscus alternifolius</i> (Vahl.)	Cyperaceae	Mariscus	Ikeregum, alubosa eranko	Stem-bases	Gonorrhoea, healing wound, , rhizome is aromatic; edible after cooking	₦200/Unit sale
4.	<i>Ipomoea involucrata</i> (P. Beauv)	Convolvulaceae	Morning glory	Ododo-odo, alukerese, Duman kwaadi	Leaves	Convulsions, purgative, eye drops, asthma, arthritis, antipyretic, yellow fever, filariasis, gynaecological diseases, gonorrhoea.	₦50/Unit sale
5.	<i>Rottboellia cochinchinensis</i> (Lour.)	Poaceae	Itchgrass	Holo	Leaves	Purgative	₦100/Unit sale
Shrubs							
6.	<i>Mallotus oppositifolius</i> (Muell.Arg)	Euphorbiaceae	Indian kamila	Oju-eja, Jeja, iyadudu, orokoro, Kpokowa, K'afar mutuwa	Leaves, roots, fruits.	Tapeworms, ringworm, pimples, bruises, astringent, anthelmintic, tonic, haemostatic.	₦200/Unit sale
7.	<i>Manniophyton fulvum</i> (Muell.-Arg.)	Euphorbiaceae	Fulvum	Ebumen	Root, shoots	Bronchitis, cough, gonorrhoea, stomach ache, Heart problems, ear treatments	₦200/Unit sale
8.	<i>Combretum zenteri</i> (Engl & Diels)	Combretaceae	Combretum	Ogan , Ogan-pupa	Root, leaves, plant and twig	Swellings, oedema, gout, diarrhoea, dysentery, malaria, menstrual pain	₦200/Unit sale
9.	<i>Combretum hispidum</i> (Laws)	Combretaceae	Bush willow	Okan	Leaves, stem, roots	Black tongue, appetizer, weakness, antipyretic.	₦100/Unit sale
10.	<i>Reissantia indica</i> (Willd.)	Celastraceae	Velvet bushwillow, Mopane paddle pod	Abodedije (Ayede-Ekiti), Ponju Owiwi	Root, bark, stem, sap	Antibacterial , febrifuge	₦200/Unit sale
Trees							

14.	<i>Azadirachta indica</i> (A.Juss)	Meliaceae	Neem tree	Eke-oyibo, Dongo-yaro	Leaves, stem, bark, seeds	Malaria, jaundice, syphilis, anthelmintics, skin disease, eczema, ringworm, emetic, laxative, sore throat	₦200/Unit sale
15.	<i>Ficus exasperata</i> Vahl.	Moraceae	Sand paper tree	Epin, Ewe-ipin	Leaves, bark, root, seeds	Stomach disorder, scabies, gonorrhoea, urinary ailments, jaundice, abortifacient, antipyretic	₦200/Unit sale
16.	<i>Albizia lebbek</i> (Benth.)	Fabaceae	Silk flower, lebbek	Igbagbo	Seeds, Leaves, Stem-bark	Astringent, mouthwash, river- blindness, gonorrhoea	₦200/Unit sale

TABLE 5: Quantitative structure of trees in the Study Area

Scientific Name	Total Individual	Density/Acre	Frequency	Abundance/Acre	R.D (%)	R.F (%)	R.A (%)	IVI
Gmelina Plantation								
<i>Azadirachta indica</i>	88	35.20	95	37.05	77.19	59.37	69.84	206.40
<i>Ficus sur</i>	26	10.40	65	16.00	22.81	40.63	30.16	93.60
Total	114	45.60	160	53.05	100	100	100	300
Teak plantation								
<i>Azadirachta indica</i>	43	17.20	75	22.93	50	38.46	44.15	132.61
<i>Ficus exasperate</i>	28	11.20	80	14.00	32.56	41.03	26.96	100.55
<i>Albizia lebbek</i>	15	6.00	40	15.00	17.44	20.51	28.89	66.84
Total	86	38.48	195	51.93	100	100	100	300

Note: R.D = Density; R.F = Relative Frequency; R.A. = Relative Abundance; IVI = Important Value Index

DISCUSSION

Statistically, significant differences were observed in the relative density of herbs, shrubs and trees found in the Gmelina Plantation. The relative density of *Commelina benghalensis* significantly differs from other herbs in the Gmelina plantation while the other herb species were not significantly different from each other. *Chromolaena odorata* is significantly different from *Manniophyton fulvum*. This is in line with the findings of Oladoye and Aduradola (2015) that noted the ability of *C. odorata* to out-compete and suppress weeds. This has equally been reported in previous studies on weed communities (Akobundu *et al*, 1999). There is no significant difference among *Cnetis ferruginea*, *Reissantia indica*, *Bridelia ferruginea* and *Annona senegalensis* in the shrubs of Gmelina plantation. The data indicate the highest density of herbs in non-woody species; *Commelina benghalensis* (101.2 plants/acre) and lowest density was observed in *Spigelia anthelmia* (18 plants/acre). Lowest density of shrubs was observed in *Manniophyton fulvum* and *Triumfetta cordifolia* (20.4 plants/acre) while the highest density was observed in *Chromolaena odorata* (77.2 plants/acre). These findings corroborate the study of Oladoye *et al* (2014) that reported on 57 species/ha to justify species richness in a forest ecosystem. *Chromolaena odorata* also had the highest relative frequency while the lowest relative frequency was observed in *Triumfetta cordifolia*.

However, in view of anthropocentric value (Table 2), Jitendra (2009) reported on rural dwellers poor knowledge of grading products for commercial marketing. Accordingly, Kohls and Uhl (1972) affirmed that the measures of locally marketed NTFPs are rarely standardized and this makes marketing to be more cumbersome. However, a handful measurement made by either the collectors

that packed it or the retailers that repack, but the fact is that the pack size varies. The pack when discreetly itemized contains 4-9 strands and leaflets and it weighs averagely 2.5g. Variation in the quantity is attributed to plant maturity and the leaves, palm size of the packer and the years of experience of the packer.

Statistically, significant differences were also observed in the relative density of shrubs and trees found in teak field but there was no significant difference in the herbs. The relative density of herb species is not significantly different from each other in teak plantation while there was a significant difference between the shrub species. *Manniophyton fulvum* significantly differs from *Reissantia indica* and *Mallotus oppositifolius*. For herbs, highest density was observed in *Synedrella nodiflora* and lowest density observed in *Rottboellia cochinchinensis*. The highest frequency was also found in *Synedrella nodiflora* and the lowest was found in *Ipomoea involucrata*. For shrubs, *Manniophyton fulvum* recorded the highest relative frequency and the lowest relative frequency was found in *Mallotus oppositifolius*. This is in line with Oladoye *et al*, (2014) that reported on variation of relative density in a riparian forest.

In Africa, medicinal uses and anthropocentric importance of traditional remedies made from indigenous plants play a crucial role in the health of millions of people. According to Abdullahi (2011), one estimate puts the number of Africans who routinely use these services for primary health care as high as 85% especially in sub-Saharan region.

The quantitative structure of trees in the study area revealed significant difference between *Azadiractha indica* and *Ficus sur* in Gmelina plantation. Also similar difference was observed in Teak plantation between *Albizia*

lebbeck and *Azadiractha indica* in terms of relative density.

The biological significance of the variation of species inequality between Gmelina and teak plantations is species diversity, however, the economic significance is utility derived from the species. This is appreciated from the diverse items from the under-storey species such as medicinal leaves, barks, fruits, roots and others categorized as Non Timber Forest Products (NTFPs) important in the livelihoods of the local people living close to the plantations. FAO (1997) noted that tropical rainforest contains no less than 60% of all higher plants known on earth and they provide all that is needed for human survival including remedies against diseases. Consequently, Popoola and Oluwalana (2001) noted that forests are usually undervalued because of a wide range of NTFPs not included in traditional financial and economic analysis of forest projects.

CONCLUSION

The findings of this research showed that the study areas had inequality in species composition in spite of having common species and the proximity of these areas. Species diversity of shrubs and trees is less than herbs and grasses in Gmelina plantation but the diversity of species in herbs and trees is less than shrubs in the teak plantation. Research conducted has shown that tree planting in tropical areas will accommodate the native forest species diversity through succession. Existing forest plantation may act as a catalyst for successful natural forest succession of shrubs, herbs and grasses using the microclimate conditions under the natural regeneration system. Hence, creating a more favourable environment for the establishment of native or indigenous forest flora can facilitate the attraction of indirect conservation of biological diversity in a particular area. The study eventually concludes that a proper

protection from human interference and scientific management of undergrowth of the study area may lead to a biodiversity rich site in the country and other tropical countries.

REFERENCES

- Abdullahi, A.A 2011. Trends and Challenges of Traditional Medicine in Africa. *African Journal of Traditional, Complementary and Alternative Medicines* 8 (5S): 115–23.
- Adebisi, L.D. 1999. Biodiversity conservation and Ethnobotany of selected grooves in Osun State, Nigeria. Ph.D Thesis in the Faculty of Agriculture and Forestry, University of Ibadan, Oyo State.
- Akobundu, I.E. Ekeleme, F and Chikoye, D. 1999. Influence of fallow management systems and frequency of cropping on weed growth and crop yield. *Weed Research*, 39: 241-256
- Beckmann, R., 1990. Rural Dieback: Restoring the balance, summer (1989/1990): *Ecos* 62:8-15.
- D'acunto, L, Semmartin, M. and Ghersa, M.C. 2016. Uncultivated margins are source of soil microbial diversity in an agricultural landscape. *Agriculture, Ecosystem and Environment* 220 : 1-7
- FAO, 1997. Medicinal plants for forest conservation and health care. FAO Paper 11. Food and Agriculture Organisation, Rome, Italy
- Gentry, A.H. and Dodson, G. 1987. Contribution of non-trees to species richness of a tropical rain forest. *Biotropica* 19: 149-156.
- Johns, T. and Maundu, P. 2006. Forest biodiversity, nutrition, and population health in market oriented food systems. *Unaslyva*; 224 (57): 34-40
- Jitendra, K. D. and O. M. Prakashb 2009. Measuring marketing channel efficiency and strategies to improve income to local communities dependent on tropical

- forests. *Journal of Sustainable Forestry*. 15 (4) : 29-52.
- Kohls, R. K and J. N Uhl, 1972. *Marketing of Agricultural Products*. Macmillan Publishing Co., Inc. New York (5th edition). 612pp.
- Laska, M.S. 1997. Structure of understorey shrub assemblages in adjacent secondary forest and old growth tropical wet forests, Costa Rica. *Biotropica* 29: 29-37.
- Mori, S.A., Boom, B.M., Carvalino, A.M. and Santos, D. 1983. The ecological importance of Myrtaceae in eastern Brazilian wet forest. *Biotropica* 15: 68-70.
- Oladoye, A.O., Olubode, O.S., Odeyale, O.O., and Ola, J.A. 2014. Structure and Composition of Woody Species in Riparian forest in the University of Agriculture, Abeokuta, Nigeria. *Biological and Environmental Science Journal of the Tropics*, 11 (3): 333-344
- Oladoye, A.O., Aduradola, A.M., Adedire, M.O., and Agboola, D.A. 2014. Composition and Stand Structure of a Regenerating Tropical Rainforest Ecosystem in South-western Nigeria. *International Journal of Biodiversity and Conservation*, 6(11): 765-776
- Oladoye, A.O., and Aduradola, A.M. 2015. Assessment of floristic composition of Forest undergrowth of International Institute of Tropical Agriculture (IITA) Forest Reserve, Ibadan, Nigeria. *International Journal of Ecology and Environmental Studies*, 3(2): 74-84.
- Pfund, J.L. 2010. Landscape-scale research for conservation and development in the tropics: fighting persisting challenges. *Current Opinion in Environmental Sustainability* 2:117-126.
- Popoola, L. and Oluwalana, S. A. 2001. Marketing of NTFPs in Nigeria. In: Adeola, A. O. and Ojo, L. O (eds): Proceeding of symposium organized in celebration of the International Biodiversity Observation year (October, 2007) Federal University of Agriculture, Abeokuta, Nigeria. 16th-17th Oct., 2001.
- Proctor, J.J., Anderson, M, Chai, P. and Vallack, H.W. 1983. Ecological studies in four contrasting lowland rain forest in Gunung Mulu National Park, Serawak. *J. Ecol.* 71: 237-260.
- Seabrook, J., 1994. *Growing understorey seed*. Greening WA. 58pp.
- Siebert, S. 2002. From shade- to sun-grown perennial crops in Sulawesi, Indonesia: implications for biodiversity conservation and soil fertility. *Biodiversity and Conservation* 11: 1889-1902.
- Soerianegara, I. and Indrawan, A. 1998. *Ekologi Hutan Indonesia*. Laboratorium Ekologi Hutan, Fakultas Kehutanan, Institut Pertanian Bogor, Indonesia. 104pp.
- Svenning, J.C. 2000. Small canopy gaps influence plant distribution in the rain forest understory. *Biotropica* 32: 252-261.
- Vinceti, B., Eyzaguirre, P. and Johns, T. 2008. The Nutritional Role of Forest Plant Foods for Rural Communities. In: Colfer, C.J.P. (ed.). Human Health and Forests: A Global Interdisciplinary Overview of Issues, practice and policy. Earthscan/ CIFOR, London, UK. pp. 63-96.
- Whitmore, T.C. 1990. *An Introduction to Tropical Rain Forests*. Oxford University Press, New York, 226pp.