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Ecological Succession in Agrarian Impacted Site in Parts of Amafor Rainforest in Ngor-Akpala Local Government Area (LGA) of Imo State, Nigeria: Phytodiversity and Species Composition Assessments

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ABSTRACT

Background: Series of ecological demand are causing significant and irreversible loss to forest resource, thus causing their disappearance at alarming rates due to demand for timber and non-timber products and for agricultural lands. In most communities of Ngor-Akpala in Imo State, where mechanized and sustainable system of agriculture is not practiced, shifting cultivation and subsistence farming are the most obvious causes of forest disturbances. **Objective:** This study elucidates the phytodiversity and composition of an agrarian impacted site in parts of Amafor forest in Ngor-Akpala, Imo State. **Methodology:** A total of five quadrate sampling plots of 20×50 m each were systematically sampled and phytosociological data were collected in both the impacted and unimpacted sites. **Results:** The impacted site had a total representative of 39 species under 17 families recorded in mosaic heterogeneity with herbs (77%) and shrubs (58%) as the most dominant life form of plant species. Phytosociological results showed that among the 39 representative species, *Spillanthes filicaulis* and *Ipomoea involucrata* recorded the highest frequency of (100 = 5.81%) occurrence. *Andropogon tectorum* (giant bluestem) had the highest density value of 11.2 = 18.01%, highest abundance value of 18.7 = 14.70% and highest Importance Value Index (IVI) of 36.20%, respectively. In distribution pattern 20 species (51.28%) had random distribution, 5 (12.82%) species in regular and 14 (35.90%) species in contiguous distribution pattern. The unimpacted site had 19 species under 14 families in climax vegetation structure of six species as herbs, 11 as shrubs and 2 as trees. Phytosociological assessment had four species with the highest frequency of 100 = 7.69% with *Manniophyton fulvum* having the highest density value of 6 = 10.24% per species and IVI of 25.11%. *Funtumia elastica* had the highest abundance of 8 = 9.30%. The distribution pattern showed 12 species (63.16%) in contiguous pattern, 4 species (21.05%) in random distribution and 3 species (15. 79%) regularly distributed. **Conclusion:** The comparative study on the similarity of the impacted and unimpacted sites shows that both sites are dissimilar with an observed index value of 0.79 higher than the 0.21 value of similarity index.

Key words: Phytosociology index, diversity, agrarian practice, ecological succession, distribution pattern

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INTRODUCTION

The tropical rainforest constitutes the most biological diverse terrestrial ecosystem on earth[1]. Across the world, 25 hot-spots have been identified on the basis of species endemism and degree of threat through habitat loss[2]. It is the predominant natural forest in Nigeria occupying about 10% of land mass[3] which have been extensively degraded and exist in patches. Forest vegetation represents an important natural resource with diverse scientific, technological, cultural and ecological values at the local, state, national and international levels of societal needs. Despite these immense economic and ecological values of forest to man[4], noted series of ecological demand incursion by the society to be causing significant and irreversible loss to this unique resource.

These forests are disappearing at alarming rates owing to deforestation for extraction of timber and other forest products and diverse forms of agricultural activities. In most communities of Ngor-Akpala in Imo State, Nigeria, especially where mechanized and sustainable system of agriculture is not practiced, shifting

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cultivation and subsistence farming as the most common operations been practiced are the most obvious causes of forest disturbances. The problem with the chronic form of disturbance is that plants or ecosystem often do not get time to recover adequately because the human on slaught never stops[5].

Several other biotic and abiotic factors have been noted as agents of species ecological amplitude[6,7,8]. This concomitantly amount to some degree of ecological succession causing direct changes in plant species abundance in terms of frequency of occurrence and density. Other succession impacts involve changes in species diversity (in terms of richness and evenness), relative density, relative frequency, relative abundance, Importance Value Index (IVI), ratio of abundance to frequency (A/F) and plant species regeneration and habit.

Diversity provides an observer a feeling of satisfaction in the natural world[9]. Phytodiversity studies in tropical rainforest are important to determine the process or mechanisms that maintain high diversity, species richness, species assemblages and at the same time providing a database about the number and status of the species existing in an area and their conservation[10,11]. An obvious approach to conserve plant biodiversity is to map distributional patterns and look for concentrations of diversity and endemism[12]. Further, management of forest requires understanding of its composition in relation to other forests, the effects of past impacts on the present status and the present relationship of the forest with surrounding land use [13]. Very often ecologists find it necessary to compare different vegetation structure and complex of the same localities and/or different localities. This comparison has usually been done for conservation and management purposes. An objective and quantitative way of comparing vegetation of two different or similar localities is to examine the similarities in species composition and content in line with conservation priorities.

Agriculture has a significant effect on species diversity and amplitude because of its prevalence over landscape. Such effect may include habitat alteration, exotic pest introduction, pollution from pesticides and fertilizer etc. Loss of plant species diversity due to agricultural expansion and plantation establishment is rapidly increasing. Such loss is often attributed to population growth particularly in suburb and in rural community such as Amafor, where such losses may be linked to rural poverty and farmers' ignorance to values and functions of biodiversity and severity of subsistence farming activity involving bush burning. Floristic diversity and phytosociological study of Amafor forest in Ngor-Akpala in Imo State, Nigeria is lacking. Therefore, the present study was undertaken to assess the plant biodiversity and vegetation analysis due to agrarian impact on Amafor forest in Ngor-Akpala LGA of Imo State, Nigeria.

MATERIALS AND METHODS

Geo-morphological description of the study area/location: Ngor-Akpala local government area among others in Eastern part of Nigeria is located in Imo State. The area is situated between latitude 05° 20'0"N and 05° 25'0"N and longitude 007°10'0"E and 007°15'0"E of the State. The local government area is housing among other autonomous community, the Amafor Community. The study location, Amafor is located north-west of Ngor-Akpala local government area in Imo State. The location is situated between latitude 05°20'0"N and 5°25'0"N and longitude 007°5'0"E and 007°10' 0"E of its location in Imo State (Fig. 1). The site is being under exploitation of agrarian human influence for domestic firewood logging, charcoal production (carbon credit) and diverse plantations of agricultural produce for both local consumption and marketing.

The study area is characterized by two season, the rainy and dry seasons. The rainy season falls with its peak between June and October, its lowest recorded from November to January with annual rainfall varying from 1500-2544.10 mm. A mean temperature of above 27°C with the lowest and highest in the area being 19 and 33°C is respectively recorded. Relative humidity is 75-90% at peak rainfall. The dry season between November and March experiences with peak temperature and humidity between January and March. This favours the luxuriant vegetation growth of the area (en.wikipedia.org/wiki/imo_state).

The area in its edaphic status is underlain by the Benin formation of coastal plain sands. This formation which is of late tertiary age is rather deep, porous, infertile and highly leached. In some areas like Okigwe, impermeable layer of clay occur near the surface while in other areas, the soil consists of lateritic material under a superficial layer of fine grained sand. In Amafor study site the soil is dominantly clay-loamy with its lateritic coloration due to the rainfall weathering and oxidation processes of iron (II) to iron (III) oxide ($Fe^{2+} \rightarrow Fe^{3+}$) causing colour change. The area is also rich in lead, zinc, coal tar (hydrocarbon formation).

The study area is in the centre of one of the agricultural zones of the State. The vegetation primarily though of climax nature is of typical secondary nature

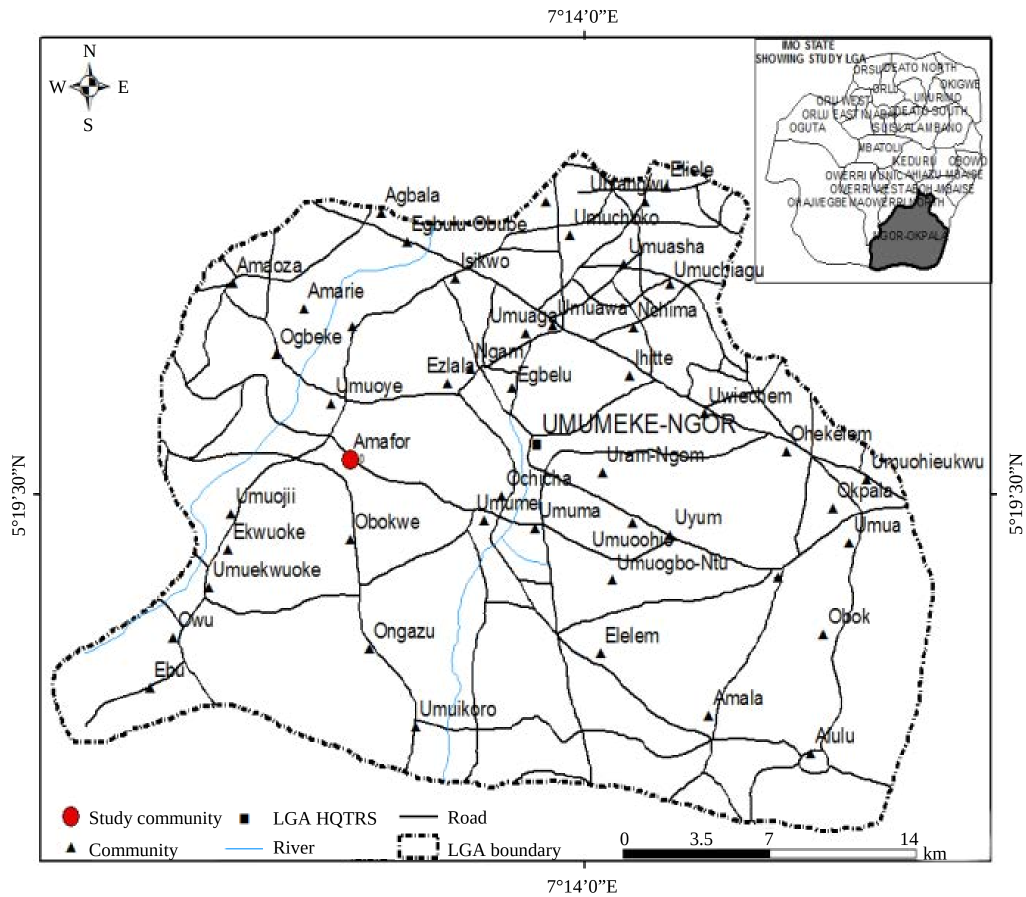

Fig. 1: Map of study area/site

with its prevalent species of ecological succession regenerating from the effect of agrarian activities. The successive vegetation of the area is characterized by prevalent species of shrubs, herbs, climbers, lianers and dominantly members of Poaceae, Asteraceae, Sterculiaceae, Connaraceae, Fabaceae, Convolvulaceae, Tiliaceae, Icacinaceae, Malvaceae, Rubiaceae, Dioscoreaceae, Melastomataceae, Euphorbiaceae, Combretaceae, Polygalaceae, Urticaceae, Polygalaceae, Passifloraceae, Cyperaceae, Apocynaceae, Loganiaceae, Dilleniaceae, Guttiferae and Verbenaceae plant families, typical of secondary succession fallowed bush. The environment has also witnessed some form of human activities such as farming far and near residential areas by the local communities leaving fields of plantations such as *Manihot* spp. (Euphorbiaceae), *Musa* spp. (Linn.) (Musaceae); *Xanthosoma malfaffa* Schott (Araceae) and *Coloccasia esculenta* (Linn.) Schott (*Araceae*). Though primarily, in a climax vegetation of various strata the effect of these agrarian activities has consequently left it with some form of irregular vegetation features. This can therefore, be categorized as a low land secondary mosaic forest as described by Hopkin[14]. However, the vegetation is yet described as rainforest vegetation in relation to similar view of vegetation analysis by SAF[15] and Edwin-Wosu[16-19].

Vegetation assessment: It was carried out by adopting the simple random sampling based on standard procedures for ecological assessment studies[20] with specific quadrate direction of 100×50 m to determine the regeneration status of the site. This was divided into sampling unit to give a total of five quadrate sampling plot of 20×50 m each and was systematically sampled. All the important representative plant species sampled were identified in the field as far as possible and were properly authenticated using flora such as[21-27].

Data analyses: The frequency (F%) of distribution, abundance (A), density (D), Relative Frequency (RF), Relative Abundance (RA), Relative Density (RD), Importance Value Index (IVI) and abundance-frequency ratio (A/F) of the representative species of the study site were estimated using the methods of Austin[28], Kershaw[29] and Shukla and Chandel[30] as modified by Bonham[31]. The species diversity and dominance over the study site was estimated using the Shannon and Weiner[32] index. Vegetation was described in semi-quantitative terms[33] and in accordance species with a wide frequency of distribution with many stands are described as very abundant (++++). Some species with similarly wide frequency of distribution but with few stands are said to be less frequent, abundant or restricted species (+++). The species with limited geographical distribution and with a few stands are termed scarce or occasional (++) and very scarce or rare (+) species. The species designated (++) and (+) are often seen as being prone to elimination due to their limited extent alone beside any other factors. Relative density, relative abundance and relative frequency were estimated following Misra[34] method while the Importance Value Index (IVI) was estimated by the cumulative ecological indices using the Shukla and Chandel[30] method. The ratio of abundance to frequency (A/F) for different species was determined for distribution patterns. Thus with the "Thumb of rule" designated as follows: Regular (<0.03), Random (0.03-0.05) and Contiguous (>0.05) distribution as adopted by Curtis and Cottam[35]. The assessment of similarity or dissimilarity for the two sites was carried out using the Sorensen[36] index.

RESULTS

The project study location with its situate lying between Lat. 5°20'0"N and 5°25'0"N and Long. 7°10'0"E and 7°15'0"E of the study area is part of Amafor tropical rainforest impacted by the unsustainable and pristine agricultural activities practiced by the people of Amafor community in Ngor-Akpalla Local Government Area of Imo State. The area under investigation is characterized by secondary vegetation complex, mosaic in nature with a heterogeneous spatial continuum arrangement, due to the biotic influence of ecological incursion. Agronomic practices such as subsistence crop farming and charcoal production carbon credit activities were been carried out, with concomitant aggressive logging and loss of forest woody species of homogenous climax nature. Despite such ecological incursion with resultant primary succession of the impacted site, the study area of assessment involving the impacted and the unimpacted control sites (Table 1- 4), respectively were observed with plant species of various strata and categories belonging to different families with representative species of the various sites recorded based on the phyto-sociological indices of ecological assessment.

In the present study the vegetation complex of the impacted site recorded a total representative of 39 species under 17 families with mosaic heterogeneity (Table 1). Four families (Poaceae, Asteraceae, Fabaceae and Rubiaceae) were prevalently dominant, with two (Asteraceae and Rubiaceae) in abundance while Poaceae and Fabaceae were found to be very abundant. Under such ecological assessment, herbs and shrubs were the most dominant plant species in the study areas. They were represented by 30 and 9 species, respectively distributed among the 17 families. Poaceae was the most diverse with 10 species, Fabaceae 7 species, Asteraceae and Rubiaceae, has three species each. Similar ecological assessment with the phytosociological index application on the species prevalence of the study area (Table 2) shows that among the 39 representative species two species (*Spillanthes filicaulis* and *Ipomoea involucrata*-morning glory) recorded the highest frequency of (100 = 5.81%) occurrence while the density per species had indicated *Andropogon tectorum* (giant bluestem) with the highest density value of 11.2 = 18.01% and highest abundance value of 18.7 = 14.70%.

The cumulative status of species prevalence among the representatives in the study site has shown 12 species with maximum value index range of 10.49-36.20% and with the highest Importance Value Index (IVI) of 36.20% recorded by *A. tectorum*. The ratio of abundance to frequency in distribution pattern of the species in the site shows that greater proportion of the species (20 = 51.28%) was randomly distributed in spatial continuum, indicating a greater impact and disturbance in the habitat while 5 (12.82%) species were regularly and 14 (35.90%) species were contiguous in distribution pattern.

In a similar assessment of the unimpacted control site a total representative of 19 species under 14 families were recorded (Table 3) in a homogenous climax vegetation structure. One family (Euphorbiaceae) was prevalently dominant and very abundant. Under such study, the life form of the species showed that six species exist as herbs in transition, eleven species as shrubs and two species as trees in which Euphorbiaceae recorded highest diversity with four species among the families of the life form habitat.

Table 1: Survey estimate of representative species around the Agrarian impacted Amafor forest in Ngor-Akpala local government area of Imo state

Species	F (%)	Family	Habit	Common name	Remark
Axonopus flexousus (Peter) Troupin	40	Poaceae	Herb		++
Andropogon tectorum Schum and Thonn.	60	Poaceae	Herb	Giant bluestem	+++
Eragrostis ciliaris (Linn.) R.Br.	40	Poaceae	Herb	Love grass	++
Spillanthes filicaulis (Schum and Thonn.) C.D. Adams.	100	Asteraceae	Herb		+++++
Scleria naumanniana Boeck	20	Cyperaceae	Herb	Bush knife	+
Melochia melissifolia Benth.	20	Sterluliaceae	Herb		+
Paspalum conjugatum Berg.	40	Poaceae	Herb	Sour grass	++
Panicum maximum Jacq.	40	Poaceae	Shrub	Guinea grass	++
Cnestis ferruginea DC.	40	Connaraceae	Shrub		++
Perotis indica (Linn.) O. Ktze	80	Poaceae	Herb		++++
Senna occidentalis (Linn.) Link.	20	Fabaceae-ceasal	Shrub		+
Chamaecrista mimosoides (Linn.) Greene	40	Fabaceae-mimo	Shrub		++
Ipomoea involucrate P. Beauv.	100	Convolvulaceae	Herb	Morning glory	+++++
Truimfetta cordifolia A. Rich.	60	Tiliaceae	Herb		+++
Icacina trichantha Olive.	80	Icacinaceae	Herb		++++
Urena lobata Linn.	40	Malvaceae	Shrub	Hibiscus bur	++
Calopogonium mucunoides Desv.	60	Fabaceae	Herb		+++
Panicum laxum Sw.	60	Poaceae	Herb		+++
Oldenlandia affinis	20	Rubiaceae	Herb		+
Dioscorea smilacifolia	20	Dioscoreaceae	Herb		+
Andropogon gayanus Kunth.	40	Poaceae	Herb	Gamba grass	++
Baphia nitida Lodd.	40	Fabaceae	Shrub		++
Aspilla bussei O. Hoffm.	80	Asteraceae	Herb	White flower Aspilla	++++
Dioda sermentosa Sw.	60	Rubiaceae	Herb		+++
Heterotis rotundifolia (Sm.) Jac.	80	Melastomataceae	Herb	Chick weed	++++
Laportea ovalifolium (Schum). Chew	40	Urticaceae	Herb	Tropical stinging nettle	++
Digitaria horizontalis Willd.	40	Poaceae	Herb	Digit grass	++
Alcalypha ciliata Forssk	40	Euphorbiaceae	Herb		++
Chromolaena odorata (Linn.) RM King and Robinson	20	Asteraceae	Herb	Siam weed	+
Desmodium scolporius (Sw.) Desv.	40	Fabaceae	Herb		++
Lonchorcarpus cyanescens (Schum and Thonn.) Benth.	60	Fabaceae	Shrub		+++
Nauclea diderrechii (De Wild and Th. Dur.) Merrill	20	Rubiaceae	Shrub		+
Alchornea cordifolia	40	Euphorbiaceae	Shrub	Christmas bush	++
Oplimenus baumanni (Retz) P. Beauv.	20	Poaceae	Herb	Grass	+
Combretum zenkeri Engl. and Diels	20	Combretaceae	Herb		+
Carpolobia lutea G.Don	20	Polygalaceae	Shrub	Poor man's candle	+
Desmodium ramosissimium G.Don	20	Fabaceae	Herb		+
Clerodendrum splendens G.Don.	40	Verbenaceae	Herb		++
Triumfetta eriophlebia Hook. f.	20	Tiliaceae	Herb		+

+ (1-25) Very scarce, ++ (26-59) Scarce, +++ (60-79) Abundant, ++++> (80-α) Very abundant, NA: Not available, F (%): Percentage frequency

Result of phytosociological assessment (Table 4) indicated four species (*H. rotundifolia*-cheekweed, *Anthonotha macrophylla*-West African rosewood, *Stachytarpheta jamaicensis*-Brazilian tea and *Harrungana madagascariensis*-dragon's blood) with the highest frequency (F%) of 100 = 7.69% occurrence among the representative while six species had maximum density value range of 4 - 6 = 6.83-10.24% with cheek weed and *Manniorphyton fulvum* recording the highest value of 6 = 10.24% species^{-1}. In similar study eleven species had maximum abundance of 4-8 = 4.65-9.30% with *Funtumia elastica* recording the highest value of 8 = 9.30% while 16 species recorded a maximum cumulative status of prevalence with a range value of 10.46-25.11% in which *M. fulvum* had the highest importance value index (25.11%). The distribution pattern recorded some level of homogeneity with majority of species in contiguous pattern of spatial continuum of 12 (63.16%) while four (21.05%) species were randomly distributed and three (15. 79%) regularly distributed.

Generally, in all bounding coordinates at the study sites, there was increase in herbaceous status in terms of species life forms in the impacted site with 77% of the representative species as herbs and increase in shrubby life form with 58% of the representative as shrubs. The herbaceous increase in the impacted site is an indication of a primary regeneration succession which seems to be in progressive transition through time toward shrubby and tree life forms if protected to conserve the

Table 2: Quantitative list of representative species around the Agrarian impacted Amafor forest in Ngor-Akpala local government area of Imo state

Species	F (%)	D	A	RF (%)	RD (%)	RA (%)	IVI	A/F
Axonopus flexousus (Peter) Troupin	40	2.6	6.5	2.33	4.18	5.11	11.62	0.16
Andropogon tectorum Schum and Thonn.	60	11.2	18.7	3.49	18.01	14.70	36.20	0.31
Eragrostis ciliaris (Linn.) R.Br.	40	1.8	4.5	2.33	2.89	3.54	8.76	0.11
Spillanthes filicaulis (Schum and Thonn.) C.D. Adams.	100	3.2	3.2	5.81	5.14	2.52	13.47	0.03
Scleria naumanniana Boeck	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Melochia melissifolia Benth.	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Paspalum conjugatum Berg.	40	1.4	3.5	2.33	2.25	2.75	7.33	0.09
Panicum maximum Jacq.	40	0.4	1.0	2.33	0.64	0.79	3.76	0.03
Cnestis ferruginea DC.	40	0.4	1.0	2.33	0.64	0.79	3.76	0.03
Perotis indica (Linn.) O. Ktze	80	3.6	4.5	4.65	5.79	3.54	13.98	0.06
Senna occidentalis (Linn.) Link.	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
*Chamaecrista mimosoides (*Linn.) Greene	40	0.4	1.0	2.33	0.64	0.79	3.76	0.03
Ipomoea involucrate P. Beauv.	100	2.4	2.4	5.81	3.86	1.89	11.56	0.02
Truimfetta cordifolia A. Rich.	60	0.6	1.0	3.49	0.96	0.79	5.24	0.02
Icacina trichantha Olive	80	1.4	1.8	4.65	2.25	1.42	8.32	0.02
Urena lobata Linn.	40	0.2	0.5	2.33	0.32	0.39	3.04	0.01
Calopogonium mucunoides Desv.	60	1.6	2.7	3.49	2.57	2.12	8.18	0.05
Panicum laxum Sw.	60	5.4	9.0	3.49	8.68	7.08	19.25	0.15
Oldenlandia affinis	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Dioscorea smilacifolia	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Andropogon gayanus Kunth.	40	3.0	7.5	2.33	4.82	5.90	13.05	0.19
Baphia nitida Lodd.	40	0.4	1.0	2.33	0.64	0.79	3.76	0.03
Aspilla bussei O. Hoffm.	80	4.2	5.3	4.65	6.75	4.17	15.57	0.07
Dioda sermentosa Sw.	60	1.0	1.6	3.49	1.61	1.26	6.36	0.03
Heterotis rotundifolia (Sm.) Jac.	80	3.2	4.0	4.65	5.14	3.14	12.93	0.05
Laportea ovalifolium (Schum). Chew	40	0.4	1.0	2.33	0.64	0.79	3.76	0.03
Digitaria horizontalis Willd.	40	2.0	10.0	2.33	3.22	7.86	13.41	0.25
Alcalypha ciliata Forssk	40	0.2	0.5	2.33	0.32	0.39	3.04	0.01
Chromolaena odorata (Linn.) RM King and Robinson.	20	0.4	1.0	1.16	0.64	0.79	2.59	0.05
Desmodium scolporius (Sw.) Desv.	40	0.6	1.5	2.33	0.96	1.18	4.47	0.04
Lonchorcarpus cyanescens (Schum and Thonn.) Benth.	60	2.4	4.0	3.49	3.86	3.14	10.49	0.07
Nauclea diderrechii (De Wild and Th. Dur.) Merrill	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Alchornea cordifolia (Schum. and Thonn.) Mull-Arg	40	1.2	3.0	2.33	1.9	2.36	6.62	0.08
Oplimenus baumanni (Retz) P. Beauv.	20	2.0	10.0	1.16	3.22	7.86	12.24	0.50
Combretum zenkeri Engl. and Diels	20	1.0	2.5	1.16	1.61	1.97	4.74	0.13
Carpolobia lutea G.Don	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
Desmodium ramosissimium G.Don	20	0.4	1.0	1.16	0.64	0.79	3.76	0.05
Clerodendrum splendens G.Don.	40	1.6	4.0	2.33	2.57	3.14	8.04	0.10
Triumfetta eriophlebia Hook. f.	20	0.2	1.0	1.16	0.32	0.79	2.27	0.05
	1720	62.2	127.2				301.22	

Table 3: Survey estimate of representative species around the Agrarian un-impacted control Amafor forest in Ngor-Akpala local government area of Imo state

Species	F (%)	Family	Habit	Common name	Remark
Alchornea cordifolia (Schum. and Thonn.) Mull-Arg	80	Euphorbiaceae	Shrub	Christmas bush	++++
Starchytarpheta jamaicensis Vahl.	100	Verbenaceae	Shrub	Brazilian tea	+++++
Cnestis ferruginea DC	60	Connaraceae	Shrub		+++++
Heterotis rotundifolia (Sm) Triana	100	Melastomataceae	Herb	Chickweed, rockrose	+++++
Barteria nigritana Hook F.	60	Passifloraceae	Shrub		+++
Anthonotha macrophylla P. Beauv	100	Fabaceae-ceasal	Shrub	African rose wood	+++++
Carpolobia lutea G. Don	40	Polygalaceae	Shrub	Poor man's candle	++
Combretum zenkeri Engl. and Diels	80	Combretaceae	Herb		++++
Pentachethra macrophylla P. Beauv	40	Fabaceae-ceasal	Tree	Oil bean	++
Manniophyton fulvum Mull-Arg	80	Euphorbiaceae	Shrub		++++
Scleria naumanniana Boeck	40	Cyperaceae	Herb	Bush knife	++
Landolphia dulcis Pichon (R.Br.)	60	Apocynaceae	Herb		+++
Anthocleista djalonesis A. Chev	80	Loganiaceae	Tree	Cabbage tree	++++
Tetracera allnifolia Willd	40	Dilleniaceae	Herb	Liana cord	++
Maesobotrya dusenii (Pax) Hutch	60	Euphorbiaceae	Shrub	White bush cherry	+++
Harrungana madagascariensis Lam. *ex* Poir.	100	Guttiferae	Shrub	Dragon's blood	+++++
Funtumia elastica (Preuss) Stapf.	40	Apocynaceae	Shrub		++
Antidesma vogelianum Mull-Arg	60	Euphorbiaceae	Shrub		+++
Vernonia ambigua Kotschy and Peyr	80	Asteraceae	Herb	Wild bitter leaf	++++

Table 4: Quantitative list of representative species around the Agrarian un-impacted control Amafor forest in Ngor-Akpala local government area of Imo state

Species	F (%)	D	A	RF (%)	RD (%)	RA (%)	IVI	A/F
Alchornea cordifolia (Schum and Thonn) Mul-Arg	80	3.0	3.8	6.15	5.12	4.42	15.69	0.05
Starchytarpheta jarmaicensis Vahl.	100	1.6	1.6	7.69	2.73	1.86	12.20	0.02
Cnestis ferruginea DC	60	4.0	6.7	4.62	6.83	7.79	19.24	0.11
Heterotis rotundifolia (Sm) Triana	100	6.0	6.0	7.69	10.24	6.98	24.91	0.06
Barteria nigritana Hook F.	60	3.6	6.0	4.62	6.14	6.98	17.74	0.10
Anthonotha macrophylla P. Beauv	100	5.0	5.0	7.69	8.53	5.81	22.03	0.05
Carpolobia lutea G. Don	40	2.0	5.0	3.08	3.41	5.81	12.30	0.13
Combretum zenkeri Engl. and Diels	80	2.4	3.0	6.15	4.10	3.49	13.74	0.04
Pentachethra macrophylla P. Beauv	40	1.0	2.5	3.08	1.71	2.91	7.70	0.06
Manniophyton fulvum Mull-Arg	80	6.0	7.5	6.15	10.24	8.72	25.11	0.09
Scleria naumanniana Boeck	40	1.0	2.5	3.08	1.71	2.91	7.70	0.06
Landolphia dulcis Pichon (R.Br.)	60	3.0	5.0	4.62	5.12	5.81	15.55	0.08
Anthocleista djalonesis A. chev	80	1.0	1.3	6.15	1.71	1.51	9.37	0.02
Tetracera alinifolia Willd	40	1.6	4.0	3.08	2.73	4.65	10.46	0.10
Maesobotrya dusenii (Pax) Hutch	60	2.0	3.3	4.62	3.41	3.84	11.87	0.06
Harrungana madagascariensis Lam ex Poir.	100	5.0	5.0	7.69	8.53	5.81	22.03	0.05
Funtumia elastica (Preuss) Stapf	40	3.2	8.0	3.08	5.46	9.30	17.84	0.20
Antidesma vogelianum Mull-Arg	60	2.0	3.3	4.62	3.41	3.84	11.87	0.06
Vernonia ambigua Ketschy and Peyr	80	5.2	6.5	6.15	11.09	7.56	24.80	0.02
	1300	58.6	86.0				302.15	

regenerating species. The comparative study on the similarity of the impacted and unimpacted sites shows that both sites are dissimilar with an observed index value of 0.79 higher than the similarity index of 0.21, though the area may not be significantly different in climatic regime and edaphic status.

DISCUSSION

One of the most important challenges for ecologist is gaining insight into the mechanisms that determine the distribution patterns of species in patchy habitats. Habitat alteration (including habitat loss, degradation and fragmentation) is now among the major risks of ecosystem degradation by human activities[37]. Man have altered ecosystem to varying degrees and the resultant array of natural, semi-natural and man made ecosystems within a landscape can be conceived as constituting both a readily measurable gradient of land use and a more complex gradient of anthropogenic effects. Thus various habitats can be regarded as spatially and temporally dynamic patches of vegetations with resultant decline in local and regional biota being subjected to diverse human interference[38]. Agrarian operation such as subsistence crop farming and carbon credit charcoal production is one of the key human induced elements in Amafor community in Imo State and this adversely determines the distribution of species and their habitat. But the most obvious and dramatic impacts are usually the direct disturbance on biodiversity leading to loss of flora and fauna complex[39]. The environmental impacts of agrarian operations have for several decades been envisaged and known to have a multiplier effect. Several studies have also shown a correlation between plant species population and diverse environmental changes.

This study shows that the flora and their environments provide a better understanding of the ecological consequences of disturbance as depicted in the result. The vegetation of the undisturbed forest was rich in trees and shrubby species than the impacted site. The low density and composition in tree and shrubs in the impacted site is attributed to the disturbances posed by agrarian practices as noted. This has been resulted to changes in vegetation structure in terms of abundance and species diversity. This corroborates[40] who observed human activity as an important factor influencing plant species biodiversity. On such impacted site, spontaneous colonization is slow and the natural vegetation succession is often inefficient to ensure proper protection against other post impact environmental influences. This also corroborates the assertions of Whisenant *et al*. and Bradshaw[41-43].

It has been lamented that over 11,300 ha of forest are been cleared annually in Nigeria forest for the establishment of monoculture plantation of indigenous and exotic trees[44]. It has also been established that the highest rate of forest modification have occurred in areas with heavy dependency on forest lands for subsistence and shifting agricultural practices largely found in developing countries[45]. These evidences present a significant and direct role of forest clearing in forest loss for farming. The greater abundance of lower vascular species among the families is an indication of a secondary vegetation structure, heterogeneous in nature as a result of the regeneration process with new species that were absent as adult. The high structural distribution of vegetation parameters in terms of life form in the undisturbed site was due to the relatively low level of disturbances. One of the fundamental and known characteristics of tropical rainforest or undisturbed natural vegetation is the great species richness or a large number of plant species in density and abundance per unit area[3]. However, there were still differences in the ranks of species frequency, diversity, density and abundance. Khater *et al*.[46] compared levels of degradation and the resulting communities and found that less degraded sites favoured woody shrubs and perennial herbs while more degraded site favoured annual plants.

Community structure can be examined through the determination of various attributes of its component species and their relationship to each other. Such attributes among others may include plant species composition, abundance, density, frequency, diversity, basal cover, Importance Value Index (IVI) etc. The ecological characteristic of an area, its species diversity and regeneration status of species and habit influences the nature of any forest community[47]. The existence of plant species in forest community largely depends also on its regeneration establishment under varied environmental condition such as increased solar radiation incident on the forest floor. Consequently this could also influence the growth stages in seedling, sapling and young herbs, shrubs and trees of plant communities that maintain the population structure of any forest.

Species richness is one of the major criteria in recognizing the importance of an area for conservation[48]. Conservation is a fundamental component of sustainable ecosystem functioning which aims at recreating habitat for wildlife and flora. Studies on changes in species diversity and floristic composition of habitats have received appreciable attention[49-51]. Several factors are known to contribute to changes in species diversity and composition at any given time and place. The impact of grazing on the floristic and structural diversity in mountain Grasslands Island from Central Argentina has been studied[52]. Similar studies on the Mediterranean Island of Corsica reported loss of plant species richness and habitat connectivity due to agricultural changes in Finland[53].

In the present research the heterogeneity of the vegetation of the impacted study area is being attributed to a retrogressive process such as the influence of farming and charcoal production operations and probably other forms of human activities, the regeneration and floristic succession of the study site. This has resulted to changes in vegetation structure in terms of abundance and species diversity. This corroborates the assertion by Cubizolle *et al*.[40] who observed human activity as an important agent influencing plant species biodiversity. There was a tremendous change in the floristic composition of the impacted study area with regard to differences in species time-lag adaptation associated with post-agrarian regeneration. This also corroborates the observation that vegetation in an anthropogenic influenced habitat is linked to ever increasing synanthropisation[54]. This was attributed to a number of direct or indirect human activities resulting to total changes in plant species biodiversity cover and loss of habitat connectivity[55,56].

The density, frequency, abundance and species diversity considered as indices of success in reforestation. Rajwar *et al*.[57] suggested that it is possible to re-establish a complete forest cover for the degraded deforested Amafor area by natural regeneration. The recorded indices are considered quite adequate to establish complete forest cover a very important step for biodiversity conservation. Ratio of abundance to frequency (A/F) indicated that the distribution of all the regenerated species in the impacted site was randomly distributed while the unimpacted site was contiguous in distribution. In a similar assertion contagious distribution pattern is the prevalent pattern in nature unlike random distribution found in every uninformed environment. Contagious distribution in natural vegetation has been reported by several workers[58]. From the research findings it is evident that the impacted forests of Amafor, are turning into diverse heterogeneous natural forest again.

CONCLUSION

The findings of present study provide a complete view of regeneration status in the study area which is rich in regenerating species that could result in the establishment of a diverse natural forest if protected to conserve the seedlings or saplings of the regenerating species. The results show that it is possible to bring the depleted area under complete forest cover through the protection of natural regeneration.

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