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Ecological Indices of Crude Oil Impacted Vegetation

[1]B. S. Dambie, [2]E. T. Jaja, [3]I. K. E. Ekweozor, [4] P. C. Nnadi

[1,2,3,4]Department of Plant Science and Biotechnology, Rivers State University, PMB 5080, Port Harcourt, Rivers State, Nigeria

* Corresponding author: barika.dambie@rsu.edu.ng

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ABSTRACT

Vegetation can be regarded as the product of multiple environmental conditions affecting sets of plants living together in a given time and place. The study will give insight into impact of crude-oil pollution on ecological indices and plant species composition of vegetation in the K-Dere community. Random sampling was used for the vegetation assessment. Four quadrat each measuring 40 m x 40 m represent the sample area from which plant species composition of the vegetation at the study site was sampled. Plot 1, 2 and 3 were sampled areas containing plant community .growing in crude oil contaminated soil whereas the control represent uncontaminated plant community. The control plot has the highest frequency with 35 plant species having 100% occurrence. Ageratum conyzoides, Panicum maximum and Ficus sp., recorded the highest density. Mucuna pruriens, Cochlospermum planchonii and Ageratum conyzoides reecorded the highest abundance. Mucuna pruriens exhibited the highest A/F ratio followed by Cochlospermum planchonii, and Ageratum houstonianum. The highest importance value index was observed in Mucuna pruriens, Ageratum conyzoids and Panicum maximum. The vegetation composition suggests active regeneration and successional recovery, with dominance shifting from herbaceous colonizers to woody species in some plots.

KEYWORDS: ecological indices, crude oil pollution, vegetation structure, importance value index, K-Dere, Nigeria

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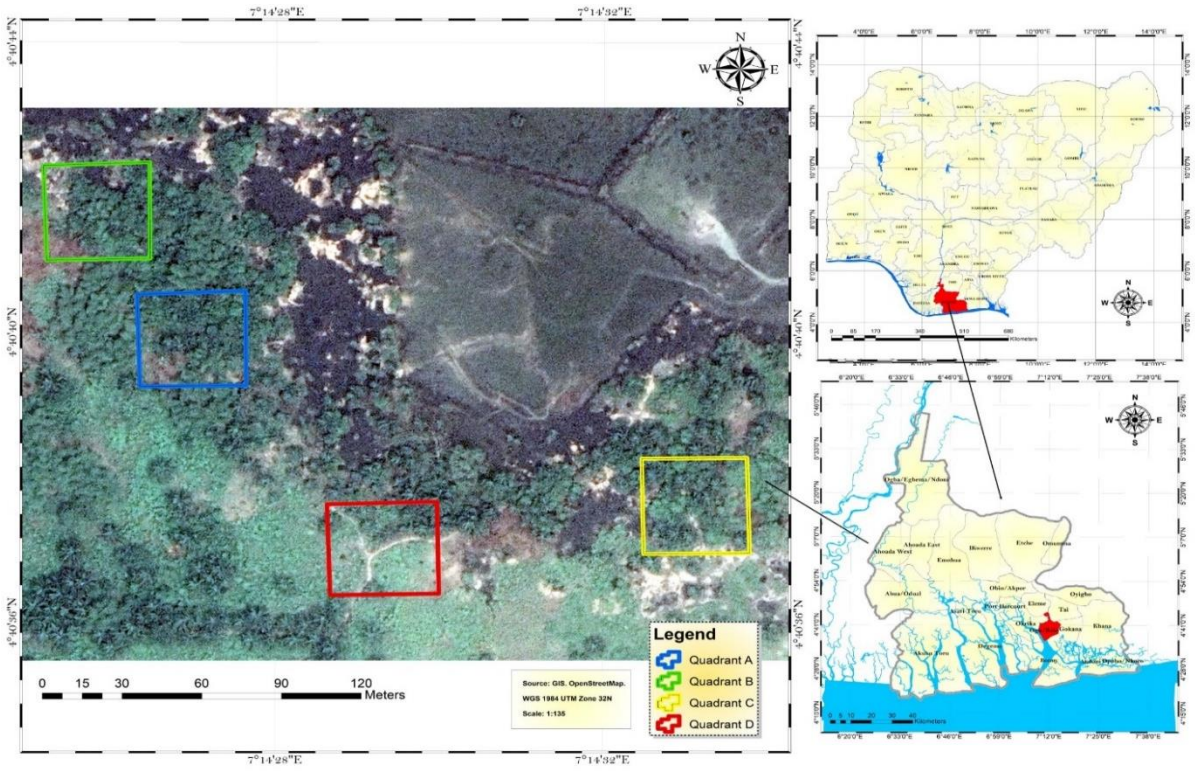
Introduction

Vegetation is the functional array of plants that exist in the landscape, plant collection and the ground cover they provide. In other words, vegetation is the plant cover of an area, including the total plants and the surface they occupy. The term vegetation is used more generally and expansively than “flora,” and typically refers to broader spatial scale (Tanee *et al*. 2023). Consequently, vegetation can be regarded as the product of multiple environmental conditions affecting sets of plants living together in a given place and time (Ramos *et al*. 2023). Vegetation plays an important socio-economic, ecological and health role such as stabilizing soil and controlling erosion especially on river banks and sloping lands; purifying the air (absorbing CO_2 and releasing O_2); recycling nutrients; regulating rainfall and floods (Tanee, et al., 2023).
Even though many landscapes worldwide are dominated by forest and grassland, understanding the individual species of a vegetation type, their distribution and abundance, importance-value index (IVI) and diversity within an ecosystem is essential for any satisfactory description of that vegetation. Such a description gives ecologists a mental picture of the vegetation and enables comparison and classification of various vegetation units (Kershaw, 1973). Global habitat loss and species extinctions have resulted in serious global attention to biodiversity issues, culminating in international programmes such as the United Nations Convention on Biological Diversity, making biodiversity measurement and monitoring the first step in successful sustainable development and conservation strategies (Pfadenhauer & Klötzli, 2020),
Crude oil has a negative impact on the soil's chemical, physical, and microbiological properties, which

lowers plant seed germination and stunts plant growth (Kayode et al., 2009).
Although a substantial amount of study has been carried out worldwide on vegetation ecological study, to the best of my knowledge there is insufficient study in Gokana Local Government Area focusing on vegetation structure in crude-oil–impacted soils in that area. The study will provide insight into the impact of crude-oil pollution on ecological indices and plant species composition of vegetation in the K-Dere community. The findings on plant species composition and ecological indices will be used to describe the vegetation-structure of the crude-oil-impacted area in the K-Dere community.

Materials and Methods

Description of the Study Site: the study area is within K-Dere community in Gokhana Local Government Area of River State, Nigeria with latitude of 4^0 65'N and the longitude of 7^0 5'E. The study area is characterized by two seasons, dry and rainy seasons. The dry season is from November to March while the rainy season is from April to October.



Map of the Study Site

Vegetation Assessment: the assessment of vegetation was carried out using simple random sampling. Four quadrat each measuring 40 m x 40 m represent the sample area from which plant species composition of the vegetation at the study site was sampled. Long measuring tape was used to map out the four corners of the sample area (quadrat) of which each was 40 m and global positioning system coordinate of each corner was recorded. The gps coordinates of each sampled area was used to generate geographic information system of each sampled area and a map showing the location of the four sampled area was created. Each sampled area represent a plot, plot 1, 2 and 3 are sampled area containing plant community growing in crude oil polluted soil while the control is a sampled area containing plant community growing on soil uncontaminated with crude oil. The plant species composition of the sampled area were identified on the field as careful as possible, authenticated, and counted.

Data Analysis: analysis of vegetation data from the study site was done using Misra (1968)

$$\text{Frequency} = \frac{\text{Total number of sample plot in which species occur}}{\text{Total number of sample plots studied.}} \times \frac{100}{1}$$

Relative frequency = $\frac{\text{Frequency of the species}}{\text{The summation of frequencies of all species in the sample area}} \times \frac{100}{1}$

Population Density = $\frac{\text{Total number of individual of species in all sample plot}}{\text{Total number of sample plots studied}}$

Relative Density = $\frac{\text{Density of an individual species}}{\text{Total densities of all species}} \times \frac{100}{1}$

Abundance = $\frac{\text{Total number of individual of species in all sample units}}{\text{Total number of sample unit in which the species occurred}}$

Relative abundance = $\frac{Abundance\,\text{occurence of the species}}{\text{Abundance occurence of the species}} \times \frac{100}{1}$

Abundance-Frequency (A/F) = $\frac{Abundance}{Frequency}$

Whitford; A/F < 0.025 regular distribution, 0.025 < A/F < 0.05 and A/F > 0.05 contagious (clumpd distribution)

Importance Value Index (IVI) which is species dominance was determined by the summation of Relative Density, Relative abundance and Relative frequency.

Results

Species Composition

The species composition of the study area showed the occurrence of 41 plant species belonging to 21 families of Fabaceae, Asteraceae, Cyperaceae, Euphorbiaceae, Trichocomaceae, Poaceae, Arecaceae, Combretaceae, Malvaceae, Convolvulaceae, Orobanchaceae, Nyctaginaceae, Amaranthaceae, Athyriaceae, Myrtaceae, Moraceae, Biaxaceae, Bioniaceae, Plantaginaceae, Cannabaceae and Oxalidaceae. The family Fabaceae exhibited the highest species representation, followed by Poaceae and Asteraceae, indicating their dominance in the study area.

Percentage Frequency: In Plot 1**,** a total of 20 plant species were recorded, exhibiting a 100% frequency of occurrence while in Plot 2**,** a total of 12 plant species were recorded, exhibiting a 100% frequency of occurrence. Similarly, in Plot 3**,** a total of 5 plant species were recorded, exhibiting a 100% frequency of occurrence. Conversely, in the control plot**,** a total of 35 plant species were recorded, exhibiting a 100% frequency of occurrence.

Density: In the four plots studied, the highest density was recorded in *Ageratum conyzoides* (53.33 in plot 1) followed by *Panicum maximum* (46.83 in plot 4), *Ficus sp.* (40.5), *Mucuna pruriens* and *Scoparia dulcissp.* (35 in plot 1) and *Bambusa vulgaris* (34.17). In contrast, low densities were recorded for species such as *Sida cordifolia,* Newbouldia sp., and Elaeis guineensis.

Abundance: Mucuna pruriens (105 in plot 1) recorded the highest abundance in the four plots studied followed by Cochlospermum planchonii (90.5), Ageratum conyzoides (80), and *Panicum maximum* (65), Ageratum houstonianum (63) and *Boerhavia diffusa* (60). Conversely, low abundance values were recorded for Elaeis guineensis, *Psidium sp.,* Newbouldia sp., and Sida cordifolia.

Table 1: Plot 1

	Scientific Name	Common Name	Family	F%	R.F	D	R.D	A	R.A	A/F	IVI
1	*Panicum maximum*	Guinea grass	Poaceae	100	3.3	6.67	1.27	6.67	1.26	0.07	5.83
2	*Pueraria sp Binth*	Tropical kudzu	Fabaceae	66.67	2.2	8.83	1.69	13.25	2.5	0.2	6.39
3	*Ageratum conyzoides*	Goat weed	Asteraceae	66.67	2.2	53.33	10.2	80	15.09	1.2	27.49
4	*Ageratum houstonianum*	Floss flower	Asteraceae	100	3.3	23.83	4.56	23.83	4.5	0.24	12.36

5	*Mikania sp.*		Asteraceae	100	3.3	5.83	1.12	5.83	1.1	0.06	5.52
6	*Cyperus rotundus*	Nut grass	Cyperaceae	100	3.3	3.83	0.73	3.83	0.72	0.04	4.76
7	*Aspilia Africa*	Wild sunflower	Asteraceae	33.33	1.1	5.67	1.08	17	3.21	0.51	5.40
8	*Alchonea cordifolia*	Christmas bush	Euphorbiaceae	100	3.3	18.33	3.51	18.33	3.46	0.18	10.27
9	*Resentia sp.*		Trichocomaceae	100	3.3	5.83	1.12	5.83	1.1	0.06	5.52
10	*Mimosa pudica*	Sensitive plant	Fabaceae	66.67	2.2	11.67	2.23	17.5	3.3	0.26	7.74
11	*Elaeis guineensis*	Palm tree	Arecaceae	100	3.3	2	0.38	2	0.38	0.02	4.06
12	*Eleusine indica*	Goose grass	Poaceae	66.67	2.2	5	0.96	7.5	1.42	0.11	4.57
13	*Axonopus compressus*	Carpet grass	Poaceae	100	3.3	5.83	1.12	5.83	1.1	0.06	5.52
14	*Emilia sonchifolia*	Tassel flower	Asteraceae	100	3.3	21.67	4.14	21.67	4.09	0.22	11.53
15	*Andropogon gayanus*	Gamba grass	Poaceae	0	0	0	0	0	0	0	0
16	*Combretam sp.*	Bush willow	Combretaceae	100	3.3	12	2.29	12	2.26	0.12	7.86
17	*Sanna alata*	Candle bush	Fabaceae	33.33	1.1	6.67	1.27	20	3.77	0.6	6.15
18	*Sida cordifolia*	Wire weed	Malvaceae	100	3.3	2	0.38	2	0.38	0.02	4.06
19	*Cyanthillium cinerem*	Little ironweed	Asteraceae	100	3.3	5.83	1.12	5.83	1.1	0.06	5.52
20	*Ipomea aquatic*	Water chestnut	Convolvulaceae	66.67	2.2	3	0.57	4.5	0.85	0.07	3.63
21	*Striga gesnerioides*	Witch weed	Orobanchaceae	0	0	0	0	0	0	0	0
22	*Boerhavia diffusa*	Hog weed	Nyctaginaceae	66.67	2.2	18.5	3.54	27.75	5.24	0.42	10.98
23	*Senna sp*		Fabaceae	66.67	2.2	12.67	2.42	19	3.58	0.29	8.21
24	*Bambusa vulgaris*	Bamboo	Poaceae	100	3.3	34.17	6.53	34.17	6.45	0.34	16.28
25	*Calopogonium sp*		Fabaceae	0	0	0	0	0	0	0	0
26	*Acacia sp*		Fabaceae	100	3.3	18.67	3.57	18.67	3.52	0.19	10.39
27	*Cyathula prostrata*	Pasture weed	Amaranthaceae	33.33	1.1	3.5	0.67	10.5	1.98	0.32	3.75
28	*Diplazium sp. sp.*		Athyriaceae	33.33	1.1	6.5	1.24	19.5	3.68	0.59	6.03
29	*Psidium sp.*	Guava	Myrtaceae	100	3.3	4	0.76	4	0.75	0.04	4.82
30	*Ficus sp.*	Fig tree	Moraceae	100	3.3	14.17	2.71	14.17	2.67	0.14	8.68
31	*Isoberlinia doka*	Doka ironwood	Fabaceae	33.33	1.1	8.33	1.59	25	4.72	0.75	7.41
32	*Mannniophyton fulvum*	Gasso	Euphorbiaceae	66.67	2.2	15	2.87	22.5	4.25	0.34	9.32
33	*Cochlospermum planchonii*	False cotton	Biaxaceae	33.33	1.1	30.17	5.77	90.5	17.08	2.72	23.95
34	*Newbouldia sp*	Boundary tree	Bigoniaceae	100	3.3	2.17	0.41	2.17	0.41	0.02	4.13
35	*Scoparia dulcissp.*	Goat weed	Plantaginaceae	100	3.3	35	6.69	35	6.6	0.35	16.60
36	*Mucuna pruriens*	Velvet bean	Fabaceae	33.33	1.1	35	6.69	105	19.81	3.15	27.61
37	*Paspalum scrobiculatum*	Crown grass	Poaceae	66.67	2.2	18.33	3.51	27.5	5.19	0.41	10.90
38	*Trema orientale*	Charcoal tree	Cannabaceae	33.33	1.1	5.67	1.08	17	3.21	0.51	5.40
39	*Albizia zygia*	West African albizia	Fabaceae	66.67	2.2	10	1.91	15	2.83	0.23	6.95
40	*Biophytum sp.*	Little tree	Oxalidaceae	100	3.3	10	1.91	10	1.89	0.1	7.10
41	*Elytrophorus spicatus*	Spike grass	Poaceae	100	3.3	33.33	6.37	33.33	6.29	0.33	15.96

Table 2: Plot 2

	Scientific Name	Common Name	Family	F%	R.F	D	R.D	A	R.A	A/F	IVI
1	*Panicum maximum*	Guinea grass	Poaceae	100	3.85	7.17	1.88	7.17	1.59	0.07	7.32
2	*Pueraria sp Binth*	Tropical kudzu	Fabaceae	33.33	1.28	15	3.94	45	9.98	1.35	15.20
3	*Ageratum conyzoides*	Goat weed	Asteraceae	100	3.85	25.17	6.61	25.17	5.58	0.25	16.04
4	*Ageratum houstonianum*	Floss flower	Asteraceae	33.33	1.28	21	5.51	63	13.97	1.89	20.77
5	*Mikania sp.*		Asteraceae	66.67	2.56	25	6.56	37.5	8.31	0.56	17.45
6	*Cyperus rotundus*	Nut grass	Cyperaceae	100	3.85	3.67	0.96	3.67	0.81	0.04	5.63
7	*Aspilia Africa*	Wild sunflower	Asteraceae	66.67	2.56	4.83	1.27	7.25	1.61	0.11	5.45
8	*Alchonea cordifolia*	Christmas bush	Euphorbiaceae	33.33	1.28	10.83	2.84	32.5	7.21	0.98	11.34
9	*Resentia sp.*		Trichocomaceae	100	3.85	5.33	1.4	5.33	1.18	0.05	6.43
10	*Mimosa pudica*	Sensitive plant	Fabaceae	33.33	1.28	10.83	2.84	32.5	7.21	0.98	11.34

11	*Elaeis guineensis*	Palm tree	Arecaceae	100	3.85	5.5	1.44	5.5	1.22	0.06	6.51
12	*Eleusine indica*	Goose grass	Poaceae	100	3.85	11.83	3.11	11.83	2.62	0.12	9.58
13	*Axonopus compressus*	Carpet grass	Poaceae	66.67	2.56	17.5	4.59	26.25	5.82	0.39	12.98
14	*Emilia sonchifolia*	Tassel flower	Asteraceae	0	0	0	0	0	0	0	0
15	*Andropogon gayanus*	Gamba grass	Poaceae	0	0	0	0	0	0	0	0
16	*Combretam sp.*	Bush willow	Combretaceae	33.33	1.28	13.67	3.59	41	9.09	1.23	13.97
17	*Sanna alata*	Candle bush	Fabaceae	33.33	1.28	6.83	1.79	20.5	4.55	0.62	7.63
18	*Sida cordifolia*	Wire weed	Malvaceae	100	3.85	2.5	0.66	2.5	0.55	0.03	5.06
19	*Cyanthillium cinerem*	Little ironweed	Asteraceae	66.67	2.56	2.17	0.57	3.25	0.72	0.05	3.86
20	*Ipomea aquatic*	Water chestnut	Convolvulaceae	100	3.85	3.33	0.87	3.33	0.74	0.03	5.47
21	*Striga gesnerioides*	Witch weed	Orobanchaceae	33.33	1.28	9	2.36	27	5.99	0.81	9.64
22	*Boerhavia diffusa*	Hog weed	Nyctaginaceae	33.33	1.28	13.33	3.5	40	8.87	1.2	13.66
23	*Senna sp*		Fabaceae	66.67	2.56	10.17	2.67	15.25	3.38	0.23	8.62
24	*Bambusa vulgaris*	Bamboo	Poaceae	33.33	1.28	9.67	2.54	29	6.43	0.87	10.25
25	*Calopogonium sp*		Fabaceae	0	0	0	0	0	0	0	0
26	*Acacia sp*		Fabaceae	33.33	1.28	10.67	2.8	32	7.1	0.96	11.18
27	*Cyathula prostrata*	Pasture weed	Amaranthaceae	100	3.85	6.67	1.75	6.67	1.48	0.07	7.08
28	*Diplazium sp. sp.*		Athyriaceae	33.33	1.28	12.17	3.19	36.5	8.09	1.1	12.57
29	*Psidium sp.*	Guava	Myrtaceae	100	3.85	5.5	1.44	5.5	1.22	0.06	6.51
30	*Ficus sp.*	Fig tree	Moraceae	66.67	2.56	5.67	1.49	8.5	1.88	0.13	5.94
31	*Isoberlinia doka*	Doka ironwood	Fabaceae	66.67	2.56	3.83	1.01	5.75	1.27	0.09	4.85
32	*Mannniophyton fulvum*	Gasso	Euphorbiaceae	100	3.85	10	2.62	10	2.22	0.1	8.69
33	*Cochlospermum planchonii*	False cotton	Biaxaceae	66.67	2.56	5.83	1.53	8.75	1.94	0.13	6.04
34	*Newbouldia sp*	Boundary tree	Bigoniaceae	66.67	2.56	3.83	1.01	5.75	1.27	0.09	4.85
35	*Scoparia dulcissp.*	Goat weed	Plantaginaceae	100	3.85	7.33	1.92	7.33	1.63	0.07	7.40
36	*Mucuna pruriens*	Velvet bean	Fabaceae	66.67	2.56	18.33	4.81	27.5	6.1	0.41	13.48
37	*Paspalum scrobiculatum*	Crown grass	Poaceae	66.67	2.56	11.67	3.06	17.5	3.88	0.26	9.51
38	*Trema orientale*	Charcoal tree	Cannabaceae	66.67	2.56	26.5	6.96	39.75	8.81	0.6	18.34
39	*Albizia zygia*	West African albizia	Fabaceae	33.33	1.28	7.5	1.97	22.5	4.99	0.68	8.24
40	*Biophytum sp.*	Little tree	Oxalidaceae	33.33	1.28	8.5	2.23	25.5	5.65	0.77	9.17
41	*Elytrophorus spicatus*	Spike grass	Poaceae	33.33	1.28	3.5	0.92	10.5	2.33	0.32	4.53

Table 3: Plot 3

	Scientific Name	Common Name	Family	F%	R.F	D	R.D	A	R.A	A/F	IVI
1	*Panicum maximum*	Guinea grass	Poaceae	33.33	1.18	21.67	6.35	65	9.23	1.95	16.77
2	*Pueraria sp Binth*	Tropical kudzu	Fabaceae	100	3.53	3.33	0.98	3.33	0.47	0.03	4.99
3	*Ageratum conyzoides*	Goat weed	Asteraceae	33.33	1.18	11.67	3.42	35	4.97	1.05	9.57
4	*Ageratum houstonianum*	Floss flower	Asteraceae	33.33	1.18	5.5	1.61	16.5	2.34	0.5	5.14
5	*Mikania sp.*		Asteraceae	33.33	1.18	8.33	2.44	25	3.55	0.75	7.18
6	*Cyperus rotundus*	Nut grass	Cyperaceae	33.33	1.18	5	1.47	15	2.13	0.45	4.78
7	*Aspilia Africa*	Wild sunflower	Asteraceae	33.33	1.18	5.5	1.61	16.5	2.34	0.5	5.14
8	*Alchonea cordifolia*	Christmas bush	Euphorbiaceae	33.33	1.18	5.5	1.61	16.5	2.34	0.5	5.14
9	*Resentia sp.*		Trichocomaceae	66.67	12.94	10.83	3.18	2.95	0.42	0.01	16.54
10	*Mimosa pudica*	Sensitive plant	Fabaceae	33.33	1.18	5.5	1.61	16.5	2.34	0.5	5.14
11	*Elaeis guineensis*	Palm tree	Arecaceae	66.67	2.35	6.83	2	10.25	1.46	0.15	5.82
12	*Eleusine indica*	Goose grass	Poaceae	66.67	2.35	9.67	2.83	14.5	2.06	0.22	7.25
13	*Axonopus compressus*	Carpet grass	Poaceae	66.67	2.35	7.17	2.1	10.75	1.53	0.16	5.99
14	*Emilia sonchifolia*	Tassel flower	Asteraceae	0	0	0	0	0	0	0	0
15	*Andropogon gayanus*	Gamba grass	Poaceae	0	0	0	0	0	0	0	0
16	*Combretam sp.*	Bush willow	Combretaceae	66.67	2.35	9	2.64	13.5	1.92	0.2	6.92
17	*Sanna alata*	Candle bush	Fabaceae	66.67	2.35	3.5	1.03	5.25	0.75	0.08	4.13
18	*Sida cordifolia*	Wire weed	Malvaceae	66.67	2.35	13	3.81	19.5	2.77	0.29	8.94

19	*Cyanthillium cinerem*	Little ironweed	Asteraceae	66.67	2.35	5.5	1.61	8.25	1.17	0.12	5.14
20	*Ipomea aquatic*	Water chestnut	Convolvulaceae	66.67	2.35	7	2.05	10.5	1.49	0.16	5.90
21	*Striga gesnerioides*	Witch weed	Orobanchaceae	33.33	1.18	4.67	1.37	14	1.99	0.42	4.54
22	*Boerhavia diffusa*	Hog weed	Nyctaginaceae	33.33	1.18	20	5.87	60	8.52	1.8	15.57
23	*Senna sp*		Fabaceae	66.67	2.35	15.33	4.5	23	3.27	0.35	10.12
24	*Bambusa vulgaris*	Bamboo	Poaceae	66.67	2.35	5.17	1.52	7.75	1.1	0.12	4.97
25	*Calopogonium sp*		Fabaceae	100	3.53	5.17	1.52	5.17	0.73	0.05	5.78
26	*Acacia sp*		Fabaceae	66.67	2.35	8.5	2.49	12.75	1.81	0.19	6.66
27	*Cyathula prostrata*	Pasture weed	Amaranthaceae	100	3.53	15	4.4	15	2.13	0.15	10.06
28	*Diplazium sp. sp.*		Athyriaceae	66.67	2.35	9.17	2.69	13.75	1.95	0.21	7.00
29	*Psidium sp.*	Guava	Myrtaceae	100	3.53	3.83	1.12	3.83	0.54	0.04	5.20
30	*Ficus sp.*	Fig tree	Moraceae	100	3.53	10.5	3.08	10.5	1.49	0.1	8.11
31	*Isoberlinia doka*	Doka ironwood	Fabaceae	33.33	1.18	5.33	1.56	16	2.27	0.48	5.02
32	*Mannniophyton fulvum*	Gasso	Euphorbiaceae	33.33	1.18	6.17	1.81	18.5	2.63	0.56	5.62
33	*Cochlospermum planchonii*	False cotton	Biaxaceae	33.33	1.18	14.17	4.15	42.5	6.04	1.28	11.37
34	*Newbouldia sp*	Boundary tree	Bigoniaceae	33.33	1.18	4	1.17	12	1.7	0.36	4.06
35	*Scoparia dulcissp.*	Goat weed	Plantaginaceae	66.67	2.35	6.67	1.96	10	1.42	0.15	5.73
36	*Mucuna pruriens*	Velvet bean	Fabaceae	66.67	2.35	5.5	1.61	8.25	1.17	0.12	5.14
37	*Paspalum scrobiculatum*	Crown grass	Poaceae	66.67	2.35	5	1.47	7.5	1.07	0.11	4.89
38	*Trema orientale*	Charcoal tree	Cannabaceae	33.33	1.18	7.17	2.1	21.5	3.05	0.65	6.34
39	*Albizia zygia*	West African albizia	Fabaceae	33.33	1.18	15.33	4.5	46	6.53	1.38	12.21
40	*Biophytum sp.*	Little tree	Oxalidaceae	33.33	1.18	5.33	1.56	16	2.27	0.48	5.02
41	*Elytrophorus spicatus*	Spike grass	Poaceae	66.67	2.35	8.83	2.59	13.25	1.88	0.2	6.83

Table 4: Plot 4 (Control)

	Scientific Name	Common Name	Family	F%	R.F	D	R.D	A	R.A	A/F	IVI
1	*Panicum maximum*	Guinea grass	Poaceae	100	2.61	46.83	7.77	46.83	15.11	0.47	25.49
2	*Pueraria sp Binth*	Tropical kudzu	Fabaceae	100	2.61	19.17	3.18	19.17	6.18	0.19	11.98
3	*Ageratum conyzoides*	Goat weed	Asteraceae	100	2.61	35.33	5.86	35.33	11.4	0.35	19.87
4	*Ageratum houstonianum*	Floss flower	Asteraceae	100	2.61	9.33	1.55	9.33	3.01	0.09	7.17
5	*Mikania sp.*		Asteraceae	100	2.61	12.5	2.07	12.5	4.03	0.12	8.72
6	*Cyperus rotundus*	Nut grass	Cyperaceae	100	2.61	11.33	1.88	11.33	3.66	0.11	8.15
7	*Aspilia Africa*	Wild sunflower	Asteraceae	100	2.61	28.33	4.7	28.33	9.14	0.28	16.45
8	*Alchonea cordifolia*	Christmas bush	Euphorbiaceae	100	2.61	33.67	5.58	33.67	10.86	0.34	19.06
9	*Resentia sp.*		Trichocomaceae	66.67	1.74	11.83	1.96	17.75	5.73	0.27	9.43
10	*Mimosa pudica*	Sensitive plant	Fabaceae	100	2.61	9.83	1.63	9.83	3.17	0.1	7.42
11	*Elaeis guineensis*	Palm tree	Arecaceae	100	2.61	10.17	1.69	10.17	3.28	0.1	7.58
12	*Eleusine indica*	Goose grass	Poaceae	100	2.61	23.33	3.87	23.33	7.53	0.23	14.01
13	*Axonopus compressus*	Carpet grass	Poaceae	100	2.61	18.17	3.01	18.17	5.86	0.18	11.49
14	*Emilia sonchifolia*	Tassel flower	Asteraceae	66.67	1.74	15.83	2.63	23.75	7.66	0.36	12.03
15	*Andropogon gayanus*	Gamba grass	Poaceae	100	2.61	18.5	3.07	18.5	5.97	0.18	11.65
16	*Combretam sp.*	Bush willow	Combretaceae	0	0	0	0	0	0	0	0
17	*Sanna alata*	Candle bush	Fabaceae	100	2.61	11	1.82	11	3.55	0.11	7.99
18	*Sida cordifolia*	Wire weed	Malvaceae	100	2.61	10.5	1.74	10.5	3.39	0.1	7.74
19	*Cyanthillium cinerem*	Little ironweed	Asteraceae	100	2.61	11.67	1.93	11.67	3.76	0.12	8.31
20	*Ipomea aquatic*	Water chestnut	Convolvulaceae	100	2.61	21.83	3.62	21.83	7.04	0.22	13.28
21	*Striga gesnerioides*	Witch weed	Orobanchaceae	100	2.61	11.67	1.93	11.67	3.76	0.12	8.31
22	*Boerhavia diffusa*	Hog weed	Nyctaginaceae	100	2.61	7.5	1.24	7.5	2.42	0.07	6.28
23	*Senna sp*		Fabaceae	66.67	1.74	8.67	1.44	13	4.19	0.2	7.38
24	*Bambusa vulgaris*	Bamboo	Poaceae	66.67	1.74	6.67	1.11	10	3.23	0.15	6.08
25	*Calopogonium sp*		Fabaceae	100	2.61	8.17	1.35	8.17	2.63	0.08	6.60
26	*Acacia sp*		Fabaceae	100	2.61	7.5	1.24	7.5	2.42	0.07	6.28

27	*Cyathula prostrata*	Pasture weed	Amaranthaceae	100	2.61	6.67	1.11	6.67	2.15	0.07	5.87
28	*Diplazium sp. sp.*		Athyriaceae	100	2.61	18.33	3.04	18.33	5.91	0.18	11.57
29	*Psidium sp.*	Guava	Myrtaceae	100	2.61	3.83	0.64	3.83	1.24	0.04	4.49
30	*Ficus sp.*	Fig tree	Moraceae	100	2.61	40.5	6.72	40.5	13.06	0.41	22.39
31	*Isoberlinia doka*	Doka ironwood	Fabaceae	100	2.61	26.83	4.45	26.83	8.66	0.27	15.72
32	*Mannniophyton fulvum*	Gasso	Euphorbiaceae	100	2.61	20	3.32	20	6.45	0.2	12.38
33	*Cochlospermum planchonii*	False cotton	Biaxaceae	100	2.61	8	1.33	8	2.58	0.08	6.52
34	*Newbouldia sp*	Boundary tree	Bigoniaceae	100	2.61	7.5	1.24	7.5	2.42	0.07	6.28
35	*Scoparia dulcissp.*	Goat weed	Plantaginaceae	100	2.61	7.33	1.22	7.33	2.37	0.07	6.20
36	*Mucuna pruriens*	Velvet bean	Fabaceae	100	2.61	6.33	1.05	6.33	2.04	0.06	5.71
37	*Paspalum scrobiculatum*	Crown grass	Poaceae	100	2.61	9.5	1.58	9.5	3.06	0.1	7.25
38	*Trema orientale*	Charcoal tree	Cannabaceae	100	2.61	15.17	2.52	15.17	4.89	0.15	10.02
39	*Albizia zygia*	West African albizia	Fabaceae	100	2.61	6.83	1.13	6.83	2.2	0.07	5.95
40	*Biophytum sp.*	Little tree	Oxalidaceae	100	2.61	10.5	1.74	10.5	3.39	0.1	7.74
41	*Elytrophorus spicatus*	Spike grass	Poaceae	66.67	1.74	6.67	1.11	10	3.23	0.15	6.08

F%= Frequency, R.D= Relative frequency, D= Density, R.D= Relative Density, A= Abundance, R.A= Relative abundance, A/F= Abundance-Frequency and IVI= Importance Value Index

Abundance-Frequence (A/F): Among the species, *Mucuna pruriens* exhibited the highest A/F ratio (3.15), followed by *Cochlospermum planchonii* with 2.72, *Panicum maximum* (1.95), *Ageratum houstonianum* (1.89), *Boerhavia diffusa* (1.8), *Albizia zygia* (1.38) and *Pueraria sp Binth* (1.35). In contrast, *Elaeis guineensis* (Palm tree), *Cyperus rotundus* (Nut grass), *Newbouldia sp.*, and *Psidium sp.* recorded low A/F values (<0.1).

Importance Value Index (IVI): Among the plots studied, *Mucuna pruriens* (27.60) has the highest IVI followed by *Ageratum conyzoides* (27.49), *Panicum maximum* (25.48), *Cochlospermum planchonii* (23.94), *Ficus sp.* (22.39) and *Ageratum houstonianum* (20.76). In contrast the lowest was recorded in *Newbouldia sp., Psidium sp.* and *Calopogonium sp.*

Discussion

The frequency analysis revealed clear patterns of species distribution and adaptability across the study plots. Species such as *Panicum maximum*, *Ageratum houstonianum*, *Cyperus rotundus*, and *Alchornea cordifolia* exhibited 100% frequency across Plots 1–3, indicating high ecological amplitude and successful colonization of disturbed or secondary successional environments (Akinsoji, 1988; Agbagwa & Ekeke, 2011). Similarly, stress-tolerant species such as *Sida cordifolia* and *Scoparia dulcis* demonstrated broad adaptability in open, nutrient-depleted soils (Akobundu & Agyakwa, 1998), while species such as *Psidium* sp., *Ficus* sp., and *Pueraria* sp. attained 100% frequency in Plot 3, suggesting competitive superiority and roles in canopy closure during late-successional stages (Whitmore, 1998). In the control plot, low-frequency species such as *Emilia sonchifolia* and *Andropogon gayanus* reflected narrow ecological tolerances or competitive exclusion under mature canopy conditions (Odum & Barrett, 2005). The predominance of Fabaceae, Poaceae, and Asteraceae in relative frequency underscores their dominance in disturbed tropical habitats, aided by nitrogen-fixing capabilities, efficient reproductive strategies, and wide ecological tolerance (Sprent, 2009; Isichei, 1995).

Density analysis revealed wide variation among species. *Ageratum conyzoides* recorded the highest mean density (11.67–53.33 individuals/m²), reflecting its aggressive colonization and prolific seed production (Ikuenobe & Anoliefo, 2003). *Mucuna pruriens* and *Scoparia dulcis* (35 individuals/m²) also showed strong establishment, with *M. pruriens*'s nitrogen-fixing ability enhancing competitiveness in degraded soils (Sprent, 2009; Uka et al., 2013). Grasses such as *Panicum maximum* and *Bambusa vulgaris* (30.16–46.83 individuals/m²) dominate early successional stages through vigorous vegetative propagation (Akinsoji, 1988). Conversely, woody species including *Elaeis guineensis* and *Newbouldia* sp. had low densities, consistent with their dependence on stable, shaded microhabitats and later successional niches (Richards,

1996; Chazdon, 2003). *Ficus* sp. attained moderate-to-high densities (up to 40.5 individuals/m²), signalling ongoing secondary woodland regeneration given its role as a keystone species in tropical ecosystems (Shanahan et al., 2001).

Abundance data confirmed *Mucuna pruriens* as the most abundant taxon (6.33–105 individuals), followed by *Ageratum conyzoides*, *Cochlospermum planchonii*, and *Ageratum houstonianum*. Their prevalence reflects ruderal life-history traits — rapid growth, high reproductive output, and efficient dispersal — characteristic of early successional communities (Chazdon, 2003; Oke & Isichei, 1997). Woody species such as *Bambusa vulgaris* and *Isoberlinia doka* contributed meaningfully to vegetation structure through high regenerative capacity and resilience to periodic disturbance (Akinsoji, 1988), whereas *Elaeis guineensis* and *Newbouldia* sp. showed low abundance (<10.5 individuals/plot), indicative of a community still in early-to-mid-successional transition.

The majority of species exhibited Abundance/Frequency (A/F) ratios >0.05, indicating a predominantly contagious (clumped) distribution pattern typical of heterogeneous, disturbed tropical ecosystems (Greig-Smith, 1983; Kent & Coker, 1992). *Mucuna pruriens* yielded the highest A/F ratio (3.15) in Plot 1, followed by *Cochlospermum planchonii* (2.72) and *Ageratum conyzoides* (1.20), reflecting strong aggregation linked to aggressive colonization, high reproductive capacity, and patchy resource availability (Ikuenobe & Anoliefo, 2003; Iwara et al., 2016). In contrast, species such as *Elaeis guineensis* and *Psidium* sp. recorded low A/F values (<0.1), suggesting random or regular distributions arising from intraspecific competition or dependence on specific edaphic conditions (Odum & Barrett, 2005). The Importance Value Index (IVI) identified *Mucuna pruriens*, *Ageratum conyzoides*, *Panicum maximum*, and *Ficus* sp. as ecologically dominant, underscoring their key structural and functional roles in vegetation recovery and nutrient cycling (Akinsoji, 1988; Sprent, 2009).

Conclusion

This study demonstrated significant vegetation heterogeneity within the study area, shaped by disturbance intensity, soil fertility, and microclimatic variation. The dominance of Fabaceae, Poaceae, and Asteraceae reflects their ecological versatility and central roles in nutrient cycling, soil stabilization, and habitat recovery. High-frequency, high-density species — notably *Mucuna pruriens*, *Ageratum conyzoides*, and *Panicum maximum* — are characteristic of early-to-mid successional communities driven by ruderal strategies, while the presence of woody species such as *Ficus* sp. and *Isoberlinia doka* signals a gradual transition toward secondary woodland regeneration. The predominantly contagious distribution pattern, revealed by A/F ratios, reflects patchy resource availability and vegetative propagation strategies across the plots, consistent with disturbed tropical ecosystems (Greig-Smith, 1983; Odum & Barrett, 2005).

The IVI results confirm ongoing successional recovery: pioneer herbs and grasses dominate open, disturbed patches, while shrubs and trees progressively re-establish ecological complexity. Collectively, the vegetation composition mirrors a dynamic, recovering ecosystem transitioning from disturbance-driven colonization toward greater structural stability — a pattern consistent with ecological succession theory (Odum & Barrett, 2005) and documented patterns in West African tropical systems (Akinsoji, 1988; Iwara et al., 2016). These findings highlight the value of phytosociological parameters in assessing ecosystem resilience, disturbance history, and conservation priorities in tropical landscapes.

References

Agbagwa, I.O. & Ekeke, C. (2011) Structure and phytodiversity of freshwater swamp forest in oil-rich Bonny, Rivers State, Nigeria. Research Journal of Forestry, 5, 66–77.

Akinsoji, A. (1988). Post-fire vegetation dynamics in a southern Guinea savanna vegetation. Nigerian Journal of Botany, 1, 45–53.

Akobundu, I.O. & Agyakwa, C.W. (1998) A Handbook of West African Weeds. Ibadan: International Institute of Tropical Agriculture.

Chazdon, R.L. (2003) Tropical forest recovery: legacies of human impact and natural disturbances. Perspectives in Plant Ecology, Evolution and Systematics, 6, 51–71.

Greig-Smith, P. (1983) Quantitative Plant Ecology, 3rd edn. Oxford: Blackwell Scientific Publications.

Ikuenobe, C.E. & Anoliefo, G.O. (2003) Influence of Chromolaena odorata and Mucuna pruriens fallow duration on weed infestation. Weed Research, 43, 199–207.

Isichei, A.O. (1995) Stocks of nitrogen in vegetation and soil in West African moist savannas and potential effects of climate change and land use on these stocks. Journal of Biogeography, 22, 393–399.

Iwara, A. I., Udo, I. A., Ogundele, F. O., & Otu, C. A. (2016). Influence of land-use type on soil properties and vegetation composition in a tropical derived savanna ecosystem. Global Journal of Environmental Sciences, 15(1), 13–22.

Kayode, J., Oyedeji, A.A. & Olowoyo, O. (2009) Evaluation of the effects of pollution with spent lubricating oil on the physical and chemical properties of soil. The Pacific Journal of Science and Technology, 10(1), 387–391.

Kent, M. & Coker, P. (1992) Vegetation Description and Analysis: A Practical Approach. Chichester: John Wiley & Sons.

Kershaw, K.A. (1973) Quantitative and Dynamic Plant Ecology, 2nd edn. London: Edward Arnold.

Misra, R. (1968) Ecology Work Book. Calcutta: Oxford and IBH Publishing Co.

Odum, E.P. & Barrett, G.W. (2005) Fundamentals of Ecology, 5th edn. Belmont, CA: Thomson Brooks/Cole.

Oke, S. O., & Isichei, A. O. (1997). Floristic and structural changes in a secondary lowland rainforest in Nigeria. Vegetatio, 133(2), 119–128.

Pfadenhauer, J.S. and Klötzli, F.A. (2020) Global Vegetation: Fundamentals, Ecology and Distribution. Cham: Springer International Publishing.

Richards, P.W. (1996) The Tropical Rain Forest: An Ecological Study, 2nd edn. Cambridge: Cambridge University Press.

Shanahan, M., So, S., Compton, S. G., & Corlett, R. (2001). Fig eating by vertebrate frugivores: A global review. Biological Reviews, 76(4), 529–572.

Sprent, J.I. (2009) Legume Nodulation: A Global Perspective. Chichester: Wiley-Blackwell.

Tanee, F. B. G., Edwin-Wosu, N. L., Ochekwu, E. B. & Albert, E. (2023). *Rudiments of quantitative and vegetation ecology.* Cel will publishers.

Uka, U. N., Igbokwe, G. O., & Okechukwu, E. C. (2013). The ecological impact of Panicum maximum on soil nutrients and microclimate. Journal of Ecology and the Natural Environment, 5(10), 271–278.

Whitford, P. B. 1949. Distribution of woodland plants in relation to succession and clonal growth. Ecology 30: 199–208.