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COMPOSITION AND DIVERSITY OF NON-TIMBER FOREST PRODUCTS (NTFPs) IN BATURIYA WETLAND GAME RESERVE, JIGAWA STATE, NIGERIA

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ABSTRACT
Inadequate documentation and information of Non-Timber Forest Products (NTFPs) in the study sites call for the assessment of composition and diversity of the concern products. Therefore, the aim of the study is to assess the Composition and Diversity of Non- Timber Forest Products (NTFPs) in Baturiya Wetland Game Reserve, Jigawa State, Nigeria. A four (4) transects of 1km length was laid at an interval of 400 m. Likewise, in each transect, 4 plots of 100 x 100 m was laid alternately along each transect at 200 m interval. Also four (4) quadrants of 1m x1m in size for small non-timber forest products was randomly laid in each 100 x100m plot for each of the habitats in each plot, plant stocks identified were recorded. Data collected were analysed using Simpson index, Sorenson index and descriptive statistic. Results showed that Upland area had the highest species, number of individual and diversity of Non–Timber Forest Product followed by Swampy area and Fadama area with the values of (94, 1464, D-0.981), (63, 842, D-0.970) and (60, 805, D-0.969) respectively. Upland area and Swampy area had the highest similarity index of 78.5%. The results suggest that the documentation, inventory and management of NTFPs should be addressed in operational plan to enhance its diversity.

Keywords: Diversity, floristic composition, Non-timber forest products, Baturiya Game reserve.

INTRODUCTION

Non-Timber Forest Products are useful substances, materials or commodity obtained from forest that do not required the harvesting of trees (FAO, 2018). The term Non- Timber Forest Products (NTFPs) emerged as an umbrella to recognize the products derived from various forest resources as a group. Non-timber forest products are plants and /or forest products that are valued for other purposes beside timber. They have been described as all biological materials of plant and animal origin other than wood that are extracted from the forest for human use and are mainly technological processing (Ibrahim *et al.,* 2016)

Ramsar, (1994) defined wetlands as areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters Ecological values of wetlands to humans consists of flood control, nutrient absorption and cycling which improve water quality, as well as protection of coastal communities from erosion and wave energy (Barbier *et al.,* 1997). Economics values of wetlands include agriculture, provision of timber, fuel wood, and non-timber products such as cotton, silk and potash (Barbier *et al.,* 19997). Non-Timber Forest Products (NTFP) are being increasingly recognized for their crucial roles in rural livelihoods, biodiversity conservation and export earnings. Wetland resources are used for many purposes and benefits which include soils for agriculture purpose, fishing for food and economy, trees for various purposes and reeds to shelter materials (Kar, 2013). Wetlands also refer to areas with water level very close to soil surface and possess water, plants, and soils. Wetlands have general functions and values which significantly recognizes the uniqueness of the environment (Nwankwoala, 2012). The importance of wetlands to life is enormous; it is used for recreational activities such as bird watching, sailing, research activities, nutrient decomposition and recycling. Globally, more than two billion people are dwelling in forests, depending on forest resources for subsistence, income and livelihood security (Ahenkan and Boon, 2011). Non timber forest products are considered to be vital for sustaining rural livelihoods, reducing rural poverty, biodiversity conservation and facilitating rural economic growth (Maske *et al.,* 2011). World Health Organization estimated that about 80% of the population of the developing countries uses non-timber forest products to meet their health and nutritional needs (Olaniyi *et al.,* 2013). The study of non-timber forest products has been dealt with by people from varied fields of study such as forestry, ethno-biology, economic botany, social development, natural resource economics, conservation biology, protected area management, agro-forestry, marketing, commercial development, ecological anthropology, cultural geography and human ecology. Therefore, objective of this study is to assess Diversity of Non-Timber Forest Products (NTFP's) in Baturiya Hadejia Wetland Game Reserve, Jigawa State, Nigeria, with a view to ensuring its sustainable management.

MATERIALS AND METHODS

Study area

Baturiya Hadejia- Wetlands is a wide expanse of flood plain wetlands situated in the Northeast Nigeria, the location lies in the sudano-sahelian zone, which is the zone between the Sudano-Savanna in the south and the Sahel in the North. The wetland is found in Yobe state, located in the Northern part of Nigeria, which

include the Nguru Lake (Eaton and Sarch, 1997). According to Ramsar, (1994), Baturiya which is a section of the Hadejia Nguru Wetlands, is located on the Latitude 12°20'0"N to 12°40'0"N and Longitude 10°10'0"E to 10°30'0"E

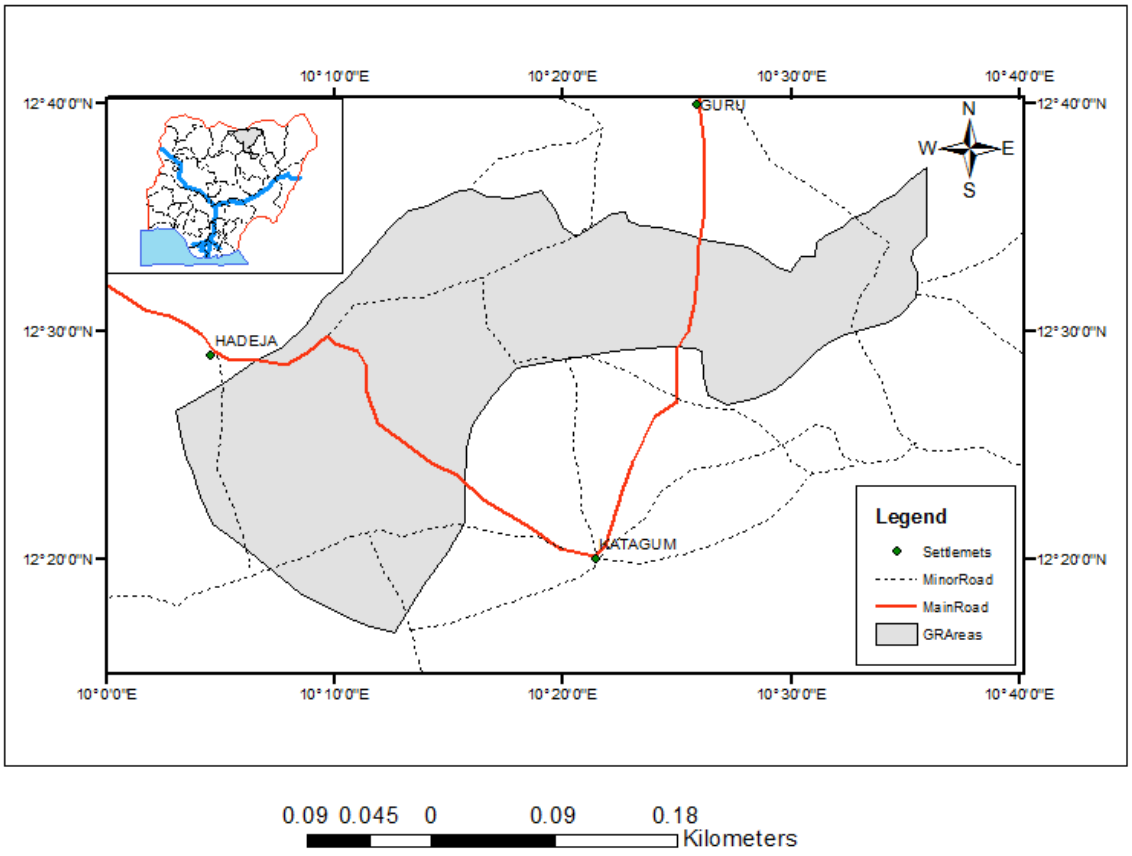

Figure 1: Map of Baturiya Wetland Game Reserve

Source: GIS Laboratory, Geography Department MAUTECH Yola 2017

Sampling technique

Systematic sampling method was adopted for this study, in which the study area was stratified according to existing habitats (Uplands, Fadama and Swamp) in the game reserve. In each habitat, 4 transect of 1km length was laid at an interval of 400 m. Likewise, in each transect, four (4) plots of 100 x100 m was laid alternately along each transect at 200 m interval. Also five (5) quadrants of 1m x 1m in size was randomly laid in each 100 x100 m plot for each of the habitats

Data collection

In each plot, non-timber forest products identified were recorded, while voucher specimen was used for collection of species that could not be identified in the field, and later were taken to the herbarium of Department of Forestry Federal University Dutse (FUD) for identification

Data analysis

(a) Descriptive Statistics was used in presenting the checklist of the non-timber forest products of the study area.

(b) Simpson diversity index was employed in assessing the diversity of Non-Timber Forest Products and is of the form

Simpson index $D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)}\right) \ldots \ldots \ldots \ldots (1)$

Where n = total number of organism of a particular species,

N = the total number of organisms of all species

(c) Sorensen's species similarity index between two sites was calculated using equation

$$SI = (\frac{2C}{a+b}) X 100.\% \ldots \ldots \ldots (2)$$

Where:
C = number of species at sites a , b
a, b= number of species at sites a, b

RESULTS AND DISCUSSIONS

Floristic composition

A total one hundred and forty (140) species of Non-Timber Forest Products were identified in 101 genera and 46 families in the game reserve. Fadama area is more peculiar with Acanthaceae, Combretaceae, Balantacaea, Cesalpinineae and Ranidae. Mimosaceae had the highest number of individual and plant species in the study area: *Acacia hockii, Acacia polyacantha, Acacia atathecantha, Acacia campyiacantha, Acacia erioloba, Acacia karro, Acacia macrostachya, Acacia oerfota***,** *Acacia Senegal, Albizia chevalieri, Parkia biglobosa, Ziziphus abyssinica, Ziziphus mauritiana, Ziziphus microphylla, Ziziphus mucronata and Zizyphus spina.* Families like Apiaceae (*Centella astiatica)*, Olacaceae (*Ximenia Americana)*, Tamaraceae (*Tamarindus indica)*, Lamiaceae (*Sienna obtusifolia)*, Polygalceae *(Securideae longependilata)* and Aracaceae (*Pistia stratiotes*) had the least number of species.

Table 1: Floristic distribution of Non Timber Forest Products and Diversity index

S/N	Habitat	Number of plant	n (n-1)	Simpson index
1	Upland area	1464	40316	0.981
2	Fadama area	842	21628	0.969
3	Swampy area	805	19360	0.970

Source: Field survey, (2019)

Diversity of Non-Timber Forest Product in Baturiya Game Reserve

Non-timber forest Products species diversity in habitat I (upland), the result indicated that upland habitat comprises of ninety-four (94) species in twenty-six (26) family and sixty-five (65) genera with diversity index of D- 0.981. Non-Timber Forest Products Species Diversity in habitat II (Fadama). Results of non-timber forest products species diversity shows that fadama habitat comprise of sixty (60) species in twenty-five (21) family and forty-three (43) genera with diversity index of D- 0.969. Non-Timber Forest Products Species Diversity in habitat III (swamp*).* Results of non-timber forest products species diversity shows that swamp habitat comprise of sixty (63) species in twenty-two (23) family and forty four (44) genera with diversity index of D- 0.970. The similarity index between the Upland area and Swampy area sites is 78.5% was proved to be the best.

Findings on NTFPs diversity indicated that Baturiya Game Reserve contained the greatest diversity in terms of non-timber forest products species diversity. The diversity of non-timber forest products was high across the three major habitats namely upland, fadama and swamp, there were disproportionately distributed among non-timber forest products diversity across the habitats thus upland has the highest Simpson diversity index of D- 0.981 followed by swamp with non-timber forest products with Simpson diversity index of D- 0.970 and fadama with least diversity index of D- 0.969. According to Aramd *et al.* (2016), the value of D ranges from 0 to 1 with this index, 0 represent high diversity and 1, no diversity thus lowers the value of D, the greater is the species diversity. Finding reveals that the game reserve is diverse in term of NTFPs because the diversity of all the habitats ranges from 0.69 – 0.981. Probably the even distribution of non-timber forest products may have given rise to a uniform habitats structure in the reserve. This is in line with Suraj and Narayan, (2016) who reported that Simpson of diversity index among the three different sites, were 0.988 (Control site 3), 0.328 (Site 1), and 0.213 (Site 2), indicating that (Site 3) has higher diversity values in comparison to the Site1 and 2. The results of plant species similarity index (71.0%, 78.5%, 61.5% between Upland area and Fadama area, Upland area and Swampy area, Swampy area and Fadama area respectively) revealed that tree species in Upland area and Swampy area are more similar than any other site combinations (Table 2). This implies that there is higher number of common tree species in the study sites. However, Onyekwelu *et al.* (2008), reported moderate similarity index between Queen's and Elephant forest, Queen's and Oluwa forest, Oluwa and Elephant forest with value of 63.4%, 58.3% and 47.4% respectively. Salami (2017), also observed moderate similarity index between Omo Biosphere Reserve and Gambari Forest Reserve with value of 58.33%.

Table 2: Site characteristics and similarity index

Habitat Combination	Similarity index	No of family	No of species	No of genus
Upland area x Fadama area	71.0	-	-	-
Upland area x Swampy area	78.5	-	-	-
Swampy area x Fadama area	61.5	-	-	-
Habitat				
Upland area	-	94	26	65
Fadama area	-	60	21	43
Swampy area	-	63	23	44

Source: Field survey, (2019)

CONCLUSION

Baturiya Game Reserve comprises of diverse and abundance plant species especially in the Upland area and Fadama areas which is worth of conserving for ecology, economy and biodiversity values. Still, the study area is under high pressure of unsustainable harvests, intensification of agriculture and sporadic debarking by traditional medical practitioners which may results to the depletion of non timber forest products in the study area. Therefore, there is need for proper inventory, documentation and management of NTFPs in the game reserve planning to enhance its genetic composition and diversity.

CONFLICT OF INTRESTS

The authors have not declared any conflict of interest.

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APPENDIXES

Table 2: Non-timber forest products Species diversity in the upland habitat in Baturiya Wetland.

S/N	Scientific Name	Family	No. of plants	n(n-1)
1	*Acacia hockii*	Mimosaceae	10	90
2	*Acacia polyacantha*	Mimosaceae	23	506
3	*Acacia atathecantha*	Mimosaceae	40	1560
4	*Acacia campyiacantha*	Mimosaceae	20	380
5	*Acacia erioloba*	Mimosaceae	21	420
6	*Acacia karro*	Mimosaceae	16	240
7	*Acacia macrostachya*	Mimosaceae	50	2450
8	*Acacia oerfota*	Mimosaceae	13	156
9	*Acacia Senegal*	Mimosaceae	40	1560
10	*Acantho hispidum*	Acanthacea	20	380
11	*Adansonia digitate*	Bombacaceae	8	56
12	*Ageratum coyzoides*	Compositae	16	240
13	*Albizia chevalieri*	Mimosaceae	16	240
14	*Alysicarpus vaginalis*	Grammenia	20	380
15	*Androphogan gayanus*	Grammenia	40	1560
16	*Anogeissas leicarpus*	Combretaceae	15	210
17	*Anona senegalensis*	Annonaceae	30	870
18	*Balanites egyptiaca*	Balanitaceae	14	182
19	*Bombax costatum*	Bombacaceae	12	132
20	*Borassus aegytinca*	Palmea	3	6
21	*Borassus aethiopum*	Palmea	5	20
22	*Carissa edulis*	Apocynaceae	3	6
23	*Cassia italic*	Calsalpiniceae	3	6
24	*Cassia singuena*	Calsalpiniceae	2	2
25	*Cassia arereh*	Calsalpiniceae	7	42
26	*Cassia tora*	Calsalpiniceae	60	3540
27	*Celtis infergriflora*	Combretaceae	19	342
28	*Centella astiatica*	Apiaceae	2	2
29	*Combretum lamprocarpum*	Combretaceae	25	600
30	*Combretum micranthum*	Combretaceae	2	2
31	*Daniellia oliveri*	Calsalpiniceae	7	42
32	*Detaruim macrocarpum*	Calsalpiniceae	2	2
33	*Dichrosachys glomerata*	Fabaceae	4	12
34	*Dichrosachys tcinerea*	Fabaceae	6	30
35	*Digitaria debilis*	Grammenia	30	870
36	*Diospyros mespiliformis*	Ebenaceae	42	1722
37	*Entandra africana*	Ebenaceae	16	240
38	*Erthrina senegalensis*	Fabaceae	9	72

39	*Erthropleum suaveolens*	Fabaceae	18	306
40	*Euphorbia basalefera*	Euphorbiacea	9	72
41	*Euphorbia lateriflora*	Euphorbiacea	2	2
42	*Euphorbia poisson*	Euphorbiacea	6	30
43	*Ficus polita*	Moraceae	7	42
44	*Ficus sycomorus*	Moraceae	18	306
45	*Fiscus thonningi*	Moraceae	9	72
46	*Fiscus iteopyla*	Moraceae	10	90
47	*Fiscus platyphylla*	Moraceae	12	132
48	*Gardenia aqualla*	Fabaceae	20	380
49	*Guiera senegalensis*	Combretaceae	18	306
50	*Guinea grass*	Grammenia	30	870
51	*Hymenocardia acida*	Euphorbiacea	17	272
52	*Hyphaene thebaica*	Palmea	90	8010
53	*Imperata cylindrical*	Grammenia	40	1560
54	*Indigofera arrtecta*	Fabaceae	10	90
55	*Ipomoea muricata*	Grammenia	15	210
56	*Jatropha chevalieri*	Euphorbiacea	9	72
57	*Jatropha curcas*	Euphorbiacea	29	812
58	*Lannea acida*	Anacardiaceae	10	90
59	*Lantana camara roxb*	Verbanaceae	4	12
60	*Leptademia hastate*	Asclepidaceae	6	30
61	*Mangifera indica*	Anacardiaceae	24	552
62	*Mimosa pigra*	Fabaceae	3	6
63	*Paninari macropylla*	Steculiaceae	17	272
64	*Parkia biglobosa*	Mimosaceae	30	870
65	*Phoenix dactylifera*	Palmea	18	306
66	*Phoenix llernianus*	Palmea	2	2
67	*Phoenix mullerrianus*	Palmea	10	90
68	*Phoenix reclinata*	Palmea	3	6
69	*Physalis divericata*	Solanaceae	25	600
70	*Pistia stratiotes*	Araceae	13	156
71	*Prosopis africana*	Mimosaceae	2	2
72	*Rauvolfia caffra*	Apocynaceae	9	72
73	*Saba florida*	Apocynaceae	2	2
74	*Sclerocarya birrea*	Anacardiaceae	2	2
75	*Securideae longependilata*	Polygalceae	2	2
76	*Sienna obtusifolia*	Lamiaceae	6	30
77	*Solanum nigrum*	Steculiaceae	2	2
78	*Sphaeranthus angustifolius*	Grammenia	10	90
79	*Spondia nombin*	Steculiaceae	21	420
80	*Steculia settigera*	Steculiaceae	19	342
81	*Steculia tregecantha*	Steculiaceae	6	30

82	*Steculia virosa*	Euphorbiacea	2	2
83	*Sterculia setigera*	Steculiaceae	6	30
84	*Strophanthus gratus*	Apocynaceae	4	12
85	*Tamarindus indica*	Tamaraceae	30	870
86	*Tridax procumbens*	Grammenia	10	90
87	*Vitellaria paradoxa*	Mimosaceae	29	812
88	*Vitex doniana*	Verbanaceae	18	306
89	*Ximenia americana*	Olaceae	20	380
90	*Ziziphus abyssinica*	Mimosaceae	10	90
91	*Ziziphus mauritiana*	Mimosaceae	29	812
92	*Ziziphus microphylla*	Mimosaceae	6	30
93	*Ziziphus mucronata*	Mimosaceae	9	72
94	*Zizyphus spina*	Mimosaceae	5	20
Total			1464	40316

Source: Field survey, 2019

Table 3: Non-timber forest products species diversity of sampled fadama habitat in Baturiya game reserve

S/N	Scientific Name	Family Name	No. plants	n(n-1)
1	*Acacia polyacantha*	Mimosaceae	10	90
2	*Acacia macrostachya*	Mimosaceae	19	342
3	*Acacia nilotica*	Mimosaceae	60	3540
4	*Acacia Senegal*	Mimosaceae	36	1260
5	*Acantho hispidum*	Acanthacea	6	30
6	*Adansonia digitate*	Bombacaceae	23	506
7	*Anogeissus leicarpus*	Combretaceae	30	870
8	*Anona senegalensis*	Annonaceae	10	90
9	*Balanites egyptiaca*	Balanitaceae	14	182
10	*Boehavia diffusa*	Nyitaginaceae	7	42
11	*Bombax costatum*	Bombacaceae	18	306
12	*Borreria stachydea*	Rubiaceae	6	30
13	*Borreria verticellata*	Rubiaceae	2	2
14	*Cassia italic*	Calsalpiniceae	10	90
15	*Cassia singuena*	Calsalpiniceae	9	72
16	*Cassia arereh*	Calsalpiniceae	4	12
17	*Celtis infergriflora*	Combretaceae	2	2
18	*Centella astiatica*	Apiaceae	2	2
19	*Combretum lamprocarpum*	Combretaceae	7	42
20	*Combretum micranthum*	Combretaceae	6	30
21	*Detaruim macrocarpum*	Calsalpiniceae	7	42
22	*Dichrostachys cinema*	Mimosaceae	2	2
23	*Diospyros mespiliformis*	Ebenaceae	46	2070
24	*Entandra africana*	Ebenaceae	5	20
25	*Euphorbia basalefera*	Euphorbiacea	2	2
26	*Euphorbia lateriflora*	Euphorbiacea	6	30

27	*Euphorbia poisson*	Euphorbiacea	3	6
28	*Ficus polita*	Moraceae	6	30
29	*Ficus sycomorus*	Moraceae	10	90
30	*Fiscus thonningi*	Moraceae	18	306
31	*Fiscus iteopyla*	Moraceae	2	2
32	*Fiscus platyphylla*	Moraceae	2	2
33	*Gardenia aqualla*	Fabaceae	14	182
34	*Guiera senegalensis*	Combretaceae	22	462
35	*Hyphaene thebaica*	Palmea	22	462
36	*Indigofera arrtecta*	Fabaceae	9	72
37	*Lannea acida*	Anacardiaceae	4	12
38	*Lantana camara roxb*	Verbenacea	10	90
39	*Lawsonia inermis*	Lythraceae	30	870
40	*Mangifera indica*	Anacardiaceae	40	1560
41	*Mimosa pigra*	Fabaceae	2	2
42	*Mitrigynia inermis*	Rubiaceae	39	1482
43	*Moringa oleafera*	Moringaceae	40	1560
44	*Nymphaea lotus*	Nymphaeceae	50	2450
45	*Paninari ployandra*	Rosaceae	2	2
46	*Piliostigma reticulatum*	Calsalpiniceae	21	420
47	*Pterocarpus erinaceus*	Fabaceae	6	30
48	*Pterocarpus santalinoides*	Fabaceae	2	2
49	*Rana clamiton*	Ranidae	9	72
50	*Rana escukate*	Ranidae	18	306
51	*Sclerocarya birrea*	Anacardiaceae	7	42
52	*Senna occidentalis*	Fabaceae	12	132
53	*Senna singuena*	Fabaceae	9	72
54	*Sienna obtusifolia*	Lamiaceae	5	20
55	*Tamarindus indica*	Tamaricaceae	12	132
56	*Vitex doniana*	Verbenacea	21	420
57	*Ximenia americana*	Olacaceae	19	342
58	*Xlopia parviflora*	Fabaceae	16	240
59	*Ziziphus microphylla*	Mimosaceae	6	30
60	*Zizyphus spina*	Mimosaceae	5	20
Total			**842**	**21628**

Source: Field survey, 2019

Table 4: Non-timber forest products diversity of sampled Swamp habitat in Baturiya wetland

S/N	Scientific Name	Family Name	No. of plants	n(n-1)
1	*Acacia hockii*	Mimosaceae	17	272
2	*Acacia atathecantha*	Mimosaceae	10	90
3	*Acacia erioloba*	Mimosaceae	15	210
4	*Acacia karro*	Mimosaceae	8	56
5	*Acacia macrostachya*	Mimosaceae	9	72

6	*Acacia nilotica*	Mimosaceae	30	870
7	*Acacia Senegal*	Mimosaceae	27	702
8	*Agaricus bispore*	Ascomycetes	50	2450
9	*Agaricus bulbosa*	Ascomycetes	40	1560
10	*Anogeissus leicarpus*	Combretaceae	22	462
11	*Balanites egyptiaca*	Balanitaceae	16	240
12	*Borassus aegytinca*	Palmea	8	56
13	*Borassus aethiopum*	Palmea	4	12
14	*Borreria stachydea*	Rubiaceae	6	30
15	*Borreria verticellata*	Rubiaceae	2	2
16	*Cassia tora*	Calsalpiniceae	2	2
17	*Detarium macrocarpum*	Fabaceae	18	306
18	*Detaruim macrocarpum*	Calsalpiniceae	10	90
19	*Dichrostachys cinema*	Mimosaceae	4	12
20	*Diospyros mespiliformis*	Ebenaceae	47	2162
21	*Entandra Africana*	Ebenaceae	7	42
22	*Entandra bilbosa*	Mimosaceae	9	72
23	*Euphorbia basalefera*	Euphorbiacea	9	72
24	*Euphorbia lateriflora*	Euphorbiacea	15	210
25	*Euphorbia poisson*	Euphorbiacea	6	30
26	*Ficus polita*	Moraceae	6	30
27	*Ficus sycomorus*	Moraceae	8	56
28	*Fiscus thonningi*	Moraceae	4	12
29	*Fiscus iteopyla*	Moraceae	9	72
30	*Fiscus platyphylla*	Moraceae	2	2
31	*Guiera senegalensis*	Combretaceae	18	306
32	*Hymenocardia acida*	Euphorbiacea	9	72
33	*Hyphaene thebaica*	Palmea	11	110
34	*Jatropha curcas*	Euphorbiacea	20	380
35	*Lannea acida*	Anacardiaceae	6	30
36	*Lawsonia inermis*	Lythraceae	8	56
37	*Leptoptilos crumeniferus*	Ciconiidae	2	2
38	*Mangifera indica*	Anacardiaceae	20	380
39	*Mimosa pigra*	Fabaceae	2	2
40	*Mitrigynia inermis*	Rubiaceae	55	2970
41	*Moringa oleafera*	Moringaceae	6	30
42	*Nymphaea lotus*	Nymphaeceae	48	2256
43	*Paninari macropylla*	Sterculiaceae	6	30
44	*Paninari ployandra*	Rosaceae	6	30
45	*Parkia biglobosa*	Mimosaceae	4	12
46	*Prosopis africana*	Mimosaceae	3	6
47	*Pterocarpus erinaceus*	Fabaceae	21	420
48	*Pterocarpus santalinoides*	Fabaceae	2	2

49	*Rana clamiton*	Ranidae	20	380
50	*Rana escukate*	Ranidae	31	930
51	*Senna occidentalis*	Fabaceae	9	72
52	*Senna singuena*	Fabaceae	6	30
53	*Spondia nombin*	Sterculiaceae	5	20
54	*Stryculia virosa*	Euphorbiacea	7	42
55	*Tamarindus indica*	Tamaricaceae	8	56
56	*Vitellaria paradoxa*	Mimosaceae	3	6
57	*Vitex doniana*	Verbenacea	4	12
58	*Xerus ruticus*	Scuiridae	2	2
59	*Ximenia americana*	Olacaceae	18	306
60	*Xlopia parviflora*	Fabaceae	6	30
61	*Ziziphus abyssinica*	Mimosaceae	6	30
62	*Ziziphus microphylla*	Mimosaceae	3	6
63	*Zizyphus spina*	Mimosaceae	10	90
Total			**805**	**19360**

Source: Field survey, 2019