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ASSESSING THE DENSITY, COMPOSITION AND DIVERSITY OF FLORA SPECIES IN FFR DARAZO, BAUCHI STATE AS A BIODIVERSITY SANCTUARY

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ABSTRACT

The study assesses the density, composition and diversity of flora species in Farin-ruwa Forest Reserve (FFR) Darazo as a biodiversity sanctuary. Point-Centre–Quarter method (PCQ)was the technique used for data collection. Simpson (1-D) and Shannon (H) diversity indices were used for data analysis. The result indicates that there are 22 plant species belonging to Eight (8) families. Combretaceae and Fabaceae had the highest individual while Moraceae had the least species in the reserve. The result further showed that Combretaceae was the most dominant family. The low basal area of 8.33m^2 indicated that the vegetation is at regenerating stage. The highest important value (IV) recorded for Anogessius species (73.63) revealed the woodland is Anogessius woodland at reclamation stage with good potential as a sanctuary for biodiversity. Findings on flora species diversity confirmed that both Simpson (1-D) and Shannon (H) values 0.96 and 0.3 shows no diversity. This reveals the poor protection status of the reserve. The study concludes that the FFR is Anogeissus woodland at a recovery stage with low flora species diversity, and that the reserve stands a chance of becoming a good biodiversity sanctuary. It is recommended that a comprehensive enrichment-planting (afforestation) programme be implemented in the reserve.

Keywords: *Density, Composition, Diversity, Biodiversity and Sanctuary*

INTRODUCTION

The forest is the environs where several species of living things comprise biodiversity through webs of life. Salami, Shuaibu, Adekunle & Ogunsola(2021)suggested that diminishing tree density and species diversity are decreasing a better functional ecosystem and destroying the effects of unviable anthropological activities on forest trees and forest resources which often lead to a drastic reduction. The nature of forest

communities, like Farin-ruwa Forest reserve Darazo, largely depends on the ecological characteristics of sites, species diversity, and regeneration status of tree species(Shuaibu &Ogunsola, 2018). The United Nation Environmental Programme (UNEP, 2010)& International Union of Conservation of Nature (IUCN, 2010), specify the variety and variability of life on earth, known as biodiversity as a measure of the variation at the genetic, species and ecosystem level. The Collins Dictionary (2014) defines sanctuary as a Nature reserve.

Shiferaw, Lemenih, &Gole (2018) reiterated that species diversity in any forest environment is often influenced by the genetic diversity of certain tree species. Therefore when the genetic diversity of major flora species is endangered or wiped out, other species exclusively associated with certain plant species may soon be rare too, making the whole forest environment to be biologically depleted. Mohammed (2021), Hegazy, Hosni, Lovett-Doust, Kabiel, Badawy, &Nwavu, (2020)&Hegazy, Hosni, El-Sheikh, Lovett-Doust, Badawi & Kabiel, 2020)&Ogwu, Osawaru and Obayuwana (2016) suggested that most tree diversity, abundance, species composition, indigenous knowledge of tree flora and conservation have been upset by human activities.

Wiafe (2016) recounted over the decades, that Africa landmass which supports a variety of flora and fauna is on a steady decline. Ogwu, Osawaru &Obayuwana (2016) recalled that its sustainable development allows humans and biodiversity to coexist side by side. Furthermore the African population rate has tremendously increased, thus leading to the rapid demand for infrastructural development. In the same vein, the alarming rate of forest depletion in Nigeria probably may have been aggravated by the surging population which ardently seeks for a massive infrastructural development and fragmental community forestlands. Asifat, Oyelowo and Orimoogunje (2019) noted with keen interest that the forest has been a continuous source of wood, charcoal, and land for agricultural purposes which have led to present depletion. Although Nigeria is exceptionally endowed with rich biological resources (FGN: 5th National Biodiversity Report, CBD, 2015; Mbaya and Hashidu, 2017) among which include the wildlife, vegetation, water bodies and mountains. The rural dwellers also depend on its biological resource for food, fiber, medicine and partly on energy (Mato, 2018). There is a strong indication that human activities have obstructed tree diversity, abundance, species composition, indigenous knowledge of tree flora and conservation

(Ogwu, Osawaru &Obayuwana, 2016; Ndubusi, 2021; Anwadike, 2020; Olonisakin, 2021; Akinyemi, Akinyemi, Oloketuyi, Oyelowo, &Adeoye, 2020; Eisawi, He, Shaheen &Yasin, 2021; &Salami, Shuaibu, Adekunle, &Ogunsola, 2021) and the outlook is worrisome (Forestry outlook studies in Africa (FOSA 2020; FRAKey findings 2020; FRA 2020; Ladan, 2015 &Mbaya, &Hashidu, 2017).Furthermore, Adeyemi, Ibe and Okedimma (2015) agreed that there has been poor documentation about Nigeria's rich biodiversity that is highly influenced by it senormous anthropogenic forces and the floral diversity.

Furthermore, Ahmed (2014), USAID/Nigeria (2008)& USAID/NIGERIA (January 2020) reported that Nigeria is faced with poor policy enforcement and high poverty rate in most rural and urban areas of Nigeria. Mantau (2014) and Ahmed (2014) both agreed that the drawbacks are usually being caused by incorrect and insufficient data on the position of biodiversity, excessive poaching activities and the increasing demand of land for the purpose of agriculture, grazing, logging for timber and fuel wood, etc.

Invariably, the statistics on the status of Farin-ruwa Forest Reserve (FFR)Darazo Local Area of Bauchi State, Nigeria look as if non-existent. Based on these recent developments, the aim and objectives of this study is to access the density, composition and diversity of flora species in FFR Darazo, Bauchi State as a biodiversity sanctuary. Hence, the dearth of sufficient scientific data on the already threatened ecosystem (Farin-ruwa Forest Reserve) since its establishment (pers.com) have made the State Government and other stakeholders not come to terms as regards the composition of the FFR, and thus attaching conservation priorities on the hidden resources for posterity (Generation yet unborn), hence the need for this study. In this work the researcher adopted the Point Centred Quarter (PCQ) method to sample the flora species. With aid of the Microsoft Excel 2010 for data management and data control, the data obtained from flora species sampled were analysed using the tree survey calculations, the Simpson's Index of Diversity and the Shannon (H) Diversity.

Methods

The study area is Farin-ruwa Forest Reserve, located in Darazo Local Government Area LGA of Bauchi State, Nigeria (See Figure 1 and 2). It is situated between latitudes 10 ^{0} 59' 43.54" N and 11^{0} 02' 87.6" N and

longitudes 10^0 15' 46.6" E and 10^{0}26' 29.5" E. It covers an area of 300.129 km^2. The reserve was gazetted in 1953 by Bauchi Native Authority Forest Reserve (Bauchi State Ministry of Environment & Forestry, 2014; (Bauchi State Ministry of Lands & Survey, May 2023).

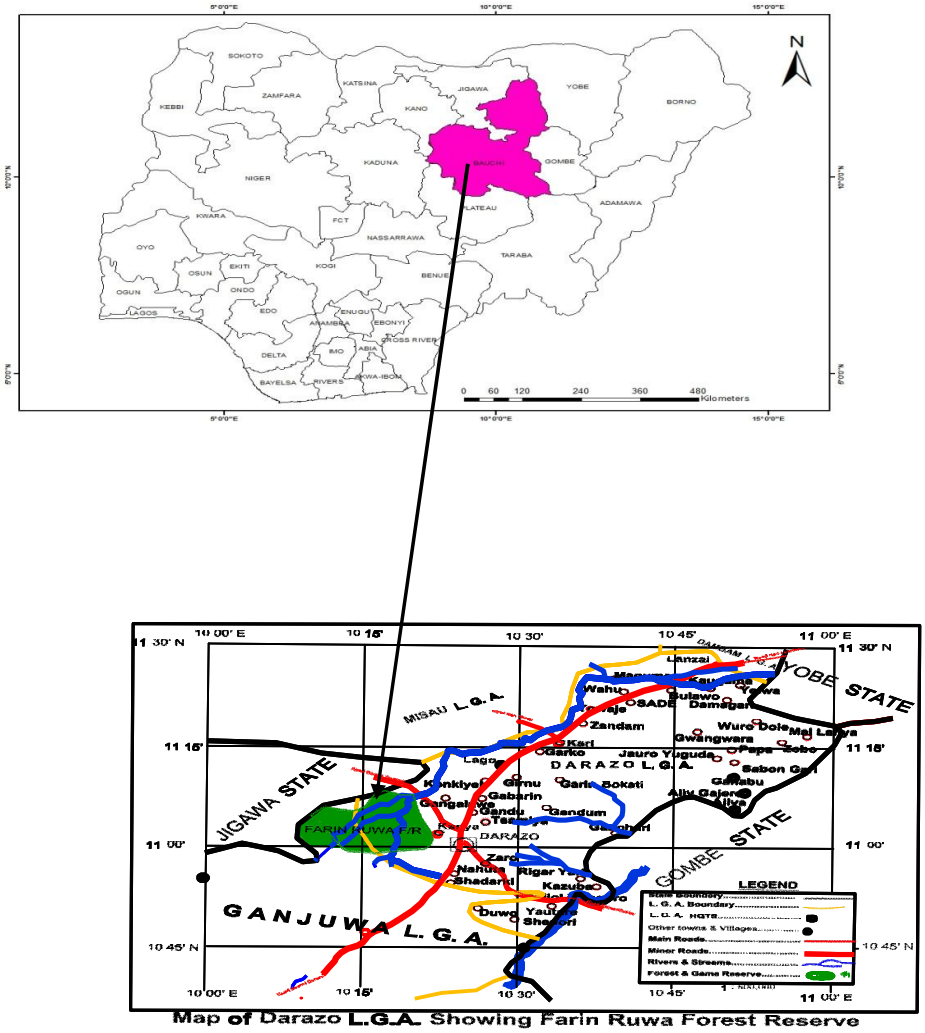

Figure 1: Map of the Study area

Source: Bauchi State Ministry of Lands and Survey (2023)

In the survey of flora species, three plots (1-3) of 1 hectare (ha) each (100 x 100 m each) were sampled. Two transects were sampled from each plot, giving a total of 6 transects (1-6). Transects 1 and 3-6 were 50 x 50 m (0.25 ha) each and transect 2 was 50 x 25 m (0.125 ha). Hence total size of transect sampled was 1.375 ha. The bearings taken during the field work were: Transect 1 was situated between 10^{0}990' 35" N and 10^{0}325' 03"

E, Transect 2 was between 10°991' 79" N and 010°324' 99" E, Transect 3 was between 10°989' 88" N and 010°312' 23" W, Transect 4 was between 10°989' 88" N and 010°319' 84" E, Transect 5 was between 10°992' 11" N and 010°336' 08" E and Transect 6 was between 10°990' 53" N and 010°335' 23" E.

Materials

The materials used for the field work include the Biodiversity Assessment kits of Flora Species but not limited to ranging pole, topographic maps of the study area, 100m tape, tree tape (for tagging), Global positioning system (GPS), line (e.g. twine rope), sampling frames, prismatic compass, recording materials and diameter tape

Figure 2: Google Map of Farin-ruwa Forest Reserve
Source: Bauchi State Ministry of Lands and Survey

Sampling technique

The sampling techniques used for the flora species was the Point Centred Quarter (PCQ). The P.C.Q. method was chosen because of its' rapidly, simplicity and its relative accuracy for sampling trees and shrubs (Jove, 2019 and Matau, 2014).

Data Source

Data collection

In the flora survey, each sampling point was considered and the centre of four quarter (quadrants) with orientation was given by the compass transverse lines. Cluster random sampling was used to elicit information on flora resources of the reserve using Point Centred quarter (P.C.Q.) (Baxter, spring 2014).

Data Analysis

The data analysis used for flora species were the tree survey calculations for the flora species using PCQ and Simpson's Index of diversity and Shannon(H) Diversity Index (Cottam and Curtis. 1956, JOVE, 2019 and Matau, 2014) as expressed in equations 1-12 below:

i. The average density (the number of trees/hectare) for trees was calculated using:

$$Average\ Density = \frac{10{,}000m^2/_{hectare}}{(Average\ point-to-tree\ distance\ in\ m)^2/_{tree}} \quad \textbf{(1)}$$

ii. The density *by species* for the trees was determined by counting the number of individuals in the sample for each species and record**.**

The total number of individuals counted was recorded using:

$$\text{Relative } Density = \frac{(\text{number of individuals of a species}}{\text{The total number of individuals counted)}} * 100 \quad \textbf{(2)}$$

iii. The basal area of the species was determined and recorded in **tabular form:**

a. The diameter measured for all trees sampled was converted using:

$$\text{Area, a} = \pi\ r^2 \quad \textbf{(3)}$$

b. The mean basal area for each species was calculated by taking the average.

c. For each species, the Basal Area (BA) and Relative Basal Area (RBA) was calculated using:

$$\text{Basal Area} = \pi * r^2 = \pi * \left(\frac{\text{DBH}}{2}\right)^2 = 3.142 * r^2 \quad \textbf{(4)}$$

Where DBH is diameter at breast height in centimeters

r is the radius

$$\text{Relative Basal Area} = \frac{\text{Basal Area}}{\text{Total Basal Area}} \text{ x } 100 \quad \textbf{(5)}$$

The Total Basal Area is the total sum of basal areas for all species (i.e. sum of all BAs). The tree basal area is the cross sectional area of a tree at breast height

iv. The frequency was determined and recorded by species.

$$\text{Frequency} = \frac{\text{no. of points at which species occurs}}{\text{total no.of points sampled}} \quad \textbf{(6)}$$

$$\text{Relative Frequency} = \frac{\text{Frequency}}{\text{Total Frequency for all species}} * 100 \quad \textbf{(7)}$$

v. The Importance Value (IV) and Relative Importance Value (RIV) of species was calculated and recorded using:

$$\text{IV} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Basal Area} \quad \textbf{(8a)}$$

$$\text{Importance Value} = \text{RD} + \text{RF} + \text{RB} \quad \textbf{(8b)}$$

And

$$\text{Relative Importance Value} = \frac{\text{Importance Value}}{\text{Total Important Value for all species}} * 100 \quad \textbf{(9)}$$

vi. Analysis on the diversity index using Simpson's Index of diversity and Shannon (H) Diversity Index for flora species

vii.

The Simpson's index of diversity of the flora species in Farin-ruwa Forest Reserve was calculated using (Simpson, 1948):

$$D = \frac{\in n\ (n-i)}{\text{N}\ (\text{N}-1)} \quad \textbf{(10a)}$$

Where

n = the no. of individual species (spp.)

N =Total no. of all spp.

$\sum$ = summation of

D = Diversity

With the index, 0 represents infinity diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity. This is neither intuitive nor logical, so to get over this problem, D is often subtracted from 1 to give:

Simpson's Index of Diversity = 1- D ..... **(10b)**

Shannon (H) Diversity Index of the flora species in Farin-ruwa Forest Reserve

The Shannon (H) Diversity Index value was calculated using the Shannon-Weiner Index (Shannon, 1948):

$$H = -\sum \text{Pi} * ln\text{Pi} \quad \textbf{(11)}$$

$$\text{H} = \sum \text{Pi} * / ln\ P_i / \quad \textbf{(12)}$$

Where

H= The Shannon's Diversity Index value

Pi = the ratio of the number of individual flora spp. to the total no. of flora spp.

ln = Natural Logarithms

$\sum$ = summation of

$/\ /$ = Absolute value

The management and control of the data obtained from the tree survey analysis and diversity index values were done with the aid of the Microsoft Excel 2010

RESULT AND DISCUSSION

Table 1 shows the stand density of flora species of FFR. *Combretum glutinosum* have the highest stand densities with a value of 14.55$\frac{Tree}{ha}$, *Anogeissus leiocarpus* have stand densities with 8.73, and *Acacia sieberana*(7.27). Other species in the FFR have a stand density ranging from 0.73 – 6.55. From the result obtained, one can appreciate that the FFR is sparsely stocked with trees per hectare indicating that it's being subjected to human or animal perturbation and or suffered severe climatic stress. Elledge and Barlow (2018) described basal area as a measure of total wood content of a tree (Biomass).From the records of the total basal area, it is an indicative that the FFR has suffered severe human perturbation(See plate 1, 2 & 3).The low basal area of 8.3m^2 indicated that the vegetation is at regenerating stage. The result further indicated that *Combretum glutinosum, Anogeissus leiocarpus* and *Acacia sieberana*are the most successful species persevering the human and animal stressors' factors or resilient to climatic stress. It has also indicated the generative tendencies of the species recovery from human and animal perturbation. Success of other species in the reserve like Acacia species, *Balanites aegyptiaca,* and *Mitragyna inermis* and *Diosypros mespiliformis* may not be unconnected to the aridity nature of the reserve as it is located in the extreme Sudan savanna zone of the state.

The findings of Zankan, Endas, Abubakar, and Yakubu (2019) which was in line with that of FFR Darazo, shows that Combretaceae and Fabaceae families were the usual plants with stand density and diversity of species in Jema'a Local Government Area of Kaduna State, Nigeria. And that such plant species have the capacity to withstand harsh climatic conditions such as drought, flood, and desertification. Zankan*et al.,* (2019) also agreed that the differences in the stand densities of these species could be inability of the species to withstand the inconsistent weather and climate conditions of the ecological zones or the level of exploitation of the woody species for wood fuel, timber, and farming, or overgrazing.
The low basal area of 8.33m^2 revealed that the plants are at rejuvenating stage.

Table 1: DBH, Density, Stand density, Total Basal Areas, RIV and RD of Flora Species Sampled in FFR

S/N	Tree species	DBH (m)	Density (Tree per plot)	Stand Density (Tree per ha)	Total Basal Area (m^2)	Relative Importance Value	Relative Dominance
1	*Combretumglutinosum*	1.48	20	14.55	1.72	16.51	20.64
2	*Feretiaapodanthera*	0.46	9	6.55	0.16	6.45	1.98
3	*Combretumhypopilinum*	0.46	6	4.36	0.17	4.76	2.03
4	*Combretummolle*	0.06	2	1.45	0.00	2.04	0.03
5	*Acacia ataxancantha*	0.30	4	2.91	0.07	3.67	0.84
6	*Casias ingueana*	0.18	5	3.64	0.02	3.83	0.29
7	*Ziziphusmauritiana*	0.01	1	0.73	0.00	1.01	0.00
8	*Combretumnigricans*	0.02	1	0.73	0.00	1.02	0.00
9	*Acacia hebeclodoides*	0.39	5	3.64	0.12	4.87	1.40
10	*Anogeissusleiocarpus*	2.33	12	8.73	4.25	24.54	51.00
11	*Balanitesaegyptiaca*	0.63	4	2.91	0.31	3.97	3.74
12	*Acacia sieberana*	1.04	10	7.27	0.86	8.90	10.27
13	*Mitragyna inermis*	0.41	3	2.18	0.13	2.90	1.56
14	*Pilostigmareticulatum*	0.12	1	0.73	0.01	1.73	0.15
15	*Danielliaoliveri*	0.47	1	0.73	0.17	1.71	2.09
16	*Setariasphacelata*	0.03	1	0.73	0.00	1.02	0.01
17	*Casiaarereh*	0.18	2	1.45	0.03	2.13	0.31
18	*Diosypros mespiliformis*	0.40	3	2.18	0.13	2.89	1.54
19	*Tamanrindus indica*	0.24	1	0.73	0.04	1.19	0.52
20	*Entada Africana*	0.10	2	1.45	0.01	1.39	0.09
21	*Acacia polyacantha*	0.25	2	1.45	0.05	2.08	0.59
22	*Ficusvo geliana*	0.31	1	0.73	0.08	1.32	0.92
	Total		**96**	**69.83**	**8.33**	**100.00**	**100.00**

Source: Field Survey, 2021

Note: The total area of transects was 1.375 hectares (ha).

Thus require good management from human perturbation. This is also in line with the works of Elledge and Barlow (2018) who reported that basal area is often the basis for making important forest management decisions such as estimating forest regeneration needs and wildlife habitat requirements.

Plate1: Household small ruminant human in the grazing Reserve

Plate2: Logging of trees by Perturbation at FFR

Plate 3: Poisonous cassava root been harvested at FFR Darazo

Composition of tree species sampled in FFR

Tables 2 is the flora composition showing the tree species distributed under families and genera in FFR Darazo. The result indicated that 96 individual trees were sampled. Combretaceae have five (5) different species comprising *Combretumglutinosum, Combretum hypopilinum, Combretum molle, Combretum nigricans* and *Anogeissusleiocarpus.* The second largest family Fabaceae has ten (10) species comprising *Acacia ataxancantha, Acacia hebeclodoide*s, *Acacia sieberana, Acacia polyacantha, Casias ingueana, Casia arereh, Pilostigma reticulatum, Daniellia oliveri, Tamanrindus indica* and *Entada Africana*. Rhamnaceae, Balanitaceae, Poaceae, Ebenaceae and Moraceae have single species each respectively. However, the occurrence of the highest number of Combretaceae family member and Fabaceae in the FFR has justified its likelihood of habouring good forage materials for wild animals in the reserve. This is in line with the works of Gulbanu (2021) which reported

that Fabaceae are good species of forage materials for wildlife. In addition the preponderance of three families with substantial number of individual species has indicated the diverse nature of the forest reserve in terms of species composition.

Table 2: Floristic Composition showing the Tree Species Distributed under Families and Genera in FFR

S/N	No of Species	Tree Species	Family	Genus
	20	*Combretumglutinosum*		
	6	*Combretum hypopilinum*		Combretum
1	2	*Combretum molle*	Combretaceae	
	1	*Combretum nigricans*		
	12	*Anogeis susleiocarpus*		Anogeissus
2	9	*Feretia apodanthera*	Rubiaceae	
	3	*Mitragyna inermis*		Feretia Mitragyna
3	1	*Ziziphus mauritiana*	Rhamnaceae	Ziziphus
	4	*Acacia ataxancantha*		Acacia
	5	*Acacia hebeclodoides*		
	10	*Acacia sieberana*		
	2	*Acacia polyacantha*		
	5	*Casiasingueana*	Fabaceae	Casia
4	2	*Casia arereh*		
	1	*Pilostigma reticulatum*		Pilostigma
	1	*Daniellia oliveri*		Daniellia
	1	*Tamanrindus indica*		Tamanrindus
	2	*Entada Africana*		Entada
5	4	*Balanites aegyptiaca*	Balanitaceae	Balanites
6	1	*Setarias phacelata*	Poaceae	Setaria
7	3	*Diosypros mespiliformis*	Ebenaceae	Diosypros
8	1	*Ficus vogeliana*	Moraceae	Ficus
Total	96	22	8	15

Source: Field Survey, 2021

Hence, it is likely the FFR if protected can be recovered and attain to its climax in terms of species richness.

Simpson index of diversity of flora species sampled in FFR

The Species diversity value using Simpson Index of diversity of flora species in FFR is presented According to Simpson's diversity

interpretation, diversity values ranges between 0- 1. Diversity of 1 indicates no diversity while 0 indicates higher species diversity. From the FFR result presented above, it can be concluded that FFR have lower species diversity. For the fact that some spp. Simpson 1- D value showed 0.96 value is still higher, indicating no diversity in the FFR. This is in line with the works of Hayatu and Abba (2021) who reported that very low diversity values are probably due to the level of deforestation going on inthestudyarea,indicatingalessstable,lesscomplexandunhealthycommunity. It could also be due to the position of study area which is not well protected.

Table 3: Simpson Index of Diversity Value of Flora Species Sampled in FFR

S/N	Tree species	No of species (n)	Total No of species (N)	$n(n-1)$	$N(N-1)$	$D = \frac{n(n-1)}{N(N-1)}$	$1-D$
1	*Combretum glutinosum*	20	**96**	**380**	**9120**	0.0417	0.96
2	*Feretia apodanthera*	9	**96**	**72**	**9120**	0.0079	0.99
3	*Combretum hypopilinum*	6	**96**	**30**	**9120**	0.0033	1.00
4	*Combretum molle*	2	**96**	**2**	**9120**	0.0002	1.00
5	*Acacia ataxancantha*	4	**96**	**12**	**9120**	0.0013	1.00
6	*Casias ingueana*	5	**96**	**20**	**9120**	0.0022	1.00
7	*Ziziphus mauritiana*	1	**96**	**0**	**9120**	0.0000	1.00
8	*Combretum nigricans*	1	**96**	**0**	**9120**	0.0000	1.00
9	*Acacia hebeclodoides*	5	**96**	**20**	**9120**	0.0022	1.00
10	*Anogeis susleiocarpus*	12	**96**	**132**	**9120**	0.0145	0.99
11	*Balanitesaegyptiaca*	4	**96**	**12**	**9120**	0.0013	1.00
12	*Acacia sieberana*	10	**96**	**90**	**9120**	0.0099	0.99
13	*Mitragyna inermis*	3	**96**	**6**	**9120**	0.0007	1.00
14	*Pilostigma reticulatum*	1	**96**	**0**	**9120**	0.0000	1.00
15	*Daniellia oliveri*	1	**96**	**0**	**9120**	0.0000	1.00
16	*Setaria sphacelata*	1	**96**	**0**	**9120**	0.0000	1.00
17	*Casia arereh*	2	**96**	**2**	**9120**	0.0002	1.00
18	*Diosypros mespiliformis*	3	**96**	**6**	**9120**	0.0007	1.00
19	*Tamanrindus indica*	1	**96**	**0**	**9120**	0.0000	1.00
20	*Entada Africana*	2	**96**	**2**	**9120**	0.0002	1.00
21	*Acacia polyacantha*	2	**96**	**2**	**9120**	0.0002	1.00
22	*Ficus vogeliana*	1	**96**	**0**	**9120**	0.0000	1.00
Total		**96**					

Source: Field work, 2021

Shannon (H) diversity index of the flora species in FFR

The Species diversity value using Shannon (H) Index of flora spp. in FFR is presented in Table 4. The result showed that *Ziziphus mauritiana, Combretum nigricans, Pilostigma reticulatum, Daniellia oliveri, Setarias phacelata, Tamanrindus indica,* and *Ficus vogeliana* all have Shannon (H) diversity of 0.05. While, *Combretum molle, Cassia arereh*, *Entada africana* and *Acacia polyacantha* has Shannon (H) diversity of 0.08. *Mitragyna inermis* and *Diosypros mespiliformis* both have DVI of 0.11. *Acacia ataxancantha* and *Balanites aegyptiaca* have Shannon (H) diversity of 0.13 respectively. *Casias ingueana* and *Acacia hebeclodoides* have Shannon (H) diversity of DVI of 0.15 respectively. Others like *Combretum hypopilinum* have 0.17*, Feretia apodanthera* 0.22, *Acacia sieberana 0.24, Anogeis susleiocarpus* 0.26 and *Combretumglutinosum* 0.33**.**

Similarly, according to Shannon (H) interpretation, diversity values ranges from 1- 0. A diversity of 0 indicates no diversity. As the value of H increases to 1, it indicates higher diversity. Therefore, the Shannon (H) computed in FFR shows no diversity, because all the computed values are less than one (1). The lower diversity value recorded in Simpson 1- D and Shannon (H) are clearly justifiable indices to draw inference that Farin-Ruwa Reserve does not have the potential of being a biodiversity hotspot (sanctuary). This may be as a result of high human activities in the reserve.

Table 4: Shannon (H) Diversity Index of Flora Species Sampled in FFR

S/N	Tree species	**No of species**	P_i	$/ln\ P_i/$	$H = P_i * / \ln P_i /$
1	*Combretumglutinosum*	20	**0.21**	**1.57**	**0.33**
2	*Feretiaapodanthera*	9	**0.09**	**2.37**	**0.22**
3	*Combretum hypopilinum*	6	**0.06**	**2.77**	**0.17**
4	*Combretum molle*	2	**0.02**	**3.87**	**0.08**
5	*Acacia ataxancantha*	4	**0.04**	**3.18**	**0.13**
6	*Casias ingueana*	5	**0.05**	**2.95**	**0.15**
7	*Ziziphus mauritiana*	1	**0.01**	**4.56**	**0.05**
8	*Combretum nigricans*	1	**0.01**	**4.56**	**0.05**
9	*Acacia hebeclodoides*	5	**0.05**	**2.95**	**0.15**
10	*Anoge issusleiocarpus*	12	**0.13**	**2.08**	**0.26**
11	*Balanites aegyptiaca*	4	**0.04**	**3.18**	**0.13**
12	*Acacia sieberana*	10	**0.10**	**2.26**	**0.24**
13	*Mitragyna inermis*	3	**0.03**	**3.47**	**0.11**
14	*Pilostigma reticulatum*	1	**0.01**	**4.56**	**0.05**
15	*Daniellia oliveri*	1	**0.01**	**4.56**	**0.05**
16	*Setaria sphacelata*	1	**0.01**	**4.56**	**0.05**
17	*Casia arereh*	2	**0.02**	**3.87**	**0.08**
18	*Diosypros mespiliformis*	3	**0.03**	**3.47**	**0.11**
19	*Tamanrindus indica*	1	**0.01**	**4.56**	**0.05**
20	*Entada Africana*	2	**0.02**	**3.87**	**0.08**
21	*Acacia polyacantha*	2	**0.02**	**3.87**	**0.08**
22	*Ficus vogeliana*	1	**0.01**	**4.56**	**0.05**
Total		96	**1.00**		**2.66**

Source: Field work, 2021

This finding is in line with the works of Asifat, Oyelowo and Orimoogunje (2019) who reported that lower Shannon Wiener Index implies that human interference such as livestock grazing, farming and selective logging were practiced.

However the preponderance of fewer species with great potential (higher Simpson 1- D values) and regenerative tendencies of the flora spp. in the reserve have indicated that the reserve is in a recovery stage. Therefore the reserve in future with improved management practices and protection stands a chance of becoming a good biodiversity sanctuary.

CONCLUSION

The low values of the stand density of the flora species of the FFR illustrates that the reserve has been overexploited and the trees are at their recovery stage. The FFR have lower flora species diversity and the Shannon (H) computed shows no diversity, due to human perturbation. These have a great negative impact on the environment, which in turn affect the existence of plants and animals and also the non-abiotic factors

of the study area (ecosystem).The floristic composition indicated that Combretaceae and Fabaceae family have the highest occurrence most likely because of their ability to withstand harsh climatic condition of FFR (study area), and have justified its likelihood of habouring good forage materials for wild animals in the reserve.

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External links

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