



Comparative Study of Phytosociological Status of Herbs and Shrubs in Nanta Forest Region, Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The objective of this study was to compare the community structure and phytosociological status of shrubs and herbs in two different vegetation stands. The study was carried out in the Nanta forest region which is situated between 25.21525° N and 75.8311° E and comes under the Sakatpura forest range, Ladpura tehsil, Kota District, Rajasthan, India. A random sampling of the flora of the protected vegetation stand (control) and non-protected vegetation stand (experimental sites) was done using quadrates of 100sqm for shrubs and 1sqm for herbs and the data was quantitatively analyzed. In the shrub and herbs layer plant species that have the highest IVI in protected sites are reported absent from non-protected sites. In the present study area, it has been observed that the stem density, basal area, and species richness are lower in non-protected vegetation stands than in protected vegetation sites. In protected and non-protected vegetation, the family Fabaceae

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dominates the vegetation in terms of IVI. In the shrub layer share of fabaceous species increased whereas in the ground layer, it decreased. Family Fabaceae have the highest species richness; 19 and 27 species in shrub and herb layers respectively in protected vegetation whereas in non-protected vegetation; 4 species each of Asteraceae and Poaceae. The Dominance-diversity curve of shrub+saplings as well as herbs+ seedlings in protected vegetation show a gradual decrease in abundance whereas non-protected vegetation exhibits a sharp decline in IVI values, indicating a natural tendency for a small number of dominating species with high relative values. Overall floral diversity is reduced and dominance increased. It can be concluded that disturbances can cause changes in species composition or sometimes total replacement of plant species. Disturbances can affect the overall phytosociological characteristics of vegetation.

Keywords: Nanta; dominance; disturbance; IVI.

1. INTRODUCTION

Forests are essential for human life because they provide a wide variety of resources and ecosystem services. However, forest cover is rapidly depleting due to a variety of factors, including increased agriculture practices, timber plantation, urbanization, road construction, and expansion of industries, which pose the most serious threat to the forest and cause severe harm to the environment [1]. Habitat loss and fragmentation are the most important causes of biodiversity destruction. Biomass extraction by grazing, fuelwood collection, and non-timber forest product (NTFP) extraction may be the most prevalent strain on forests in developing nations. Tropical dry forest, despite accounting for a major share of the rural population's biomass demands, is particularly understudied in India.

India, with its 2.4% land area, is a megadiverse country contributing 7 to 8% of all recorded species, including 45000 plant species in the world [2]. National Forest Commission of India reported that as many as one-third of all endemic species face the threat of extinction [3]. In the present scenario, the extinction rates of biodiversity are 100 to 1000 times their pre-human level, those species that are assigned as threatened species will be extinct in the next century because the future rate of extinction will be 10 times higher than current rates. The rate of eradication of endemic species is higher due to precise knowledge of regions that are particularly rich in biodiversity [4]. Approximately 500,000 species are spread over the world of which 100,000-160,000 are still unexplored or may be threatened [5]. According to the IUCN Red Data book, more than 42,100 species are under threat and facing a high risk of extinction, resulting both directly and indirectly from human deeds. Unregulated grazing, shifting cultivation, land

diversion for developmental and infrastructure projects, and unsuitable use of forest resources are the major causes of vegetation degradation. In the Kota district of Rajasthan, there is a total of 546.73 sq km (10.48% of total GA) area covered under forest cover which is 3.27 sq km less than the 2017 assessment [6].

Conservation of forests serves to protect and preserve biodiversity, prevent the extinction of endangered species, and maintain ecological balance. Forest conservation aims to know the composition of tree species and age distribution in order to plan restoration accordingly. The composition of plant community and distribution of plant species in the region is the reflection of environmental gradients. Hence, assessment of forest composition and community structure is a very necessary tool for management and conservation planning [7]. The floristic inventory, species diversity, and vegetational structure are important for the assessment of natural forests in a particular region and to recommend conservation planning [8].

Community structure, composition and function are three important characteristic features of forest ecosystems that are changing in response to topography, disturbances, succession, climatic, and edaphic factors [9]. The extent of changes in forest cover is studied through phytosociological characteristics, usually by density and basal cover, which are the important bases of study for different vegetation types [10]. Vegetation analysis provides detailed information about the turnover rate of species, community organization, and niche resource distribution patterns in a forest [11]. Phytosociological studies are required for conservation planning and long-term utilization [12]. The current study offers a detailed comparative analysis of community structure and phytosociological status

of the Nanta forest region, Kota district, Rajasthan.

1.1 Study Area

The study was carried out in the Nanta forest region which is located in the Sakatpura forest range in forest division Kota. Nanta is situated between 25.21525°N and 75.8311° E and lies under Ladpura Tehsil of Kota district (Rajasthan). Nanta also has its historical significance as the famous “Abheda Mahal” and “Karni Mata” temple lies in its boundaries. Recently the Abheda Biological Park has been developed here for the protection of wildlife. Data was collected from the Nanta forest region from March 2020 to April 2022, and two stands were taken into account; one is a protected vegetation stand (control site) and the other is a non-protected vegetation stand (experimental site).

In the study area it was recorded that in non-protected areas, there are disturbances in the

form of grazing, collection of forest resources (leaves, fuel wood, gum, etc.), and movement of vehicles. In protected areas also there is some form of disturbance but it is negligible.

2. MATERIALS AND METHODS

2.1. Vegetation sampling: To determine the flora of the protected vegetation stand (control site) and non-protected stand (experimental site) random sampling was done using quadrates of different sizes for shrubs, and herbaceous plants. The standard size of the quadrates for sampling shrubs, woody climbers + saplings, and herbs + seedlings taken are 10x10m (100sqm), and 1x1m (1sqm) respectively. In each quadrat, individuals within the girth range of 10.5 to 30.0 cm at the ground level were considered as shrubs, woody climbers +saplings, and individuals < 10.5 cm girth at ground level were considered as herbs+seedlings. A total of 90 quadrates for shrubs and 300 quadrates for herbs are laid in each of the sampling sites.

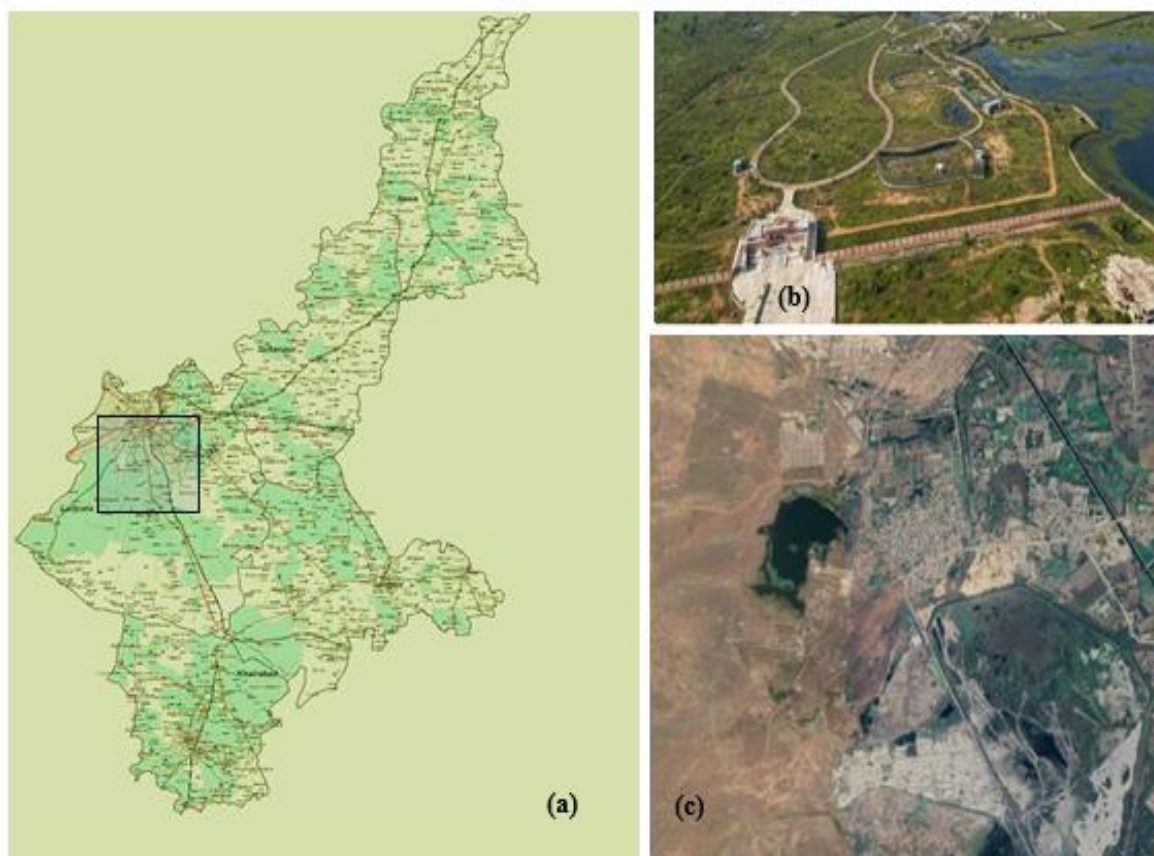


Fig. 1. (a) Map of Kota District showing study area (in box). (b) protected vegetation stand (drone view). (c) Satellite view of the study area

2.2 Phyto-sociological analysis of vegetation:

The vegetation data were quantitatively analyzed for frequency, density, basal area, and IVI (Importance Value Index) following Mueller-Dombois and Ellenberg [13] and Magurran [14]. Basal areas of the shrubs were expressed as m²/ha and herbs were expressed as cm²/m². Further dominance-diversity curve was prepared for each vegetation layer separately by plotting species IVI against the species sequence [15]. Total density/ha for shrub, density/sqm for herb, basal area/ha for shrub, basal area/sqm for herb and species richness of shrub and herb were also tabulated.

$$\text{Basal area} = \pi r^2 \quad \text{where, } \pi = 3.14$$

$$\text{D(density)} = \frac{\text{number of aboveground stems of species counted}}{\text{Sample area (ha)}}$$

$$\text{RD(relative density)} = \frac{\text{Density of species A}}{\text{Total density of all species}} \times 100$$

$$\text{F(frequency)} = \frac{\text{The number of plots where that species occur}}{\text{Total number of plots}} \times 100$$

$$\text{RF (relative frequency)} = \frac{\text{frequency of species A}}{\text{Total frequency of all species}} \times 100$$

$$\text{Dominance} = \frac{\text{Basal area of a species A}}{\text{Area sampled(m}^2\text{)}}$$

$$\text{RDo (Relative Dominance)} = \frac{\text{Dominance of species A}}{\text{Total dominance of all species}} \times 100$$

$$\text{IVI} = \text{Relative density} + \text{Relative frequency} + \text{Relative Dominance}$$

3. RESULTS

In the protected vegetation sites, the total density of shrubs and herbs were recorded as 259.33 ind./ha and 86.61 ind./m² respectively, whereas in the non-protected site, the density of the shrub and herbs were 141.33 ind./ha and 12.88 ind./m² respectively. The total basal area calculated for shrub and herbs in the control site were 1.924 m²/ha and 73.441 cm²/m², whereas in the non-protected site, the total basal area calculated for shrub and herbs were 1.420 m²/ha and

10.357cm²/m² respectively. Species richness of shrub species reduced from 45 in protected vegetation to 12 in non-protected vegetation, whereas in herbaceous layer species richness reduced from 163 to 28 (Table 1).

In the shrub layer of the control site, *Mitragyna parviflora*. (Roxb.) Korth has the highest IVI (21.05) followed by *Anogeissus pendula* Edgew. (20.39) and *Hyptis suaveolens* (L.) Poit. (19.48) thus dominant in this area whereas in the experimental site, *Ziziphus nummularia* (Burm.f.) Wight & Walk. -Arn. is dominant having the highest IVI (66.28) followed by *Prosopis juliflora* (Swartz) DC. (60.99) and *Acacia leucophloea* (Roxb.) Willd. (40.26) (Table 2).

In the herbaceous ground cover grass species *Apluda mutica* L (IVI 18.70), and *Themeda quadrivalvis* (L.) Kuntze (IVI 9.19) are dominant in protected vegetation whereas in non-protected vegetation *Cynodon dactylon* (L.) Pers. (IVI 22.60), *Eragrostis pilosa* (L.) P. Beauv. (IVI 22.18) and *Chloris virgatus* SW. (IVI 18.88) are dominant (Table 3).

In protected vegetation only 9 shrub species account for >50% of the IVI and 36 shrub species contribute to <50% of IVI. 19 shrub species of the family Fabaceae account for 1/3rd of the IVI in protected vegetation. In non-protected vegetation, only 12 shrub species contribute to the total IVI whereas out of 12 species, fabaceous shrubs share the largest part of IVI (142.23). 12 shrub species that are common to both sites share almost 1/3rd IVI (112.92) in protected vegetation.

In protected vegetation, 15 herbaceous species having higher IVI account for >1/3rd of the IVI (108.97), whereas in non-protected vegetation only 5 herbaceous species (4 Poaceae & 1 Euphorbiaceae) account for nearly 1/3rd of the IVI. In protected vegetation, 19 herbaceous plants of the family Poaceae account for > 1/3rd of total IVI (106.23) whereas the family Fabaceae which has the largest number of plant species (27) accounts for a total IVI of only 27.83.

In the shrub layer, *Mitragyna parviflora*. (Roxb.) Korth., *Anogeissus pendula* Edgew, and *Hyptis suaveolens* (L.) Poit. which have the highest IVI in protected vegetation were reported absent from non-protected sites. In the herbaceous ground cover grass *Apluda mutica* L. and *Themeda quadrivalvis* (L.) Kuntze have the highest value of IVI and was absent from non-protected vegetation sites.

In terms of density, *Hyptis suaveolens* (L.) Poit. (23.33 ind/ha) has the highest density followed by *Ziziphus nummularia* (Burm.f.) Wight & Arn. (16.67ind/ha) and *Balanites aegyptiaca* (L.) Delile (16.33ind/ha). In terms of basal area *Anogeissus pendula* Edgew. (0.226 m²/ha) top the list followed by *Azadirachta indica* A. Juss (0.201 m²/ha) and *Mitragyna parviflora*. (Roxb.) Korth. (0.196 m²/ha). In non-protected areas *Cynodon dactylon* (L.) Pers. has the highest density and basal area followed by *Eragrostis pilosa* (L.) P. Beauv. (density 1.01 and 1.00; basal area 0.82 and 0.79 respectively) (Table 3).

The Dominance-diversity curve of shrubs and saplings, in non-protected vegetation sites exhibits a sharp decline in the corresponding IVI values, whereas shrub & herb species in protected vegetation are showing gradual decrease in abundance. Steep fall in dominance-diversity curve signify very few species with high values in relative terms (Fig. 2 & 3). In non-protected stand only, few species have maximum IVI indicating that only few species are abundant (Figure 2 & 3). Most of the herbaceous species in the ground cover have lower IVI values indicating few dominant species.

4. DISCUSSION

In the present study area, it has been observed that the stem density and basal area are lower in non-protected vegetation stands than in protected vegetation sites. Many researchers have reported that such results are due to various human disturbances in non-protected vegetation sites [16,17]. In the shrub layer of the control site, the basal area of saplings of

Anogeissus pendula Edgew is higher than *Hyptis suaveolens* (L.) Poit. but the density of *Hyptis suaveolens* (L.) Poit. is higher, because this species is an invasive species with massive seed production and is considered as a weed globally [18]. It also shows that species with higher basal areas do not necessarily have higher densities, demonstrating the size differences among species [19].

Important value index (IVI) not only presents the overall picture of the ecological importance of a species in a community [20] but is useful to compare the ecological importance of the species and determine their priority for conservation [21]. According to Noraimy *et al.*, the species having the highest IVI is considered dominant in the community [22]. In protected and non-protected vegetation, fabaceous plant species show dominance. In both the stands in the shrub layer Family Fabaceae recorded maximum basal area, it covered 45% of the total basal area in the protected vegetation stand and 60% of the total basal area in the non-protected stand. Fabaceae is one of the families that have a superior capacity to withstand the harsh conditions presented in degraded land and is able to grow in low-nutrient soil [23]. Earlier studies in this region also indicated the dominance and abundance of Fabaceae [24,25].

The result indicates that high IVI was attributed to few species in both sites. These species are well adapted to the existing level of disturbances in the study area. Variation in IVI shows the different ecological importance of each species in the study sites.

Table 1. A comparison of the status of vegetation forming the shrub layer and ground cover of the protected vegetation and non-protected vegetation in terms of phytosociological parameters

Parameters	Values	
	Protected vegetation stands	Non-protected vegetation stands
Total density of shrub /ha	259.33	141.33
Total density of herbs /m ²	86.61	12.88
Total basal area of shrubs (m ² /ha)	1.924	1.420
Total basal area of herbs (cm ² /m ²)	73.441	10.357
Species richness of shrub	45	12
Species richness of herbs	163	28

Table 2. Phytosociological analysis; Relative Frequency (RF), Relative Density (RD), Relative Dominance (RDo), and Important Value Index (IVI) of shrub layer in the protected stands and non-protected vegetation stands

S. N	Name of Species	Family	Protected Vegetation				Non-Protected vegetation			
			RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
1	<i>Abelmoschus moschatus</i> Medicus	Malvaceae	1.00	1.28	1.01	3.29	-	-	-	-
2	<i>Acacia catechu</i> (L.) (L.f.) Willd.	Fabaceae	1.99	1.28	4.04	7.31	-	-	-	-
3	<i>Acacia leucophloea</i> (Roxb.) Willd.	Fabaceae	3.98	3.20	10.10	17.29	8.85	9.39	22.02	40.26
4	<i>Acacia nilotica</i> (L.) subsp. indica(Benth.)Brenan	Fabaceae	2.99	2.56	8.08	13.63	4.42	4.69	3.96	13.08
5	<i>Acacia senegal</i> (L.) Willd.	Fabaceae	0.40	0.26	0.81	1.46	-	-	-	-
6	<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	1.00	0.64	2.02	3.66	-	-	-	-
7	<i>Anogeissus pendula</i> Edgew.	Combretaceae	2.99	5.76	11.64	20.39	-	-	-	-
8	<i>Azadirachta indica</i> A. Juss.	Meliaceae	3.98	5.12	10.34	19.45	4.42	2.35	5.50	12.28
9	<i>Balanites aegyptiaca</i> (L.) Delile	Zygophyllaceae	3.98	6.27	3.17	13.43	-	-	-	-
10	<i>Bauhinia racemosa</i> Lam.	Fabaceae	0.80	0.51	0.26	1.57	-	-	-	-
11	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	2.99	2.56	8.08	13.63	-	-	-	-
12	<i>Calotropis procera</i> (Alton) W.T.Alton	Apocynaceae	4.98	3.20	0.40	8.59	6.64	5.87	1.24	13.74
13	<i>Capparis decidua</i> (Forssk.) Edgew.	Capparaceae	0.80	0.51	0.26	1.57	-	-	-	-
14	<i>Cassia fistula</i> L.	Fabaceae	0.40	0.26	0.52	1.17	-	-	-	-
15	<i>Cassia siamea</i> (Lam.) H.S.Irwin & Barneby	Fabaceae	0.40	0.26	0.52	1.17	-	-	-	-
16	<i>Celosia argentea</i> L.	Amaranthaceae	1.99	3.84	0.48	6.32	-	-	-	-
17	<i>Dalbergia sissoo</i> Roxb. ex DC.	Fabaceae	1.00	0.64	0.32	1.96	-	-	-	-
18	<i>Datura innoxia</i> Mill.	Solanaceae	1.20	0.90	0.45	2.54	6.64	4.69	1.76	13.09
19	<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	Fabaceae	5.58	3.84	1.94	11.36	6.64	8.22	12.33	27.18
20	<i>Dolichandrone falcata</i> (Wall.ex Dc.) Seem.	Bignoniaceae	1.00	0.64	0.32	1.96	-	-	-	-
21	<i>Echinops echinatus</i> Roxb.	Asteraceae	3.98	4.48	2.26	10.73	7.52	5.63	2.11	15.27
22	<i>Ficus racemosa</i> L.	Moraceae	1.99	1.28	0.65	3.92	-	-	-	-
23	<i>Grewia tenax</i> (Forssk.) Fiori	Malvaceae	1.00	0.64	0.73	2.36	-	-	-	-
24	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Ulmaceae	0.40	0.26	0.13	0.78	-	-	-	-
25	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	7.97	8.96	2.55	19.48	-	-	-	-
26	<i>Indigofera oblongifolia</i> Forssk.	Fabaceae	1.99	3.84	1.09	6.92	-	-	-	-
27	<i>Indigofera tinctoria</i> L.	Fabaceae	0.80	1.92	0.97	3.69	-	-	-	-
28	<i>Jatropha curcus</i> L.	Euphorbiaceae	1.00	0.64	0.18	1.82	-	-	-	-
29	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	1.99	3.84	1.09	6.92	-	-	-	-

S. N	Name of Species	Family	Protected Vegetation				Non-Protected vegetation			
			RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
30	<i>Kirganelia reticulata</i> (Poir.) Baill.	Phyllanthaceae	1.99	1.28	0.65	3.92	-	-	-	-
31	<i>Lantana camara</i> L.	Verbenaceae	3.59	2.56	0.73	6.87	8.85	5.87	1.24	15.96
32	<i>Leucaena leucocephala</i> (Lam.) de Wit.	Fabaceae	4.98	3.20	1.62	9.80	-	-	-	-
33	<i>Martynia annua</i> L.	Martyniaceae	1.99	1.92	2.18	6.09	-	-	-	-
34	<i>Mitragyna parviflora</i> . (Roxb.) Korth.	Rubiaceae	5.98	4.99	10.08	21.05	-	-	-	-
35	<i>Ocimum basilicum</i> L.	Lamiaceae	1.99	2.56	0.32	4.88	-	-	-	-
36	<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	0.60	0.38	0.44	1.42	2.21	1.17	2.75	6.14
37	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Fabaceae	0.40	0.26	0.13	0.78	-	-	-	-
38	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	1.99	1.66	2.57	6.23	-	-	-	-
39	<i>Prosopis juliflora</i> (Swartz) DC.	Fabaceae	1.00	1.28	0.65	2.92	17.70	23.47	19.82	60.99
40	<i>Securinega leucopyrus</i> (Willd.) Müll.Arg.	Phyllanthaceae	1.99	1.28	0.65	3.92	3.98	4.69	7.05	15.72
41	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	1.00	0.64	0.32	1.96	-	-	-	-
42	<i>Tamarindus indica</i> L.	Fabaceae	1.00	0.64	0.73	2.36	-	-	-	-
43	<i>Typha elephantina</i> Roxb.	Typhaceae	0.60	1.28	2.59	4.46	-	-	-	-
44	<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	0.40	0.26	0.13	0.78	-	-	-	-
45	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Rhamnaceae	5.98	6.40	1.82	14.20	22.12	23.94	20.21	66.28

Table 3. Phytosociological analysis; Relative Frequency (RF), Relative Density (RD), Relative Dominance (RDo), and Important Value Index (IVI) of the herbaceous layer in the protected stands and non-protected vegetation stands

S. N	Name of Species	Family	Protected Vegetation				Non-Protected vegetation			
			RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
1	<i>Abelmoschus moschatus</i> Medicus	Malvaceae	0.60	0.46	0.62	1.67	-	-	-	-
2	<i>Abutilon hirtum</i> (Lam.) Sweet	Malvaceae	0.60	0.15	0.14	0.88	-	-	-	-
3	<i>Acacia catechu</i> (L.)	Fabaceae	0.24	0.05	0.04	0.33	-	-	-	-
4	<i>Acacia leucophloea</i> (Roxb.) Willd.	Fabaceae	0.30	0.06	0.05	0.41	-	-	-	-
5	<i>Acacia nilotica</i> (L.) subsp. <i>indica</i> (Benth.) Brenan	Fabaceae	0.60	0.35	0.32	1.26	-	-	-	-
6	<i>Acacia senegal</i> (L.) Willd.	Fabaceae	0.06	0.01	0.01	0.08	-	-	-	-
7	<i>Acalypha indica</i> L.	Euphorbiaceae	0.60	0.23	0.31	1.13	1.72	2.71	2.65	7.07
8	<i>Achyranthes aspera</i> L.	Amaranthaceae	2.38	0.81	0.75	3.94	3.44	2.71	2.65	8.79
9	<i>Aerva lanata</i> (L.) Juss.	Amaranthaceae	0.71	0.23	0.21	1.16	-	-	-	-

Protected Vegetation							Non-Protected vegetation			
S. N	Name of Species	Family	RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
10	<i>Aeschynomene indica</i> L.	Fabaceae	0.30	0.75	0.84	1.89	-	-	-	-
11	<i>Ageratum conyzoids</i> L.	Asteraceae	0.24	0.12	0.13	0.48	-	-	-	-
12	<i>Ageratum houstonianum</i> L.	Asteraceae	0.12	0.12	0.11	0.34	-	-	-	-
13	<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	0.12	0.02	0.02	0.16	-	-	-	-
14	<i>Alloteropsis cimicina</i> (L.) Stapf	Poaceae	0.60	1.15	0.89	2.64	-	-	-	-
15	<i>Alternanthera sessilis</i> (L.) R. Br.	Amaranthaceae	1.79	0.69	0.64	3.12	2.58	3.25	3.17	9.01
16	<i>Alysicarpus vaginalis</i> (L.) DC.	Fabaceae	0.12	0.06	0.05	0.23	-	-	-	-
17	<i>Amaranthus hybridus</i> L.	Amaranthaceae	0.54	0.29	0.17	1.00	-	-	-	-
18	<i>Ammannia baccifera</i> L.	Lythraceae	0.60	0.35	0.26	1.20	-	-	-	-
19	<i>Anagallis arvensis</i> L.	Primulaceae	1.19	0.57	0.52	2.28	1.72	2.56	2.49	6.77
20	<i>Andrographis paniculata</i> (Burm.f) Nees	Acanthaceae	1.79	0.58	0.90	3.27	-	-	-	-
21	<i>Anogeissus pendula</i> (Edgew)	Combretaceae	0.60	0.29	0.27	1.15	-	-	-	-
22	<i>Apluda mutica</i> L.	Poaceae	1.19	7.50	10.00	18.70	-	-	-	-
23	<i>Argemone mexicana</i> L.	Papaveraceae	0.60	0.23	0.26	1.09	1.37	2.32	2.27	5.97
24	<i>Argyrea nervosa</i> (Burm.f.) Bojer	Convolvulaceae	0.06	0.01	0.01	0.08	-	-	-	-
25	<i>Aristida adscensionis</i> L.	Poaceae	0.60	2.86	2.15	5.61	-	-	-	-
26	<i>Azadirachta indica</i> A.Juss.	Meliaceae	0.60	0.23	0.31	1.13	-	-	-	-
27	<i>Balanites aegytiaca</i> (L.) Delile	Zygophyllaceae.	0.60	0.12	0.11	0.82	-	-	-	-
28	<i>Bauhinia racemosa</i> Lam.	Fabaceae	0.06	0.02	0.02	0.10	-	-	-	-
29	<i>Blastania garcinii</i> (Burm. F.)	Cucurbitaceae	0.30	0.12	0.11	0.52	-	-	-	-
30	<i>Blumea laciniata</i> (Wall. ex Roxb.) DC.	Asteraceae	1.19	0.58	0.53	2.30	3.44	3.18	3.10	9.71
31	<i>Bombax ceiba</i> L.	Malvaceae	0.06	0.01	0.01	0.08	-	-	-	-
32	<i>Borreria pusilla</i> (Wall.) DC.	Rubiaceae	0.12	0.33	0.38	0.83	-	-	-	-
33	<i>Bothriochola pertusa</i> (L.) A.Camus	Poaceae	0.60	3.46	2.05	6.11	-	-	-	-
34	<i>Brachharia mutica</i> (Forssk.) Stapf	Poaceae	0.60	1.13	1.05	2.77	-	-	-	-
35	<i>Brachiararia ramosa</i> (L.) Stapf	Poaceae	0.48	3.93	3.63	8.04	4.81	7.59	4.74	17.14
36	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	0.30	0.06	0.05	0.41	-	-	-	-
37	<i>Caesulia axillaris</i> Roxb.	Asteraceae	0.36	0.58	0.53	1.47	-	-	-	-
38	<i>Calotropis procera</i> (Alton) W.T.Alton	Apocynaceae	0.30	0.06	0.05	0.41	-	-	-	-
39	<i>Capparis decidua</i> (Forssk.) Edgew.	Capparaceae	0.12	0.05	0.04	0.21	-	-	-	-
40	<i>Capparis sepiaria</i> L.	Capparaceae	0.12	0.22	0.25	0.58	-	-	-	-
41	<i>Cardiospermum halicacabum</i> L.	Sapandaceae	0.30	0.29	0.27	0.85	-	-	-	-

Protected Vegetation							Non-Protected vegetation			
S. N	Name of Species	Family	RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
42	<i>Cassia fistula</i> L.	Fabaceae	0.06	0.01	0.02	0.09	-	-	-	-
43	<i>Cassia occidentalis</i> L.	Fabaceae	0.30	0.30	0.47	1.07	-	-	-	-
44	<i>Cassia siamea</i> (Lam.) H.S.Irwin & Barneby	Fabaceae	0.06	0.02	0.02	0.10	-	-	-	-
45	<i>Cassia tora</i> L.	Fabaceae	1.07	0.27	0.25	1.58	1.72	2.71	2.65	7.07
46	<i>Cayratia trifolia</i> (L.) Domin	Vitaceae	0.60	0.22	0.25	1.06	-	-	-	-
47	<i>Celosia argentea</i> L.	Amaranthaceae	0.60	0.46	0.43	1.48	-	-	-	-
48	<i>Chloris virgatus</i> SW.	Poaceae	0.54	2.27	2.11	4.92	-	-	-	-
49	<i>Chrozophora rottleri</i> (Geis) A.Juss.ex Spreng.	Euphorbiaceae	0.60	0.46	0.52	1.57	5.15	7.67	6.06	18.88
50	<i>Cleome viscosa</i> L.	Cleomaceae	0.48	0.12	0.15	0.75	1.72	0.77	0.76	3.25
51	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	0.48	0.12	0.04	0.63	-	-	-	-
52	<i>Commelina albescens</i> Hassk	Commelinaceae	0.60	0.23	0.21	1.04	-	-	-	-
53	<i>Commelina benghalensis</i> L.	Commelinaceae	0.48	0.35	0.32	1.14	-	-	-	-
54	<i>Convolvulus prostrates</i> Forsk.	Convolvulaceae	0.60	0.24	0.14	0.98	-	-	-	-
55	<i>Conyza bonariensis</i> L.	Asteraceae	0.30	0.35	0.32	0.96	-	-	-	-
56	<i>Corchorus olitorius</i> L.	Malvaceae	0.60	0.45	0.50	1.55	-	-	-	-
57	<i>Corchorus trilocularis</i> L.	Malvaceae	0.30	0.35	0.32	0.96	-	-	-	-
58	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	0.60	0.23	0.26	1.09	-	-	-	-
59	<i>Cucumis callosus</i> (Rott.) Cogn.	Cucurbitaceae	0.60	0.21	0.19	1.00	-	-	-	-
60	<i>Cucumis maderaspatanus</i> L.	Cucurbitaceae	0.60	0.22	0.20	1.02	-	-	-	-
61	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	Commelinaceae	0.30	0.46	0.43	1.19	-	-	-	-
62	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.19	0.46	0.35	2.00	6.53	8.13	7.94	22.60
63	<i>Cyperus alulatus</i> Kern.	Cyperaceae	0.89	2.31	2.14	5.34	-	-	-	-
64	<i>Cyperus iria</i> L.	Cyperaceae	0.83	2.30	2.13	5.26	-	-	-	-
65	<i>Cyperus rotundus</i> L.	Cyperaceae	1.19	1.14	1.06	3.39	-	-	-	-
66	<i>Dactyloctenium aristatum</i> Link	Poaceae	0.54	3.23	2.42	6.19	-	-	-	-
67	<i>Dalbergia sissoo</i> Roxb. ex DC.	Fabaceae	0.30	0.06	0.06	0.42	-	-	-	-
68	<i>Datura innoxia</i> Mill.	Solanaceae	1.79	0.35	0.32	2.45	-	-	-	-
69	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Poaceae	1.19	2.31	2.59	6.09	3.44	7.59	7.41	18.43
70	<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	Fabaceae	0.60	0.27	0.25	1.11	-	-	-	-
71	<i>Digera muricata</i> (L.)	Amaranthaceae	0.30	0.12	0.11	0.52	-	-	-	-
72	<i>Dolichandrone falcate</i> (Wall.ex Dc.) Seem.	Bignoniaceae	0.06	0.01	0.01	0.08	-	-	-	-

Protected Vegetation							Non-Protected vegetation			
S. N	Name of Species	Family	RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
73	<i>Echinochloa colona</i> (L.) Link	Poaceae	0.60	2.31	2.14	5.04	-	-	-	-
74	<i>Echinochloa crus-galli</i> (L.) P. Beauv	Poaceae	0.89	2.42	2.24	5.56	-	-	-	-
75	<i>Echinops echinatus</i> Roxb.	Asteraceae	1.79	2.54	3.97	8.30	3.09	3.87	3.78	10.74
76	<i>Eclipta alba</i> (L.) Hassk.	Asteraceae	0.30	0.12	0.11	0.52	-	-	-	-
77	<i>Elytraria acaulis</i> (L.f.) Lindau	Acanthaceae	0.30	0.35	0.32	0.96	-	-	-	-
78	<i>Enicostema axillare</i> (Poir.ex Lam.) A.Raynal	Gentianaceae	0.30	0.35	0.32	0.96	-	-	-	-
79	<i>Eragrostis gangetica</i> (Roxb.)Steud.	Poaceae	0.60	1.15	0.87	2.62	-	-	-	-
80	<i>Eragrostis pilosa</i> (L.) P.Beauv.	Poaceae	1.07	2.31	2.59	5.97	6.87	7.75	7.56	22.18
81	<i>Euphorbia hirata</i> L.	Euphorbiaceae	1.49	1.15	1.07	3.71	4.30	2.40	5.27	11.97
82	<i>Euphorbia hypericifolia</i> L.	Euphorbiaceae	0.66	0.24	0.22	1.12	4.64	2.32	2.27	9.23
83	<i>Evolvulus alsinoides</i> L.	Convolvulaceae	0.30	0.24	0.22	0.76	-	-	-	-
84	<i>Ficus racemosa</i> L.	Moraceae	0.30	0.06	0.05	0.41	-	-	-	-
85	<i>Ficus religiosa</i> L.	Moraceae	0.18	0.03	0.03	0.25	-	-	-	-
86	<i>Gomphrena celosoides</i> Mart.	Amaranthaceae	0.30	0.22	0.29	0.81	-	-	-	-
87	<i>Grewia tenax</i> (Forssk.) Fiori	Malvaceae	0.12	0.02	0.03	0.17	-	-	-	-
88	<i>Hedyotis hispida</i> Retz.	Rubiaceae	0.12	0.12	0.11	0.34	-	-	-	-
89	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Ulmaceae	0.06	0.02	0.02	0.10	-	-	-	-
90	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	1.19	1.14	1.06	3.39	-	-	-	-
91	<i>Imperata cylindrica</i> (L.) Raeuschel.	Poaceae	0.30	1.10	0.86	2.25	-	-	-	-
92	<i>Indigofera cordifolia</i> Heyne. ex Rot	Fabaceae	0.60	0.45	0.42	1.46	-	-	-	-
93	<i>Indigofera linnaei</i> Ali	Fabaceae	0.60	0.46	0.43	1.48	-	-	-	-
94	<i>Indigofera oblongifolia</i> Forsk.	Fabaceae	0.60	0.35	0.32	1.26	-	-	-	-
95	<i>Indigophera tinctoria</i> L.	Fabaceae	0.42	0.35	0.32	1.08	-	-	-	-
96	<i>Ipomea pes-tigridis</i> L.	Convolvulaceae	0.60	0.22	0.20	1.02	-	-	-	-
97	<i>Ipomoea eriocarpa</i> R.Br.	Convolvulaceae	1.19	0.35	0.32	1.86	-	-	-	-
98	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	1.19	0.46	0.43	2.08	-	-	-	-
99	<i>Justicia simplex</i> D. Don	Acanthaceae	0.60	0.58	0.53	1.71	-	-	-	-
100	<i>Kirganelia reticulata</i> (Poir) Baill.	Phyllanthaceae	0.12	0.03	0.03	0.19	-	-	-	-
101	<i>Kyllinga bulbosa</i> P. Beauv.	Cyperaceae	0.24	0.69	0.64	1.57	-	-	-	-
102	<i>Lablab purpureus</i> (L.) Sweet	Fabaceae	0.89	0.23	0.21	1.34	-	-	-	-
103	<i>Lantana camara</i> L.	Verbenaceae	1.07	0.23	0.86	2.16	1.72	3.10	3.02	7.84
104	<i>Launaea procumbens</i> (Roxb.)	Asteraceae	0.89	0.23	0.26	1.38	6.01	2.94	2.87	11.83

Protected Vegetation							Non-Protected vegetation			
S. N	Name of Species	Family	RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
105	<i>Leucaena leucocephala</i> (Lam.) de Wit.	Fabaceae	0.30	0.23	0.21	0.74	-	-	-	-
106	<i>Leucas aspera</i> (Willd) Link	Lamiaceae	0.89	0.35	0.32	1.56	-	-	-	-
107	<i>Lindernia parviflora</i> (Roxb.) Haines	Linderniaceae	0.12	0.29	0.04	0.45	-	-	-	-
108	<i>Ludwigia perennis</i> L.	Onagraceae	0.18	0.12	0.11	0.40	-	-	-	-
109	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	0.30	0.23	0.21	0.74	1.72	1.39	1.36	4.47
110	<i>Martynia annua</i> L.	Martyniaceae	1.19	0.29	1.07	2.55	-	-	-	-
111	<i>Melochia corchorifolia</i> L.	Malvaceae	0.30	0.17	0.16	0.63	-	-	-	-
112	<i>Merremia emarginata</i> (Burm f.) Hall. fil.	Convolvulaceae	0.30	0.35	0.32	0.96	-	-	-	-
113	<i>Merremia tridentate</i> (L.)	Convolvulaceae	0.30	0.29	0.27	0.85	-	-	-	-
114	<i>Mitragyna parviflora</i> . (Roxb.) Korth.	Rubiaceae	1.19	0.21	0.19	1.59	-	-	-	-
115	<i>Momordica dioica</i> Roxb.ex.Willd.	Cucurbitaceae	0.12	0.06	0.05	0.23	-	-	-	-
116	<i>Murdannia nudiflora</i> (L) Brenan	Commelinaceae	0.30	0.46	0.43	1.19	-	-	-	-
117	<i>Occimum basilicum</i> L.	Lamiaceae	0.30	0.40	0.37	1.08	-	-	-	-
118	<i>Oxystelma esculentum</i> (L.f.) Sm.	Apocynaceae	0.42	0.46	0.43	1.31	-	-	-	-
119	<i>Parthenium hysterophorus</i> L.	Asteraceae	0.30	0.12	0.15	0.57	3.44	2.32	2.27	8.03
120	<i>Passiflora foetida</i> L.	Passifloraceae	0.12	0.12	0.11	0.34	-	-	-	-
121	<i>Pergularia daemia</i> (Forsk) Chiov.	Asclepiadaceae	1.79	0.58	0.53	2.90	-	-	-	-
122	<i>Peristrophe paniculata</i> (Forssk.) R.K. Brummitt	Acanthaceae	1.19	0.55	0.51	2.26	-	-	-	-
123	<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	0.06	0.01	0.02	0.09	-	-	-	-
124	<i>Phyllanthus maderaspatensis</i> L.	Phyllanthaceae	1.79	0.68	0.63	3.10	3.44	1.55	1.51	6.50
125	<i>Phyllanthus urinaria</i> L.	Phyllanthaceae	1.79	0.69	0.64	3.12	-	-	-	-
126	<i>Phyllanthus virgatus</i> Forst.f.	Phyllanthaceae	1.19	0.46	0.43	2.08	-	-	-	-
127	<i>Physalis minima</i> Linn.	Solanaceae	0.30	0.23	0.21	0.74	-	-	-	-
128	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Fabaceae	0.06	0.01	0.01	0.08	-	-	-	-
129	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	0.24	0.05	0.02	0.30	-	-	-	-
130	<i>Polygonum barbatum</i> L.	Polygonaceae	0.60	0.58	0.53	1.71	-	-	-	-
131	<i>Polygonum plebeium</i> R.Br.	Polygonaceae	0.60	0.35	0.32	1.26	4.30	2.71	2.65	9.65
132	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	0.60	0.58	0.53	1.71	-	-	-	-
133	<i>Portulaca oleracea</i> L.	Portulacaceae	0.30	0.24	0.22	0.76	-	-	-	-
134	<i>Pulicaria crispa</i> (Cass.) B&H.f.	Asteraceae	0.60	0.47	0.63	1.70	-	-	-	-
135	<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae	1.19	1.13	1.51	3.83	-	-	-	-

Protected Vegetation							Non-Protected vegetation			
S. N	Name of Species	Family	RF 1	RD1	RDo1	IVI 1	RF2	RD2	RDo2	IVI 2
136	<i>Rhynchosia minima</i> (L.) DC.	Fabaceae	2.38	2.31	3.61	8.30	-	-	-	-
137	<i>Ruellie Grandiflora</i> (Forssk.) Blatter	Acanthaceae	0.89	0.35	0.46	1.70	-	-	-	-
138	<i>Rumex dentatus</i> L.	Polygonaceae	0.60	0.23	0.26	1.09	3.44	2.32	2.27	8.03
139	<i>Rungia repens</i> (L.) Nees	Acanthaceae	1.19	1.15	1.07	3.41	-	-	-	-
140	<i>Saccharum spontaneum</i> L.	Poaceae	1.19	0.58	0.49	2.26	-	-	-	-
141	<i>Securinega leucopyrus</i> (Willd.) Müll.Arg.	Phyllanthaceae	0.30	0.06	0.06	0.42	-	-	-	-
142	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	0.30	0.06	0.05	0.41	-	-	-	-
143	<i>Setaria pumila</i> (Poir.) Roem. & Schult.	Poaceae	1.19	2.29	1.80	5.27	-	-	-	-
144	<i>Sida acuta</i> Burm. f.	Malvaceae	1.19	0.29	0.27	1.75	-	-	-	-
145	<i>Sida cordifolia</i> Linn.	Malvaceae	0.60	0.45	0.42	1.46	-	-	-	-
146	<i>Sida ovata</i> Forssk.	Malvaceae	0.60	0.35	0.32	1.26	-	-	-	-
147	<i>Sida spinosa</i> L.	Malvaceae	0.48	0.17	0.16	0.81	-	-	-	-
148	<i>Solanum nigrum</i> L.	Solanaceae	0.30	0.22	0.25	0.76	-	-	-	-
149	<i>Solanum virginianum</i> L.	Solanaceae	0.60	0.46	0.43	1.48	3.44	2.94	6.46	12.84
150	<i>Sonchus oleraceus</i> L.	Asteraceae	0.30	0.12	0.11	0.52	-	-	-	-
151	<i>Sphaeranthus indicus</i> L.	Asteraceae	0.60	0.58	0.53	1.71	-	-	-	-
152	<i>Sporobolus coromandelianus</i> (Retz.) Kunth	Poaceae	0.60	2.29	2.12	5.00	-	-	-	-
153	<i>Stylosanthes fruticosa</i> (Retz.) Alston	Fabaceae	0.36	0.17	0.10	0.63	-	-	-	-
154	<i>Tamarindus indica</i> L.	Fabaceae	0.06	0.02	0.02	0.10	-	-	-	-
155	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	0.06	0.01	0.01	0.08	-	-	-	-
156	<i>Themeda quadrivalvis</i> (L.) Kuntze	Poaceae	0.30	4.62	4.28	9.19	-	-	-	-
157	<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae	0.30	0.12	0.11	0.52	-	-	-	-
158	<i>Tridax procumbens</i> L.	Asteraceae	2.38	1.14	1.06	4.58	4.81	3.10	3.02	10.93
159	<i>Typha elephantena</i> Roxb.	Typhaceae	0.12	0.23	0.21	0.56	-	-	-	-
160	<i>Urginea indica</i> (Roxb.) Kunth	Liliaceae	0.30	0.22	0.29	0.81	-	-	-	-
161	<i>Vernonia cinerea</i> (L.) Less.	Asteraceae	1.19	0.58	0.53	2.30	3.44	3.25	3.17	9.86
162	<i>Xanthem strumarium</i> Linn.	Asteraceae	0.60	0.35	0.32	1.26	-	-	-	-
163	<i>Ziziphus nummularia</i> (Burm.f.) Wightt & Arn.	Rhamnaceae	1.19	0.33	0.31	1.84	5.15	3.80	3.70	12.65

DOMINANCE AND DIVERSITY

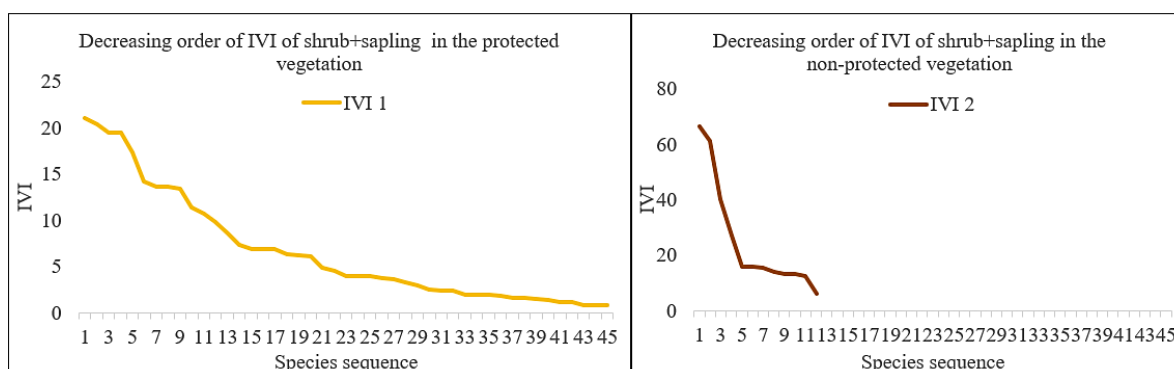


Fig. 2. Dominance-diversity curve of shrubs+saplings in protected and non-protected vegetation stands. (species sequence on X axis and IVI on Y axis)

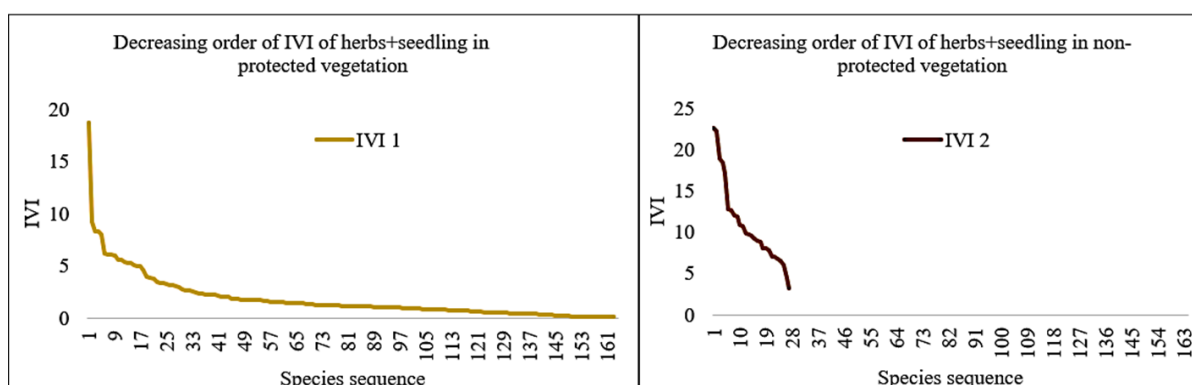


Fig. 3. Dominance-diversity curve of herbs+seedlings in protected and non-protected vegetation stands. (species sequence on X axis and IVI on Y axis)

Among shrub Species *Ziziphus nummularia* (Burm.f.) Wight & Walk. Arn, *Prosopis juliflora* (Swartz) DC. and *Acacia leucophloea* (Roxb.) Willd.) can survive in poor climatic conditions. Dominance of *Acacia* species being strong competitors in their environment [26] shows dominance in the study area. Due to their high resiliency to drought and grazing [27,28] it holds a preferential place in afforestation in context of land degradation. The species *Ziziphus nummularia* (Burm.f.) Wight & Arn is highly draught tolerant and can survive in harsh conditions [29]. The species *Prosopis juliflora* (Swartz) DC. is an exotic species and indicates that exotic species can grow faster than other species and spread over the land that is barren and non-protected [30]. It not only thrives but improves the environment around it [31,32,33].

Among herbs, species of Poaceae are the most dominating species having maximum IVI in protected vegetation, which shows their

ecological importance. In non-protected stands dominant species in the herbaceous layer belong to the family Poaceae but the species composition has changed. Family Poaceae helps in soil stabilization, erosion prevention, and the formation of channels for water infiltration. When grasses die and degrade, they add organic matter to the soil, increasing its fertility [34].

Several studies have found a predominance of annuals, mostly grasses on disturbed site soils [35, 36]. Because annuals are more adaptive, have a short life span and high reproductive capacity, allow grasses to rapidly colonize the open spaces created by disturbances. The results show that species that contribute to the largest share of IVI are changed in two sampling sites. Variation in dominance in two sites may be due to physical and biological disturbances which is a major source of variation in community structure [37,38].

A sharp decline in the Dominance-diversity curve of shrubs and herbs in non-protected vegetation indicates a natural tendency for a small number of dominating species with higher relative values whereas vegetation of protected sites presents a more diverse species assemblage than non-protected site in terms of species richness and equitability in which individuals are distributed among species. In the herbaceous layer, only a few species are abundant, monopolizing a considerable proportion of dominance while most of the species share a lower range of dominance. The dominance diversity curve indicates the random distribution of shrubs and herbs in protected areas in comparison to non-protected areas [39].

Natural as well as man-made disturbances are integral drivers of forest dynamics that are visible in changes in species composition and diversity which determine the flow of ecosystem services and its productivity [40,41,42]. Lower density and species richness in non-protected vegetation show the presence of disturbances in the study area. Disturbance gradients may cause changes in the structural attributes of forests [43] and plant diversity and other associated vegetation attributes are negatively affected by increasing frequency and intensity of disturbances [44,45]. Anthropogenic disturbance has also been linked to a decrease in stem density of plants in a number of other tropical forest areas [46]. Many species are absent or present in insufficient numbers at the experimental site due to anthropogenic influences [47] the condition which has the potential to result in the gradual extinction of many forest species. According to research undertaken in various parts of the world, the biological diversity of plants and other features of forest vegetation such as density, basal area, and species diversity decrease as the degree of disturbance increases [48,49]. The variation in species may be due to changes in elevation, topography, forest microclimate, soil type, and rainfall patterns and levels and types of human-caused disturbances such as grazing, wood cutting, etc [50].

The most interesting fact is that in non-protected vegetation *Chrozophora rottileri* (Geis) A. Juss.ex Spreng. which is not reported in shrub layer in both the vegetation contributes 2.85% share of total IVI in herb layer in non-protected sites as compared to 0.523% share of total IVI in protected sites. It is an invasive species native to tropical Africa [51]. Disturbance acts in plant communities in another way, however, by

promoting invasions by non-native and weedy plant species [52,53,54] which can reduce or displace native species, both plant and animal, and may even alter ecosystem function [55,56]. Microenvironmental variables change with the seasons, and can also influence the growth stage of plant communities, i.e., seedlings, saplings, and young trees, which support any forest's population structure [57].

5. CONCLUSION

In the present study area, it has been observed that the stem density, basal area, and species richness are lower in non-protected vegetation stands than in protected vegetation stands. According to the "intermediate disturbance hypothesis," the highest species occur when the disturbance frequency is at an intermediate level, but in the present study area, the disturbance frequency is high. The difference in vegetation in both stands is due to various anthropogenic factors present here. Increased anthropogenic activity and its detrimental effects on biodiversity are confirmed by the markedly decreased biodiversity in non-protected vegetation stands. The unexplored Nanta forest area and various wild species present here must be conserved as a genetic reservoir. The present scenario demands urgent attention to conserve the plant diversity of this region to avoid the risk of extinction of the plant species.

In both the shrub and herb layer there is a total absence of plant species that were dominant in protected vegetation. The stem density, basal area and species richness are lower in non-protected vegetation stands than in protected vegetation sites. Results of the present investigation proves that disturbances can cause changes in species composition or sometimes total replacement of plant species, reduced diversity and increased dominance, thus affecting overall phytosociological characteristic of vegetation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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