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A COMPREHENSIVE PHYTOSOCIOLOGICAL STUDY ON PAVITRA VANA AT ARKERA RAICHUR KARNATAKA INDIA

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ABSTRACT

This Paper Reveals A Comprehensive Micro-Phytosociological Analysis Of Pavitra Vana, A Sacred Grove Located At Arkera, Raichur, Karnataka, India. Sacred Groves Need To Be Conserved As They Provide Significant Ecological And Cultural Importance As It Is Acting As The Best Place For The Regeneration Of Native Plant Species As Well As Acting As A Seed Gene Pool For Future Regeneration. Through An In-Depth Examination Of Plant Diversity Indices, Including The Shannon-Weiner And Simpson's Diversity Indices, This Study Reveals A Well-Balanced Ecosystem Characterized By Substantial Species Richness And Evenness. The Taxonomic Composition, Both At The Family And Genus Levels, Underscores The Ecological Predominance Of Families Such As Fabaceae, Asteraceae, And Malvaceae, While Genera Like Vachellia And Phyllanthus Exhibit Notable Functional Diversity. These Findings Highlight The Critical Conservation Role Of Sacred Groves, Which Act As Biodiversity Hot Spots That Fulfill Numerous Ecological Functions, Including Soil Stabilization, Pollinator Habitat Support, And Resilience Against Environmental Stressors. This Study Emphasizes The Urgent Need For The Conservation Of Sacred Groves, Underscoring Their Integral Role In Regional Biodiversity Conservation Strategies And Their Ecological Value In Sustaining Functional And Niche-Specialized Plant Groups.

***KEYWORDS**: Biodiversity, Sacred Grove, Species Diversity, C, Pavitra Vana Arkera, Shannon-Weiner Index, Simpson's Diversity Index, Fabaceae, Functional Diversity, Ecosystem Stability.*

Article History

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INTRODUCTION

Biodiversity therefore means the number of living species in any given ecosystem, biome, or the globe as a whole. The large number of species and the corresponding ecosystems on Earth are the basis of life on our planet (Zuidema *et al*., 1996). Interpreted as the sum total of genes species and ecosystems in a given area, biodiversity supports global stability at several levels. Not only has the concept of biodiversity been established to be of immense ecological, but it is also of social, economic, and even philosophical concern to the prospects of all nations. Biodiversity conservation ensures that species loss is prevented, hereby approached carried out in protection areas. Such activities include re-interpolations of indigenous species, rehabilitation of habitats, or regulation/reestablishment of preexisting exotic species regarding the intactness and resilience of these crucial settings. In another definition, biodiversity is about survival and economic development, it is about every living form, ecosystem, and process at the genetic, species, and ecosystem levels (McNeely *et al.,* 1990). Besides the moral and aesthetic aspects, biodiversity is of great economic use, as the source of timbers, foods, fibers, industrial enzymes, flavors, fragrances cosmetics, emulsifiers, dyes, plant growth regulators, and pesticides (Mannion, 1995; Costanza *et al.,* 1997). These resources attest to the importance of biological diversity to human and economic well-being and resilience.

Phytosociology, the study of plant communities and their interactions with the environment is crucial for understanding biodiversity, ecosystem functioning, and conservation strategies.By analyzing species composition, abundance, and spatial distribution, phytosociological studies facilitate the development of ecological models and sustainable management practices (Kent, 2012). Such investigations are crucial for determining the abiotic influences that underpin plant formations and for sensing changes due to climatic change, land-use transformation, or natural disturbance (Braun-Blanquet, 1932). Finally, phytosociology offers key data that embrace conservation and management actions, as well as, preparing the ecosystems to meet the environmental changes. New directions in the development of phytosociological studies concern the functional traits and phylogeny of organisms affecting community architecture (Pillar&Sosinski, 2013). This integrative approach enriches traditional species-based methods by incorporating ecological and evolutionary perspectives, thereby offering deeper insights into ecosystem dynamics and resilience (Chave, 2013). In highly disturbed landscapes, such as urban and agricultural areas, phytosociological studies yield essential information for restoration ecology and the conservation of native species. By understanding the interactions between functional traits and community composition, these studies facilitate informed decision-making for effective restoration strategies and biodiversity preservation.

Pavitra Vana a place of religious worship as a sacred grove has a tremendous amount of ecological and cultural importance for storing the civilization's indigenous plant species thus acting as a very old recorded technique of conservation (Bhagwat & Rutte, 2006). These groves offer ample scope for phytosociological investigations, as these forests are relatively undisturbed and possess high species endemic with many rare plants recorded from them (Gadgil & Vartak, 1976). Studying plant community composition trends within the Pavitra Vana may help to understand the roles of different species and influences species–species relationships, resource availability, and ecosystem stability. Such understanding helps us to have a better understanding of the variety of life forms in the world and also helps people who are interested in the preservation of these important habitats. The following broad specific objectives have been developed for this detailed phytosociological survey, to determine Species composition, Dominance, and Diversity patterns in Pavitra Vana with reference to environmental gradients and anthropogenic factors on the plant community. Besides, the outcomes of this study will help to enhance the scientific understanding of such culturally and ecologically valuable areas as the sacred groves of India and contribute to their preservation accordingly.

MATERIALS AND METHODOLOGY

Study Area

The study area Pavitra Vana at Arkera is a village coming under Devadurga Taluk in Raichur District, Karnataka State, India. Central 9.4 hectares Arkera village, Devadurga Taluk of Raichur District, Karnataka, state of India. There are 1,206 houses and 7,091 people inhabiting this area. Arkera village in Raichur district of Karnataka is at a distance of approximately 16.167^{o} North latitude and 77.366^{o} East longitude. The altitude of Raichur district, within which Arkera lies, is around 448 meters (1,470 feet) above mean sea level, which is typical for the area's topography, shown in Figure 1.

Methodology

The survey had been planned in such a way as to cover all the possible forest areas of the region viz., Arkera in the Raichur District, Karnataka, India during all the seasons. Comprehensive and exhaustive data on the vegetation of the entire forest area was collected. Fidelibus and Mac Aller (1995) have agreed that in a study site, quadrate can be established regularly, subjectively, or randomly. The floristic and physiognomic characteristics were studied and recorded during the said period. A stratified random sampling approach was established. A squared field plot of size 10m x 10m (Standardized Quadrat Structure) was inventoried. During the survey, most of the species were identified and recorded on site, if immediate identification was not possible, specimens were collected for later identification with keys. Unidentified plants were collected, dried using standard herbarium techniques, and identified. Plant species identification was conducted using the following references: *Flora of Gulbarga District* by Seetharam *et al*., (2000), *Flora of the Presidency of Madras* (Volumes I to III) by Gamble (1957), *Flora of North Eastern Karnataka* by N.P. Singh (1988), and the detailed studies *Flora of Karnataka* (Volume I, 1984 and Volume II, 1996) by Saldanha *et al.*, Photographs and voucher specimens of the identified species were deposited in the Herbarium of the Department of Botany at Sunrise University, Alwar, Rajasthan (HSUR).

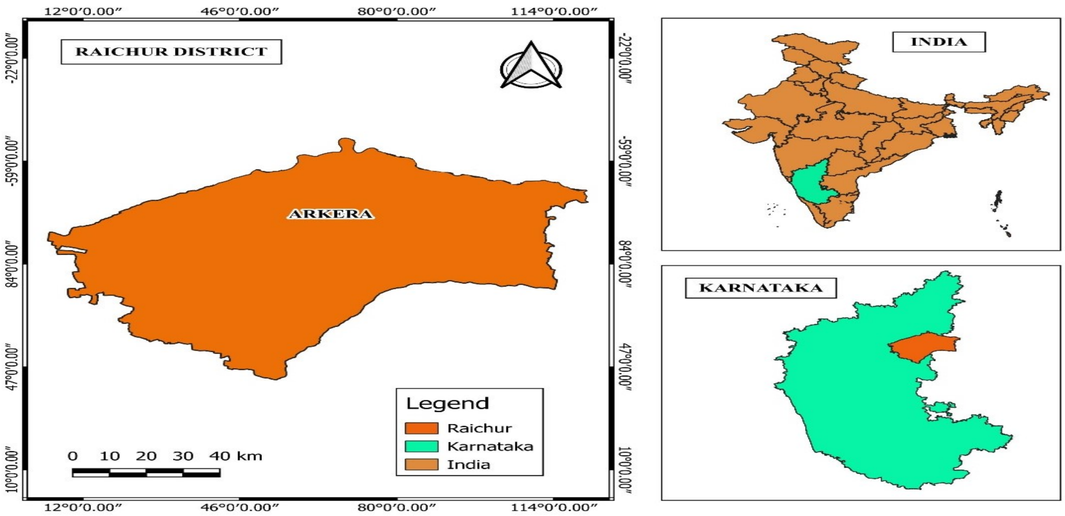

Figure 1: Map of Raichur District showing Pavitra Vana at Arkera Village.

The recorded data were utilized to calculate the following calculation.

- Frequency – Proportion of the total number of samples taken that contain the species.

  % F = No. of quadrats in which species present/ Total no. of quadrats studied × 100

- Density – Number of individuals expressed per unit area.

  D = No. Of individuals of a species/ Total no. of quadrats studied

- Abundance – Total number of individuals of a species in all quadrats studied.

  AB = Total no. of individuals of a species/ No. Of quadrats in which the species occurred

- Shannon-Weiner Diversity Index (H')

The Shannon-Weiner Index is calculated using the formula:

$$H' = -\sum_{i=1}^{S} p_i \ln(p_i)$$

Where:

H′ is the Shannon-Weiner Diversity Index,

S is the total number of species,

pi is the proportion of individuals or abundance of species iii relative to the total number of individuals for all species,

ln is the natural logarithm.

- Simpson’s Diversity Index (D)

The Simpson’s Diversity Index has two common versions, D and 1 - D (or 1 / D for the reciprocal Simpson’s index).

$$D = \sum_{i=1}^{S} p_i^2$$

Where

D is Simpson’s Index,

S is the total number of species,

Pi is the proportion of individuals or abundance of species iii relative to the total number of individuals for all species.

For Simpson's Diversity Index, 1 - D or the reciprocal 1 / D is often used to interpret diversity, where higher values indicate greater diversity.

RESULT AND DISCUSSION

Floristic Composition

The data collected from the study area of Pavitra Vana at Arkera in the Raichur District, Karnataka, India during the field sampling is tabulated and consolidated (Table-1). In the present study, 242 plant species were recorded belonging to 170 genera distributed among 58 families. The present study showed a greater number of plant species than the phytosociological studies of sacred groves, in Raichur District, Karnataka, India. The plant species of 242 from 58 families were calculated for density, abundance, and frequency percentage of various plant species across different families by quadrate method Pavitra Vana Arkera.

Density (A/B): A measure of population density in terms of the number of individual species per unit of space.

Abundance (A/C): Shows the number of people per sample area or sampling unit as a mean.

Frequency (%) (C/B * 100): Shows the number of people per sample area or sampling unit as a mean.

Measures are given in terms of density, abundance, and frequency distribution of plant species in relation to different families as depicted in the table.

Density

The top densities were found in *Heteropogoncontortus* (4.00), *Mesosphaerum suaveolens* (3.90), *Dactyolectniumaegypticum* (3.90), and *Mukiamadaraspatana* (3.80) have the highest density values. These species are notably dominant in the study area, suggesting they are well-suited to the local conditions and likely play significant roles in the ecosystem's structure and function. Moderately high-density species with density values between 3.70 and 3.50 include *Momordica cymbalaria, Senna uniflora, Tephrosia villosa*, and *Dichrostachys cinerea* which shows a good existence of the species but with slightly less dominance than top density species. These plants further support plant and animal species' diversification and ecosystem stability, and they probably promote other biological functions. The Consistent Density Range (3.30) The numerous species in the table exhibit a density of 3.30, including *Barleriaprionitis, Cadabafruticosa, Cleome viscosa, Diplocyclospalmatus*, and *Senna auriculata*. This indicates that these species are commonly encountered within the study plots but are not as individually dominant as the high-density species. The broad presence of many species at this density suggests a stable and well-distributed plant community. The Low-to-Moderate Density (3.20 and below) Species like *Coccinia grandis, Indigofera glandulosa, Prosopis juliflora*, and *Tribulus Terrestris* have lower density values, which may indicate either less favourable conditions for these species or niche adaptations that restrict their numbers. While they are less dominant, they still contribute to ecosystem complexity and potentially fill specialized roles.

Abundance

These are species that form the densest population of the sampled area. These include *Mukiamadaraspatana*(7.60), *Gyrocarpus americanus*(7.00) and *Indigofera cordifolia*(6.80). Their density indicates that species can readily adapt to the local environment and possibly play an important role in supporting other species.The Moderately High Abundance of Plants with abundance values from 6.17 to 5.50 (e.g., *Momordica cymbalaria, Senna uniflora, Tephrosia villosa, Cynodondactylon* and *Urochloapanicoides*) indicate that these species are fairly common but slightly less prevalent than the top abundance species. It suggests that they play a role in enhancing the diversification and stability of the habitat because they perform other ecological functions. A sixty percent species abundance falls within the Intermediate Abundance Range of 5.40 to 5.00 and they are J*atropha gossipifolia, Phyllanthus virgatus, Guilandinabonduc*, and *Parthenium hysterophorus*. These plants are common but not as widespread in terms of sheer coverage, which indicates that they may be best adapted to particular niches or microclimates within the larger plant community. The Low to Moderate abundance species with abundance values geometric mean at or equal to 5.00 such as *Annona squamosa, Albizia amara, Prosopis juliflora*, and *Aristida adscensionsis* refer to species that are scarce within the study area. These plants may well be restricted by certain environmental parameters or may lack competitiveness with other species. Even though there are not many of them in the wild, their existence is a plus to the total diversification of the system.

Frequency

High-frequency species with a frequency of 80-90%, such as *Achyranthes aspera, Alternanthera philoxeroides, Justicia diffusa, Rungialinifolia*, and *Agave ameri*cana, are present in nearly all sampling units. High frequency suggests these species are very well-suited to the environment and can be found consistently across the landscape. Their dominance in frequency indicates that they likely contribute significantly to the structure and ecological functions of this habitat. Moderate-to-High Frequency Range A large number of species (70%) appear in the samples consistently but are slightly less widespread than the highest-frequency species. Some of these are *Barleriaprionitis, Amaranthus viridis, Tridex procumbens, Dichrostachyscineria,* and *Vachellia horrida*. These species may well fill a range of roles in relation to the other member species of the habitat complex and could be involved in resource cycling, the structure of the habitat, or in interactions with faunahigh and Consistent Species Frequency and its consequences High and consistent frequency of some species across the sampling units suggests the ecological importance of some plant species in the functioning of ecosystems. Scrub species can therefore regulate the ecosystem by supporting consistently those organisms that depend on them for food and habitation thus increasing the health and variety of the ecosystem. Some high-frequency species may be Indicator Species and can point at certain soil, moisture, or light requirements in the sampled site or area; these may include: *Justicia glauca, Oxystelma esculentum*, and *Tridex procumbens*. These species were always present in the analyses, which means they could be used to track the changes in the environment through the years.

Figure 2: Study Area Pavitra Vana at Arkera in the Raichur District, Karnataka, India.

For Conservation and Management High frequency of detected species across the multiple areas imply that these plants are able to survive the current environmental conditions. These conditions can be preserved which can support the strategy for the conservation of biological diversity. It can be hypothesized that lower-frequency species may have different or specific requirements and may point to ecological niches that also need conservation for the stabilization of species composition. Diversity Across Ecological Niches with the high alternation of various species in different plant families (for example Poaceae, Fabaceae, and Euphorbiaceae) reveals a balance of the micro and macroenvironment. This variation may also improve the ability of the habitat to be less vulnerable to complications such as drought pest infestation or even climate change, the panoramic view is given in Figure 2.

This number of individuals is relatively equal when compared to the floristic composition of the selected sacred groves of the Perambalur district (Rajkumar *et al*., 2014). In a similar study, Parthasarathy *et al.,* (2008) enumerated 102 trees and 47 lianas from 75 groves in the Pudukkottai district itself. The floristic study of vegetation is important to determine the distribution of food plants for wildlife (Ejtehadi*et al.,* 2005). Several studies concerning floristic inventory were reported including International Journal of Botany Studies www.botanyjournals.com 482 260 species in 176 genera and 62 families from Malliganatham (John Britto and Senthilkumar, 2001). Thus, floristic diversity assessment of vegetation composition, and understanding species richness and diversity patterns is fundamental for the conservation of these natural areas (Zhang *et al.,* 2013; Vinothkumar *et al.,* 2011).

Table 1: Calculating the Density, Abundance, and Frequency by Quadrate Method-Pavitra Vana Arkera

S. No.	Plant Species	Family	Density = A/B	Abundance = A/C	Frequency (%) = C/B* 100
1	BarleriaprionitisL.	Acanthaceae	3.30	4.71	70
2	Barleria tomentosaVahl	Acanthaceae	2.00	3.33	60
3	Dipteracanthusprostrates (Poir.) Nees	Acanthaceae	2.40	4.00	60
4	Justicia diffusaWilld.	Acanthaceae	2.70	3.38	80
5	Justicia GlaucaRottler ex Nees	Acanthaceae	2.20	3.14	70
6	Rostellularia procumbens(L.) Nees	Acanthaceae	3.00	6.00	50
7	Rungia elegans(Spreng.) Nees	Acanthaceae	2.10	3.50	60
8	TrianthemaportulacastrumL.	Aizoaceae	2.50	4.17	60
9	Achyranthes asperaL.	Amaranthaceae	1.90	2.11	90
10	Alternanthera pungensKunth	Amaranthaceae	1.80	2.57	70
11	Alternanthera sessilis (L.) R.Br.ex DC.	Amaranthaceae	2.20	3.67	60
12	Alterntheraphiloxeroides(Mart.) Griseb.	Amaranthaceae	1.80	2.00	90
13	Amaranthus spinosusL.	Amaranthaceae	1.90	3.80	50
14	Amaranthus viridisL.	Amaranthaceae	2.70	3.86	70
15	Chenopodium albumL.	Amaranthaceae	2.30	3.83	60
16	Pupalialappacea(L.) Juss. Ex Poir.	Amaranthaceae	2.20	3.14	70
17	Annona squamosaL.	Annonaceae	2.50	5.00	50
18	Calotropis gigantean(L.) W.T.Aiton	Apocynaceae	1.90	3.17	60
19	Calotropis procera(Aiton) Dryand.	Apocynaceae	2.20	3.14	70
20	Carissa spinarumL.	Apocynaceae	1.90	3.80	50
21	Catheranthuspussilus(Murray) G. Don	Apocynaceae	1.40	1.75	80
22	Hemidesmous indicus(L.) R. Br.	Apocynaceae	1.70	3.40	50
23	Oxystelma esculentum (L.f.) sm.	Apocynaceae	1.50	2.14	70
24	Pergulariadaemia(Forssk.) Chiov.	Apocynaceae	1.70	2.83	60
25	Stephanotis volubilisL.	Apocynaceae	1.40	1.75	80
26	Wirightia tinctoria(Roxb.) R.Br.	Apocynaceae	1.20	2.00	60
27	Aristolochia indicaL.	Aristolochiaceae	1.60	2.29	70
28	Aristolochiabracteolate Lam.	Aristolochiaceae	1.70	3.40	50
29	Agave AmericanaL.	Asperagaceae	1.40	1.75	80
30	Asparagus racemosusWilld.	Asperagaceae	1.90	3.80	50
31	Aloe vera(L.) Burm. f.	Asphodelaceae	2.00	3.33	60
32	AcanthospermumhispidumDC.	Asteraceae	1.80	3.60	50
33	Ageratum conyzoidesL.	Asteraceae	2.20	3.67	60
34	Blumeaobliqua(L.) Druce	Asteraceae	1.30	2.60	50
35	Blainvillaeacmella(L.) Philipson	Asteraceae	1.50	2.14	70
36	Caesulia axillarisRoxb.	Asteraceae	1.90	3.17	60
37	Ecliptaprostrata(L.) L.	Asteraceae	2.00	4.00	50
38	EchinopsechinatusRoxb.	Asteraceae	1.80	3.00	60
39	Epaltesdivaricate (L.) Cass.	Asteraceae	1.40	2.00	70
40	LagasceamollisCav.	Asteraceae	1.80	3.00	60
41	Launaea procumbens(Roxb.) Ramayya & Rajagopal	Asteraceae	2.10	2.63	80
42	Parthenium hysterophorusL.	Asteraceae	2.50	5.00	50
43	PulicariawightianaDC.	Asteraceae	1.80	2.25	80
44	Soncus asper(L.) Hill	Asteraceae	1.80	3.00	60
45	Sphaeranthus indicusL.	Asteraceae	1.70	2.83	60

Table 1: Contd.,

46	Tridex procumbensL.	Asteraceae	2.30	3.29	70
47	Vernonia cinerea(L.) Less.	Asteraceae	2.50	4.17	60
48	Vicoa indica(Buch.- Ham. Ex D. Don) DC.	Asteraceae	2.00	2.86	70
49	Xanthium indicumKoen. Ex Roxb.	Asteraceae	2.20	3.67	60
50	Dolichandrone atrovirens(Roth) Sprague	Bignoniaceae	1.20	2.40	50
51	Coldenia procumbensL.	Boraginaceae	1.40	2.33	60
52	HeliotropiummarifoliumRetz.	Boraginaceae	1.50	3.00	50
53	Trichodesma indicum(l.) R. Br.	Boraginaceae	2.20	3.14	70
54	Trichodesma zeylanicum(Burm.f.) R.Br.	Boraginaceae	2.60	4.33	60
55	Cereus peruvianus(L.) Mill.	Cactaceae	1.40	2.00	70
56	Capparis divaricate Lam.	Capparaceae	2.90	4.83	60
57	Capparis sepiaraL.	Capparaceae	2.70	3.86	70
58	Capparis zyelanicaL.	Capparaceae	2.60	3.25	80
59	Cadabafruticose (L.) Druce	Capparaceae	3.30	5.50	60
60	Maeruuaoblongifolia(Forssk.) A.Rich.	Capparaceae	2.40	3.43	70
61	Cleome chelidoniiL.f.	Cleomaceae	2.20	2.75	80
62	Cleome gynandraL.	Cleomaceae	2.90	4.83	60
63	Cleome viscosaL.	Cleomaceae	3.30	4.71	70
64	Combretum albidumG. Don	Combratceae	1.40	2.33	60
65	Terminalia arjuna(Roxb. Ex DC.) Wight &Arn.	Combratceae	2.20	3.67	60
66	CommelinabenghalensisL.	Commelinaceae	2.30	4.60	50
67	CyanotisarachnoideaC.B. Clarke	Commelinaceae	2.40	4.00	60
68	Cyanotis axillaris(L.) D. Don ex Sweet	Commelinaceae	2.20	3.14	70
69	Cyanotis fasciculata(B. Heyne ex Roth) Schult. &Schult.f.	Commelinaceae	2.10	3.00	70
70	Convolulus arvensisL.	Commelinaceae	2.30	4.60	50
71	Convolvulus rotterianusVahl	Convoluvulaceae	2.20	3.67	60
72	Cuscuta chinensisLam.	Convoluvulaceae	2.10	4.20	50
73	CuscutareflexaRoxb.	Convoluvulaceae	2.00	3.33	60
74	Evolvulusalsinoides(L.) L.	Convoluvulaceae	2.20	4.40	50
75	Ipomea obscura(L.) Ker Gawl.	Convoluvulaceae	2.30	3.83	60
76	Ipomoea nil(L.) Roth	Convoluvulaceae	2.40	4.80	50
77	Ipomoea pes-tigrisL.	Convoluvulaceae	2.20	3.67	60
78	Ipomoea quamoclitL.	Convoluvulaceae	2.90	5.80	50
79	Alangium salviifoilum (L.f.) Wangerin	Cornaceae	1.50	2.50	60
80	Luffa cylindrica(L.) M. Roem.	Cucurbitaceae	1.90	3.80	50
81	Coccinia grandis(L.) Voigt	Cucurbitaceae	3.20	5.33	60
82	Diplocyclospalmatus(L.) C.Jeffery	Cucurbitaceae	3.30	6.60	50
83	Momordica cymbalariaFenzl	Cucurbitaceae	3.70	6.17	60
84	Mukiamadaraspatana(L.) M. Roem.	Cucurbitaceae	3.80	7.60	50
85	Cyperus compressusL.	Cyperaceae	2.20	3.67	60
86	Cyperus haspanL.	Cyperaceae	2.50	5.00	50
87	Cyperus pulchellusR.Br.	Cyperaceae	2.60	4.33	60
88	Acalypha indicaL.	Euphorbiaceae	3.30	4.71	70
89	Acalypha lanceolataWilld.	Euphorbiaceae	3.20	6.40	50
90	Chrozophora plicata(Vahl) A.Juss. ex Spreng.	Euphorbiaceae	2.50	4.17	60
91	Chrozophora rottleri (Geiseler) A. Juss. Ex Spreng.	Euphorbiaceae	2.70	4.50	60
92	Croton bonplandianusBaill.	Euphorbiaceae	3.10	6.20	50
93	Euphorbia heyneanaSpreng.	Euphorbiaceae	2.30	4.60	50
94	Euphorbia hirtaL.	Euphorbiaceae	2.60	4.33	60
95	Givotiarottleriformis (Willd.) Griff.	Euphorbiaceae	2.20	4.40	50
96	Jatropha glanduliferaRoxb.	Euphorbiaceae	3.10	5.17	60
97	Jatropha gossipifoliaL.	Euphorbiaceae	2.70	5.40	50

Table 1: Contd.,

98	Abrus precatoriusL.	Fabaceae	2.30	3.83	60
99	Albizia amara(Roxb.) B. Boivin	Fabaceae	2.50	5.00	50
100	Bauhinia racemosaLam.	Fabaceae	2.20	3.67	60
101	ClitoriaterneteaL.	Fabaceae	2.90	4.83	60
102	Crotalaria medicagineaLam.	Fabaceae	2.50	4.17	60
103	Crotalaria pusillaHeyne ex Roth	Fabaceae	2.70	5.40	50
104	Crotolariahebecarpa(DC.) Baker	Fabaceae	3.30	6.60	50
105	Cullen corylifolium(L.) Medik.	Fabaceae	2.70	4.50	60
106	Dichrostachyscineria(L.) Wight &Arn.	Fabaceae	3.50	5.00	70
107	GuilandinabonducL.	Fabaceae	3.20	5.33	60
108	Hardwickiabinate Roxb.	Fabaceae	2.20	4.40	50
109	Indigofera cordifoliaHeyne ex Roth	Fabaceae	3.40	6.80	50
110	Indigofera glandulosaWilld.	Fabaceae	3.20	5.33	60
111	Indigofera linnaeiAli	Fabaceae	2.20	3.67	60
112	Indigofera trifoliataL.	Fabaceae	3.20	6.40	50
113	Mimosa hamataWilld.	Fabaceae	2.80	5.60	50
114	Mimosa pudicaL.	Fabaceae	2.40	4.80	50
115	Pongamia pinnata(L.) Pierre	Fabaceae	2.70	4.50	60
116	Prosopis cineraria(L.) Druce	Fabaceae	2.70	4.50	60
117	Prosopis juliflora(Sw.) DC.	Fabaceae	3.00	5.00	60
118	Rhynchosiaviscosa(Roth) DC.	Fabaceae	2.20	4.40	50
119	Senna auriculata(L.) Roxb	Fabaceae	3.30	6.60	50
120	Senna occidentalis(L.) Link	Fabaceae	2.40	4.00	60
121	Senna uniflora(Mill.) H.S.Irwin& Barneby	Fabaceae	3.70	6.17	60
122	Sesbania bispinosa(Jacq.) W. Wight	Fabaceae	2.30	4.60	50
123	Stylosanthes fruticose(Retz.) Alston	Fabaceae	2.20	4.40	50
124	Stylosantheshamata(L.) Taub.	Fabaceae	2.60	4.33	60
125	Tephrosia pumila(Lam.) Pers.	Fabaceae	2.70	4.50	60
126	Tephrosia purpurea(L.) Pers.	Fabaceae	3.30	5.50	60
127	Tephrosia villosa(L.) Pers.	Fabaceae	3.70	6.17	60
128	Vachellia eburnea(L.f.) P.J.H.Hurter	Fabaceae	3.10	6.20	50
129	Vachellia farnesiana(L.) Wight &Arn.	Fabaceae	2.40	4.00	60
130	Vachellia horrida(L.) Kyal. &Boatwr.	Fabaceae	2.20	3.14	70
131	Vachellia leucophloea(Roxb.) Maslin, Seigler & Ebinger	Fabaceae	2.50	3.57	70
132	Vachellia nilotica(L.) Delile	Fabaceae	2.40	4.00	60
133	Vigna aconitifolia(Jacq.) Marechal	Fabaceae	2.70	4.50	60
134	Vigna trilobata(L.) Verdc.	Fabaceae	2.70	4.50	60
135	Vigna vexillata(L.) A.Rich.	Fabaceae	2.20	3.14	70
136	Zornia gibboseSpan.	Fabaceae	2.50	3.57	70
137	Pithecellobium dulce(Roxb.) Benth.	Fabaceae	2.50	4.17	60
138	Enicostemmaaxillare(Lam.) A.Raynal	Gentianaceae	2.20	3.14	70
139	Gyrocarpus americanusJacq.	Hernandinaceae	3.50	7.00	50
140	Anisomelesmalabarica(L.) R.Br. ex Sims	Lamiaceae	2.50	3.57	70
141	Clerodendrum phlomidisL.f.	Lamiaceae	3.30	5.50	60
142	Mesosphaerum suaveolens(L.) Kuntze	Lamiaceae	3.90	6.50	60
143	Leonotis nepetiifolia(L.) R.Br.	Lamiaceae	3.10	6.20	50
144	Leucas aspera(Willd.) Link	Lamiaceae	3.00	5.00	60
145	Leucas martinicensis(Jacq.) R.Br.	Lamiaceae	2.80	4.67	60
146	OcimumbasilicumL.	Lamiaceae	3.30	5.50	60
147	OcimumfilamentosumForssk.	Lamiaceae	2.80	4.67	60
148	Ocimum sanctumL.	Lamiaceae	3.30	5.50	60
149	Vitex negundoL.	Lamiaceae	2.80	5.60	50
150	Cassytha filiformisL.	Lauraceae	2.20	3.14	70
151	Michelia champacaL.	Magnoliaceae	1.90	2.71	70

Table 1: Contd.,

152	Abelmochusficulneus(L.) Wight &Arn.	Malvaceae	2.20	3.67	60
153	Abutilon hirtum(Lam.) Sweet	Malvaceae	2.80	4.67	60
154	Abutilon indicum(L.) Sweet	Malvaceae	2.70	4.50	60
155	Corchorus aestuansL.	Malvaceae	2.90	4.14	70
156	Corchorus olitoriusL.	Malvaceae	2.80	4.67	60
157	Grewia damineGaertn.	Malvaceae	2.20	3.67	60
158	Grewia tenax(Forssk.) Fiori	Malvaceae	2.30	3.29	70
159	Grewia villosaWilld.	Malvaceae	2.50	3.57	70
160	Hibiscus lobatusBuch.-Ham. ex Roxb.	Malvaceae	2.20	3.67	60
161	Pavonia odorataWilld.	Malvaceae	3.30	6.60	50
162	Pavonia zeylanica(L.) Cav.	Malvaceae	3.10	5.17	60
163	Sida acutaBurm.f.	Malvaceae	3.30	4.71	70
164	Sida cordata(Burm.f.) Borss.Waalk.	Malvaceae	3.20	5.33	60
165	SidarhombifoliaL.	Malvaceae	3.00	5.00	60
166	Sida spinosaL.	Malvaceae	3.10	5.17	60
167	Trimufettarhomboidei Jacq.	Malvaceae	2.90	4.14	70
168	TriumfettamalabaricaRoth	Malvaceae	2.80	4.00	70
169	Waltheria indicaL.	Malvaceae	2.70	4.50	60
170	Martynia annuaL.	Martyniaceae	2.70	4.50	60
171	Azadirachta indicaA.Juss.	Meliaceae	2.90	4.83	60
172	Melia azedarachL.	Meliaceae	2.40	3.43	70
173	Tinospora cordifolia (Willd.) Miers	Menispermaceae	2.90	4.83	60
174	Cocculus hirsutus(L.) Diels	Menispermaceae	2.80	4.67	60
175	Glinusoppositifolius(L.) Aug.DC.	Molluginaceae	2.40	3.43	70
176	Paramollugo nudicaulis(L.) Govaerts	Molluginaceae	2.20	3.67	60
177	Ficus benghalensisL.	Moraceae	2.80	4.67	60
178	Ficus religiosaL.	Moraceae	2.90	4.14	70
179	Moringa oleiferaLam.	Moringaceae	2.20	3.67	60
180	MuntingiacalaburaL.	Muntunginaceae	2.40	4.00	60
181	Syzygiumcumini(L.) Skeels	Myrtaceae	2.70	3.86	70
182	BoehraviadiffusaL.	Nyctaginaceae	3.00	5.00	60
183	BoerhaviaerectaL.	Nyctaginaceae	3.10	5.17	60
184	Jasminum arborescensRoxb.	Olacaceae	2.70	3.86	70
185	Jasminum auriculatumVahl	Olacaceae	2.40	4.00	60
186	Sopubiadelphinifolia(Roxb.) G.Don	Orobanchaceae	2.20	3.67	60
187	Striga angustifolia(D.Don) Saldanha	Orobanchaceae	2.70	4.50	60
188	Striga gesnerioides(Willd.) Vatke	Orobanchaceae	2.60	3.71	70
189	Argemone Mexicana L.	Papavaraceaea	2.90	4.14	70
190	Passiflora foetidaL.	Passifloraceae	2.50	4.17	60
191	Sesamum indicumL.	Pedaliaceae	2.20	4.40	50
192	Phyllanthus amarusSchumach. & Thonn.	Phyllanthaceae	2.80	4.67	60
193	Phyllanthus maderapatensisL.	Phyllanthaceae	2.90	4.14	70
194	Phyllanthus reticulataPoir.	Phyllanthaceae	2.20	3.67	60
195	Phyllanthus virgatusG.Forst.	Phyllanthaceae	2.70	5.40	50
196	Veronica scutellate L.	Plantaginaceae	2.50	4.17	60
197	Plumbago zeylanicaL.	Plumbaginaceae	2.70	3.86	70
198	Aristida adscensionsisL.	Poaceae	3.00	5.00	60
199	Aristida hystrix (Thunb.) Roem. & Schult.	Poaceae	3.30	5.50	60
200	Aristida setaceaRetz.	Poaceae	3.10	5.17	60
201	Bambusa arundinacea(Retz.) Willd.	Poaceae	1.90	2.71	70
202	Chloris virgataSw.	Poaceae	3.40	5.67	60
203	Cynodondactylon(L.) Pers.	Poaceae	3.70	6.17	60
204	Digitaria ciliaris(Retz.) Koeler	Poaceae	3.00	5.00	60
205	Dactyolectniumaegypticum(L.) Willd.	Poaceae	3.90	5.57	70
206	Dichanthiumannulatum(Forssk.) Stapf	Poaceae	3.10	5.17	60
207	Eragrostis minorHost	Poaceae	3.30	5.50	60

Table 1: Contd.,

208	Eragrostisviscosa(Retz.) Trin	Poaceae	3.40	5.67	60
209	Heteropogoncontortus(L.) P.Beauv. ex Roem. & Schult.	Poaceae	4.00	5.71	70
210	Trachys muricata(L.) Desv.	Poaceae	3.30	5.50	60
211	UrochloapanicoidesP.Beauv.	Poaceae	3.70	6.17	60
212	Polygala arvensisWilld.	Polygalaceae	3.30	4.71	70
213	Portulaca oleraceaL.	Portulacaceae	2.90	4.83	60
214	Portulaca Pilosa L.	Portulacaceae	2.90	4.14	70
215	Ziziphus nummularia(Burm.f.) Wight &Arn.	Rhamnaceae	2.70	4.50	60
216	Zizipusoenophila(L.) Mill.	Rhamnaceae	2.80	4.67	60
217	Canthiumcoromandelicum(Burm.f.) Alston	Rubiaceae	2.70	3.86	70
218	Catunaregam spinosa(Thunb.) Tirveng.	Rubiaceae	2.40	3.43	70
219	OldenlandiacorymbosaL.	Rubiaceae	3.30	5.50	60
220	Morinda tinctoriaRoxb	Rubiaceae	2.40	3.43	70
221	SpermacocearticularisL.f.	Rubiaceae	2.20	3.14	70
222	Spermacoce pusillaWall.	Rubiaceae	2.10	3.50	60
223	Aegle marmelos(L.) Correa	Rutaceae	2.90	4.83	60
224	Chloroxylon swietenia DC.	Rutaceae	2.20	4.40	50
225	Cardiospermum halicacabumL.	Sapindaceae	3.00	4.29	70
226	SapindusemerginatusVahl	Sapindaceae	2.00	3.33	60
227	Verbascum coromandelianum(Vahl) Kuntze	Scrophulariaceae	1.90	3.17	60
228	Datura stramoniumL.	Solanaceae	2.20	3.14	70
229	Physalis minimaL.	Solanaceae	2.40	4.00	60
230	Physalis peruvianaL.	Solanaceae	2.20	3.67	60
231	Solanum nigrumL.	Solanaceae	2.80	4.00	70
232	Solanum trilobatumL.	Solanaceae	2.20	3.67	60
233	Datura InnoxiaMill.	Solanaceae	2.10	3.50	60
234	Holoptelia integrifolia(Roxb.) Planch.	Ulmaceae	2.90	4.83	60
235	Lantana camaraL.	Verbinaceae	2.80	4.00	70
236	Priva cordifolia(L.f.) Druce	Verbinaceae	2.30	3.83	60
237	Stachyterpeta jamaicensis(L.) Vahl	Verbinaceae	2.70	5.40	50
238	Hybanthusenneaspermus(L.) F.Muell.	Violaceae	2.90	4.83	60
239	Cissus repandaVahl	Vitaceae	2.20	3.67	60
240	Balanites roxburghiiPlanch.	Zygophyllaceae	2.80	4.00	70
241	Tribulus terrestrisL.	Zygophyllaceae	3.00	5.00	60

Biodiversity indices - Shannon-Weiner Diversity Index, Simpson's Diversity Index and Species Diversity Index

The biodiversity profile of the sacred grove – Pavitra Vana Arkerawas measured using important parameters such as the Shannon-Weiner Diversity Index, Simpson's DI, and Species DI. They provided information on the abundance, distribution, and general diversity of species in this sacred grove.

Shannon-Weiner Diversity Index (4.19)

The Shannon-Weiner Diversity Index of 4.19 suggests a high level of diversification that is present in Pavitra Vana Arkera. Usually, first-order values are 1.5 to 3.5, and higher than 4 can be said to represent a very diverse list. This implies that Pavitra Vana Arkera stands as a habitat of diverse species with relatively similar richness, hence a complex and diverse ecosystem. Introducing, there was an increased Shannon-Weiner index indicating assurance of ecosystem stability and heterogeneity since the diversities will always help to buffer the effects of environmental disturbances and stressors. Some of the Selected plants shown in Plate 1.

Plate 1: Some of the Selected Plants Listed at Pavitra Vana Arkera.

Simpson's Diversity Index (1.00)

Simpson's Diversity Index is one of the types of measures in life diversity that is defined as the chance of strictly random selection of two species at random in a sample. The index takes values between 0 and 1, with the values nearer to 1 signifying relatively high levels of species diversity and the dominance of no single form. A Simpson's Diversity Index of 1.00 suggests almost maximal diversity with very low dominance of individual species. This implies a high level of species coexistence, where no single species significantly outnumbers others, fostering balanced interactions among species within the grove.

Species Diversity Index (0.71)

The Species Diversity Index value of 0.71 is another method of looking at species T, richness, and evenness. While slightly less than the Shannon-Weiner and Simpson indices, this value will also suggest that there is a high level of species diversity within the grove and that there may be one or two species that are slightly more dominant than the other species found in the grove would suggest. This diversity value might mean that there is a difference in the microenvironments in the grove, some species may include some species that are peculiar to some part of the grove only hence the slight variation in the abundance in the grove, depicted in Table 2.

Table 2: Biodiversity indices of Pavitra Vana Arkera

S. No	Sacred Grove	Shannon-Weiner Diversity Index	Simpson's Diversity Index	Species Diversity Index
1	Pavitra Vana Arkera	4.19	1.00	0.71

The Ecological Stability values are high in Shannon-Weiner and Simpson's indices indicating an ecosystem that is ecologically stable, and resilient and likely supports a range of ecological functions, including nutrient cycling, habitat provision, and pollination, given in Figure 3. High biodiversity within sacred groves like Pavitra Vana Arkera reflects their role as important refuges for local flora, potentially conserving genetic diversity and providing habitats for rare or endemic species (Magurran, 2004; Bhagwat and Rutte, 2006). The Conservation Significance of Sacred groves is that nearly every culture has some sacred grove that is a repository of biological diversity. Although this data suggests that the conservation of such bio-diverse areas should continue in order to preserve them from experiences such as deforestation, urbanization, or invasion by other species. It also helps support ecosystem services valued by people inhabiting these groves, such as providing clean air and water, acting as a buffer against climate change, or serving to sustain and promote scientific study and ecotourism (Tilman,1999; Khumbongmayum *et al.,* 2005).

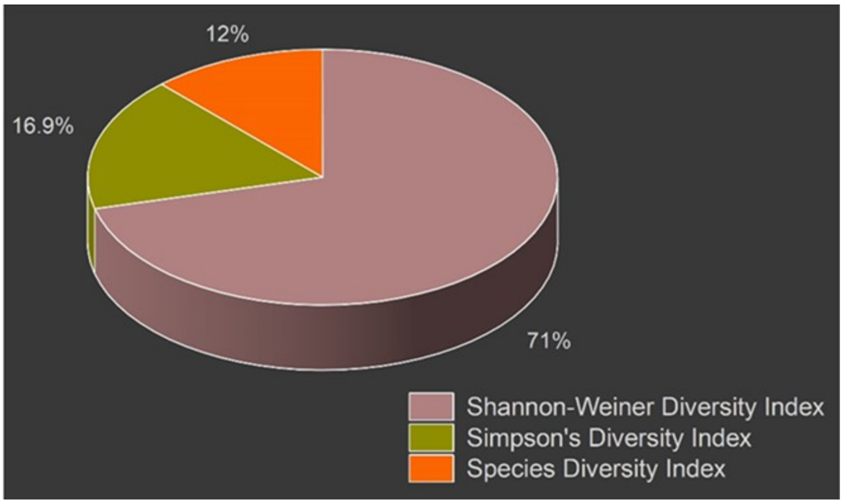

Figure 3: Biodiversity indices - Pavitra Vana Arkera.

Based on the diversity indices it is recommended that sustainable management of Pavitra Vana Arkera should maintain the current habitat features which support this level of diversity. This could include eradicating invasive species, protecting the physical landscape structure of the sacred grove, and encouraging people's knowledge of the sacred grove. Involving people in educational programs and community participation could be effective in positive conservation efforts to make people become stewards of the grove which will result in consistent protection of the grove's bio-diversity (Whittaker, 1972; Ramanujam and Kadamban, 2001).

Pavitra Vana Family and Number of Species List

The particularity of the family, the richness of the plant species in the particular ecosystem, the number of species noted per family, and similar data may provide useful information on how diverse and, in terms of ecology, valuable each of the plant families located within the area inquired might be and illustrated in Figure 4.

Dominance of Fabaceae and Malvaceae

Fabaceae and Malvaceae are the largest families of the plant with 40 and 26 species respectively as shown in Figure 5. A considerably high first authority of Fabaceae, a family that contains many nitrogen-fixing species, indicates that it may play a role as an agent of soil fertility and ecosystems. Likewise, Malvaceae which occurs virtually in all the regions of the world contributes to the promotion of species diversity and plays several functions such as acting as habitats for insects and animals (Hooper *et al*., 2005).

Diversity in Asteraceae and Poaceae

Other families to be listed as having a large number of species are Asteraceae with 18 species and Poaceae with 14 species. Asteraceae can be largely linked with pollinator support because of the flower structure which is more preferred by insect species. The grass family, Poaceae is a centre of gravity for the ground cover and combating the menace of soil erosion by holding up the structural basis of the ecosystem (Tilman *et al.,* 1997).

Presence of Ecologically Significant Families

The inclusion of such families like Cucurbitaceae (5 species), Euphorbiaceae (10 species), and Lamiaceae (10 species) warms that the unique plants were distributed caring different functions in the balance of ecosystem like ground protecting plants, medicinal plants for animals as well as feeding and nesting plants for pollinators. For instance, Lamiaceae has species that encourage pollinators and may also be useful for medical purposes hence availing more than one kind of stock, both conserving species and adding to the information resulting from traditional ethnobotanical practices (Vitousek& Walker, 1989).

Low Representation of Certain Families

Some families like Aizoaceae, Cactaceae, and Vitaceae are monotypic, meaning that in the ecosystem the species may be rare endemics, or else they may be species that are confined to micro-sites within the ecosystem. Their importance exists in the fact that they fill narrow-specialization habitats and can improve the stability of the environment to changes (Lugo and Helmer, 2004).

Ecological Implications of Family Diversity

The above plant families embrace diverse ecological roles, including nutrient cycling function by Fabaceae, soil stabilization by Poaceae, and pollination support by Asteraceae and Lamiaceae. Often, this is considered essential because different species carry out similar functions.So, if one is removed there are others who can take its place, hence the functional diversity offers protection from disturbance (Pimm *et al.*, 1988).

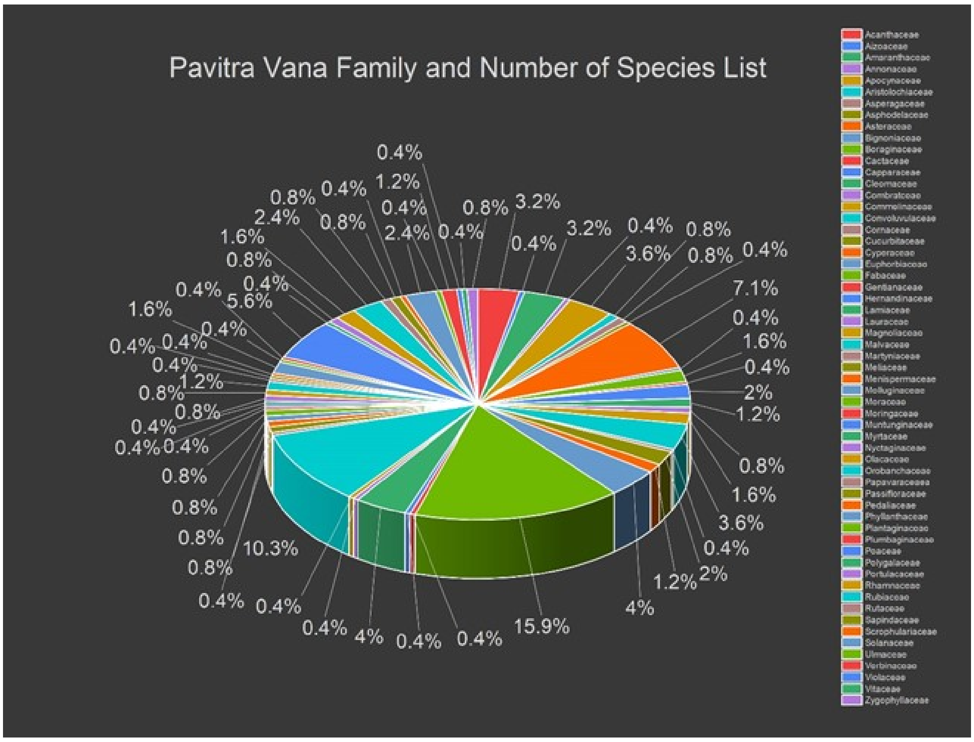

Figure 4: Pavitra Vana Family and Number of Species List.

Generic Level Distribution

Genera with High Species Representation

Four species of Vachellia, Ipomea, Indigofera, Sida, and Phyllanthus are the most dominant genera of the plant listed above and shown in Figure 6. This can be perceived as high species representation Which indicates that these generators should have a large ecological niche, probably to local conditions, and might be performing different ecological roles. For instance, species in the Vachellia genus may be associated with nitrogen fixation, which is essential in the enhancement of soil quality, Indigofera and Phyllanthus species may have some use in medicinal or other ecologically supportive qualities to do with the overall biological strength of ecosystems.

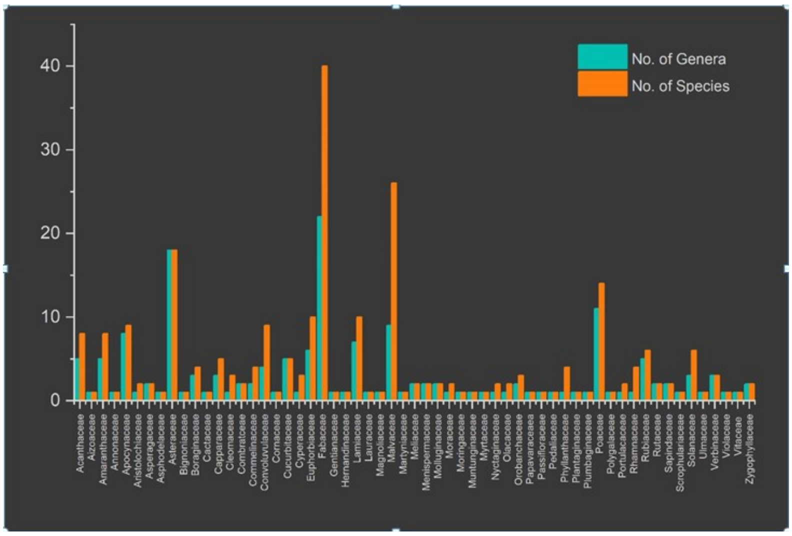

Figure 5: Family Wise Distribution.

Genera with Moderate Representation (2-3 Species)

While a number of genera boast few species, there are also those with moderate numbers of recognized varieties: for instance, there are only 3 different species of Alternanthera, Crotalaria, and Senna each. This variety creates ecological stability given that these genera may occupy different positions and have different relations with local entomofauna, pollinators, and herbivores. Other genera such as Tephrosia and Cyanotis are also worthy of mention because some of the species within them can help in attraction of pollinators and contribute to the diversification of the environment and its rational use.

Genera with Lower Representation (2 Species)

Those genera with only two species or less have their representation indicating low density but essential features to the system; the genera include Calotropis, Aristolochia, Datura, and Solanum among others. For example, members of the Calotropis genus are used in folk medicine and are drought-resistant; members of the Datura and Solanum contain species with both ecological and ethnomedical importance. These genera may reflect lower species richness but can contribute to functional divergence and thus increase the overall functional differentiation that exists within ecosystems. For instance, Ficus and Jasminum are usually hosts of some particular animal activities such as fruit-eating birds or mammals for seed dispersal.

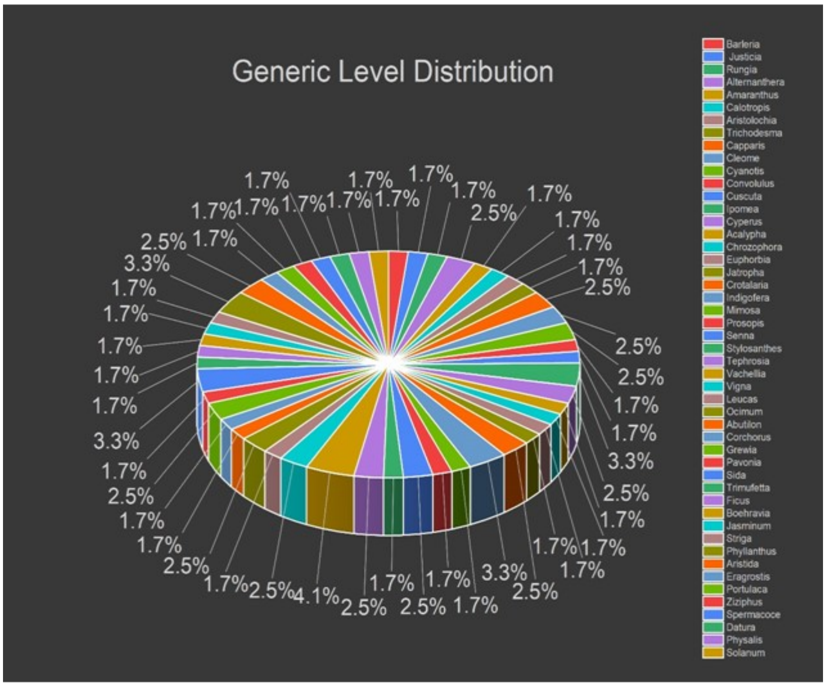

Figure 6: Generic Level Distribution.

Potential Ecological Roles and Interactions

Many of these genera, such as Prosopis, Mimosa, and Sida, are well-adapted to various environmental stresses (e.g., drought tolerance, nitrogen fixation) and contribute to the ecosystem's resilience. Genera like Leucas and Ocimum attract pollinators, supporting food webs, while Abutilon and Pavonia contribute to soil stabilization.

According to the findings of Tilaman*et al*., 1997 this shows generic diversity contributes to ecosystem production by increasing functional processes throughout species. Some genera including Vachellia and Indigofera have nitrogen-fixing properties enabling soil fertility and enhancing productivity for other species. Pimm *et al.*, 1988 have described how the unusual genera and species increase the stability of the ecological system. Restricted genera such as Aristolochia and Calotropis have fewer species but do offer an important role in terms of buffering ecosystems that might undergo alterations that can be detrimental with time as they act within more narrow ecological roles. Hooper *et al.*, 2005 agree with this by stressing functional diverseness pointing out that genera with a variety of versions (e.g., nitrogen-fixing plants in Fabaceae; pollinator support in Lamiaceae) provide more manifold esoteric services. Species such as Cyanotis and Tephrosia sustain different plant and pollinator relationships and promote increased diversity.

CONCLUSION

The findings of the results described and summarized here altogether highlight the presence of a diverse and diverse plant community in the study area, indicating a dense and diverse network of plant–plant and plantenvironment interactions that underpins stability, resilience, and a diversified biosphere. In the Species Diversity, the high of Shannon-Weiner and Simpson's Diversity Index means that species are evenly distributed in the ecosystem and none of the species highly dominate the ecosystem. This balance is beneficial as it minimizes the risk of ecosystem collapse due to the loss of any one species, thus promoting resilience against environmental pressures. Families like Fabaceae, Asteraceae, and Malvaceae exhibit the highest number of species, highlighting their adaptability to the region's environmental conditions and their ecological importance. Furthermore, the highly diverse genera can directly support key ecosystem services, including nitrogen fixation provided by Vachellia species and pollination facilitated by insects in the Phyllanthus genus, as well as soil stability. These families and genera not only function to support vast biodiversity but also play an important role in ecological service. In terms of adaptation, many genera have specific roles in the ecosystem, as are the general examples of Calotropis and Cyanotis, which provide M&S within ecosystems. This functional diversity means that no matter what happens in change, the ecosystem is protected because every genus fills the position that is vital to the well-being of the system. The remaining sacred groves like the Pavitra Vana Arkera biosphere registered a high value of species and richness indices indicating that sacred groves are the best place preservation status of special species and groups. These groves act as productive habitats and sanctuaries to species that possibly may likely face hardship in other regions. They are essential for in situ conservation, as genetic stocks and traditional knowledge, respectively. As with other tropical forests, the data presented show an intricate interlocking mechanism of various species and genera to form the ecosystem food chain and nutrient cycling and habitat creation. This feature can be envisaged through the representation of the different bio-geographical developments; the occurrence of rare and widespread genera; and the variations in plant species that play vital roles in fulfilling the different ecological niches, so as to exhibit the sustainability of the ecosystem against external pressures. This study paints a picture of a highly bio-diverse and ecologically balanced system, marked by a wide array of plant species, families, and genera that together enhance resilience, stability, and ecosystem health. The diversity observed not only enriches ecological functions but also reinforces the area's conservation value, emphasizing the need for continued protection and sustainable management to preserve this natural wealth for future generations.

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