

Angiosperm Diversity of agro-ecosystems-a case study from Kooroppada Gramapanchayath, Kottayam, Kerala State

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ABSTRACT

The diversity of angiosperms in Kooroppada gramapanchayath has been analysed. The angiosperm species diversity indicated that nine sites had uniform diversity due to plantation of agro-ecosystem in nature. The highest distribution frequencies showed by *Ageratum conyzoides*, *Glycosmis pentaphylla* and *Hevea brasiliensis* in herbs, shrubs and climbers and trees categories respectively. *Oldenlandia corymbosa*, *Psychotria flavida* and *Hevea brasiliensis* showed the highest density values among the herbs, shrubs and climbers and trees categories respectively. The abundance value showed highest in herbs by *Bambusa vulgaris* and *Bulbophyllum sterile*, in shrubs and climbers by *Psychotria flavida* and in among trees by *Hevea brasiliensis*. During the study, the Rubiaceae endemic shrub *Ixora johnsonii* Hook.f has encountered in rubber plantations. The Shannon Weiner index indicated that the species are distributed uniformly and show high diversity without dominant species.

Key words : Biodiversity assessment, Agro-ecosystems, Phytosociology

Introduction

Biodiversity is the variety of life on the Earth. It includes diversity at the genetic level, such as that between individuals in a population or between plant varieties, the diversity of species, and the diversity of ecosystems and habitats. Biodiversity has evolved over the last 3.8 billion years even though five major extinction events have been recorded over this period. Thus, the biodiversity is a result of a series of turnovers in the rate of evolution and extinction since the geological past. Assessing the status and trends of biodiversity is essential for sustainable development strategies at all levels, from village to nation to region. In India, the plant diversity was assessed by different authors. The flora and

fauna of Kerala especially in the Western Ghats in general have been discussed by several authors like Mani (1974); Ahmedullah and Nayar (1987); Nair and Daniel (1986). It was estimated that the state of Kerala has 4968 angiosperms. Besides there natural vegetation, the plantations across the state supports a variety of flora and fauna with notable conservation measures. Several endangered and vulnerable species of plants and animals are associated with the plantations in Kerala.

Materials and Methods

Study area and Physiography: The study area was the Kooroppada gramapanchayath in Kottayam district, Kerala state. It has an area of 27.42 Km². The

general elevation range consist of 20m to 70m asl of Midland region and has isolated hillocks and medium hills, midland laterites and lateritic mounds, swamps, marshes, valleys, agricultural lands, plantations and sacred groves. The major geological formation in the gramapanchayath is Archaean formation and soil type ranges from gravelly clay, clayey loamy, gravelly loam and sandy. The major stream in the panchayath is Pannamthodu, which feeds in the Meenachil River.

Floristic analysis: Plants were collected from 9 sites of the study area during different seasons. Voucher specimens were prepared using the normal herbarium techniques and deposited in the Herbarium, CMS College, Kottayam. Collected plants were identified by using standard floras (Hooker, 1872–1897; Gamble and Fischer, 1915–1936, Antony, 1989). The plants were enumerated according to APG III and the nomenclature and citations follow IPNI (2020), verified with the online databases of WCSP (2020) and The Plant List (2020). Endemism and the distribution of species were treated according to Ahmedullah & Nayar (1987), and Sasidharan (2004). RET (Rare, Endangered and Threatened) status of the species were treated as global scale based on IUCN (2020).

Phytosociological analysis: The quantitative data were gathered by quadrat method based on species-area curve method (Braun-Blanquet, 1932) for 9 sites. Frequency, density and abundance for trees, shrubs and herbs were calculated (Simpson, 1949; Shannon and Weiner, 1963; Pascal, 1988). The data were analysed for species composition, structure and profile as per Curtis and McIntosh (1951) and Shannon-Weiner's diversity index (H').

Results and Discussion

Species diversity: The plant species diversity has analysed site wise and found that the general flora dominated by herbaceous members and trees. In site I - Kaarimala, a total of 27 angiosperms including 9 herbs, 8 shrubs and climbers and 10 trees observed from the quadrat studies. In site II – Thottappalli, there are 20 angiosperms including 8 herbs, 5 shrubs and climbers and 7 trees. In the third site – Lakkattoor, 23 angiosperms including 7 herbs, 7 shrubs and climbers and 9 trees observed. The fourth site – Kandankavu has 23 angiosperms including 11 herbs, 3 shrubs and climbers and 9 trees.

The site V – Kooroppada encountered a total of 21 angiosperms including 6 herbs, 5 shrubs and climbers and 10 trees. The 6th site – Parappatupady has 19 species consists of 2 herbs, 10 shrubs and climbers and 7 trees. The site VII – Lakkattoor Temple encountered a total of 21 species of angiosperms consists of 3 herbs, 7 shrubs and climbers and 10 trees. The angiosperm diversity of site VIII – Pannagam indicated that, there are 26 species including 8 herbs, 6 shrubs and climbers and 12 trees present. The 9th site – Puthukulam has a total of 24 species including 7 herbs, 15 shrubs and climbers and 7 trees (Tables 1–3).

Distribution frequency of species: The most frequent herbs observed among the sites are *Ageratum conyzoides* (100.00) followed by *Ananas comosus*, *Axonopus compressus* and *Dissotis rotundifolia* (83.33). Among the shrubs and climbers, *Glycosmis pentaphylla* (83.33) dominated followed by *Cardiospermum halicacabum*, *Lantana camara*, *Psychotria flavida* and *Pueraria phaseoloides* (66.66). The endemic nearly threatened *Ixora johnsonii* has 50% distribution among the sites. Among the frequency of trees, *Hevea brasiliensis* (100.00) dominated followed by *Areca catechu*, *Cocos nucifera*, *Mangifera indica*, *Moringa oleifera* and *Tectona grandis* (66.66). No natural species was encountered above 50% frequency in the quadrats (Table 1).

Distribution density of species: The distribution density of herbs indicated that *Oldenlandia corymbosa* has the highest (2), followed by *Bulbophyllum sterile* (1.5), *Ananas comosus* (1.33), *Ageratum conyzoides*, *Axonopus compressus*, *Colocasia esculenta* (1.16) and *Biophytum sensitivum* (1.13). The highest density of shrubs and climbers category has noticed by *Psychotria flavida* (1.5) followed by *Glycosmis pentaphylla* (1.16), *Ixora johnsonii* and *Thottea siliquosa* (1). Among the trees, *Hevea brasiliensis* (2.66) was dominated followed by *Tectona grandis* (1.33). This distribution density is typical of plantation agroecosystem where trees are planted in uniform pattern (Table 2).

Abundance of species: The abundance of plant species in indicated a uniform pattern. Among the herbs, the highest abundance value has shown by *Bambusa vulgaris* and *Bulbophyllum sterile* (3). Among the shrubs and climbers category the highest abundance value has been shown by *Psychotria flavida* (2.66), followed by *Hemidesmus indicus*, *Ixora johnsonii* and *Thottea siliquosa* (2). The highest abun-

Table 1. Frequency of herbs, shrubs, climbers and trees from various sites (I-IX). (Species with single site location are excluded in the table, quadrat size 10×10m for trees, 5×5m for shrubs, climbers and epiphytes and 1×1m for herbs).

Botanical Name	I	II	III	IV	V	VI	VII	VIII	IX
Herbs									
<i>Ageratum conyzoides</i>	-	100	-	66.66	33.33	-	-	-	-
<i>Biophytum sensitivum</i>	-	-	-	50	-	-	66.66	50	-
<i>Centella asiatica</i>	-	-	66.66	-	66.66	-	-	-	33.33
<i>Cleome rutidosperma</i>	-	50	33.33	66.66	-	-	-	-	-
<i>Curculigo orchoides</i>	-	-	-	33.33	-	-	66.66	-	-
<i>Dissotis rotundifolia</i>	-	83.33	-	-	-	33.33	-	33.33	-
<i>Justicia japonica</i>	66.66	33.33	50	-	-	-	-	-	-
<i>Mimosa pudica</i>	66.66	-	66.66	-	50	-	-	-	-
<i>Naragamia alata</i>	-	-	-	50	-	-	-	33.33	-
<i>Oldenlandia corymbosa</i>	83.33	-	66.66	-	-	-	-	-	-
<i>Ophiorrhiza mungos</i>	50	-	-	-	-	-	-	50	-
<i>Peperomia pellucida</i>	50	-	33.33	66.66	33.33	33.33	-	50	50
<i>Phyllanthus amarus</i>	66.66	66.66	-	-	-	-	-	-	-
<i>Torenia bicolor</i>	-	-	-	33.33	-	-	-	33.33	33.33
<i>Vandellia pedunculata</i>	50	-	50	50	50	-	-	-	-
Shrubs and Climbers									
<i>Canthium angustifolium</i>	-	-	33.33	-	50	-	-	-	-
<i>Cayratia pedata</i>	50	16.66	-	-	-	-	-	33.33	33.33
<i>Chasalia curviflora</i>	33.33	-	33.33	-	-	-	50	-	-
<i>Gloriosa superba</i>	33.33	-	50	-	-	50	33.33	-	33.33
<i>Glycosmis pentaphylla</i>	50	33.33	50	66.66	-	83.33	-	-	50
<i>Ixora coccinea</i>	16.66	-	-	-	-	-	33.33	-	-
<i>Ixora johnsonii</i>	50	50	-	33.33	50	-	-	-	33.33
<i>Leea latifolia</i>	16.66	-	16.66	-	-	-	-	-	-
<i>Psychotria flavida</i>	50	-	50	-	-	-	33.33	66.66	50
<i>Rauvolfia serpentina</i>	-	-	-	33.33	33.33	-	33.33	-	33.33
<i>Salacia fruticosa</i>	-	-	-	-	-	-	-	33.33	33.33
Trees									
<i>Aegle marmelos</i>	-	-	16.66	-	-	-	16.66	-	16.66
<i>Alstonia scholaris</i>	-	16.66	16.66	-	-	-	-	-	-
<i>Areca catechu</i>	66.66	33.33	-	-	66.66	-	-	-	-
<i>Artocarpus heterophyllus</i>	33.33	-	-	50	-	-	33.33	-	33.33
<i>Artocarpus hirsutus</i>	50	16.66	-	16.66	-	-	-	-	-
<i>Caryota urens</i>	-	-	-	16.66	-	-	-	16.66	-
<i>Citrus maxima</i>	-	33.33	-	-	-	-	-	33.33	-
<i>Cocos nucifera</i>	50	-	-	66.66	-	33.33	33.33	-	-
<i>Ficus benghalensis</i>	-	-	-	-	33.33	-	16.66	-	-
<i>Garcinia gummi-gutta</i>	16.66	-	16.66	33.33	-	-	50	-	16.66
<i>Hevea brasiliensis</i>	100	-	83.33	66.66	-	83.33	-	66.66	83.33
<i>Mangifera indica</i>	66.66	50	16.66	66.66	66.66	-	-	-	33.33
<i>Saraca asoca</i>	-	-	-	16.66	16.66	-	-	-	-
<i>Strychnos nux-vomica</i>	16.66	-	-	-	-	-	-	50	-
<i>Tectona grandis</i>	-	50	-	66.66	-	66.66	-	50	33.33

dance value among the trees shown by *Hevea brasiliensis* (2.66) followed by *Alstonia scholaris*, *Annona squamosa*, *Caryota urens* and *Tectona grandis* (2) (Table 3).

Shannon-Weiner's diversity index: Shannon-

Weiner's diversity index (H'), was calculated from the study area ranges from 1.18886 to 1.38273 which indicated that, the area has uniform distribution and rich in diversity (Table 4).

Table 2. Density of herbs, shrubs, climbers and trees from various sites (I-IX). (Species with single site location are excluded in the table).

Botanical Name	I	II	III	IV	V	VI	VII	VIII	IX
Herbs									
<i>Ageratum conyzoides</i>		1.16		1.16	0.5				
<i>Biophytum sensitivum</i>				1.33			1	0.66	
<i>Centella asiatica</i>			0.66		0.83				0.33
<i>Cleome rutidosperma</i>		0.66	0.33	0.66					
<i>Curculigo orchiooides</i>				0.33			0.83		
<i>Dissotis rotundifolia</i>		1				0.5		0.33	
<i>Justicia japonica</i>	1.16	0.33	0.5						
<i>Mimosa pudica</i>	1.16		0.66		0.83				
<i>Naragamia alata</i>				0.83				0.33	
<i>Oldenlandia corymbosa</i>	2		0.66						
<i>Ophiorrhiza mungos</i>	1							0.66	
<i>Peperomia pellucida</i>	1		0.33	0.83	0.5	0.33		0.66	0.66
<i>Phyllanthus amarus</i>	1.16	0.83							
<i>Torenia bicolor</i>				0.33				0.33	0.5
<i>Vandellia pedunculata</i>	1		0.5	0.5	0.66				
Shrubs and Climbers									
<i>Canthium angustifolium</i>			0.33		0.66				
<i>Cayratia pedata</i>	0.5	0.16						0.33	0.5
<i>Chasalia curviflora</i>	0.5		0.33				0.66		
<i>Gloriosa superba</i>	0.5		0.5			0.66	0.33		0.5
<i>Glycosmis pentaphylla</i>	0.66	0.33	0.66	1.16		1			0.83
<i>Ixora coccinea</i>	0.16						0.5		
<i>Ixora johnsonii</i>	1	0.66		0.66	0.66				0.66
<i>Leea latifolia</i>	0.16		0.16						
<i>Psychotria flavida</i>	1.33		0.66				0.66	0.83	1.5
<i>Pueraria phaseoloides</i>		0.83							
<i>Rauvolfia serpentina</i>				0.33	0.33		0.5		0.33
<i>Salacia fruticosa</i>								0.33	0.33
Trees									
<i>Aegle marmelos</i>			0.16				0.16		0.16
<i>Alstonia scholaris</i>		0.16	0.33						
<i>Areca catechu</i>	0.83	0.33			0.66				
<i>Artocarpus heterophyllus</i>	0.33			0.66			0.5		0.5
<i>Artocarpus hirsutus</i>	0.66	0.16		0.16					
<i>Caryota urens</i>				0.33				0.16	
<i>Citrus maxima</i>		0.33						0.33	
<i>Cocos nucifera</i>	0.5			0.66		0.33	0.33		
<i>Ficus benghalensis</i>					0.33		0.16		
<i>Garcinia gummi-gutta</i>	0.16		0.16	0.33			0.5		0.16
<i>Hevea brasiliensis</i>	2.66		1.33	1.33		1		1.16	1.33
<i>Mangifera indica</i>	0.83	0.5	0.16	0.83	0.66				0.33
<i>Oroxylum indicum</i>			0.16			0.33			0.16
<i>Saraca asoca</i>				0.16	0.16				
<i>Strychnos nux-vomica</i>	0.16							0.66	
<i>Tectona grandis</i>		0.5		1.33		0.83		0.66	0.33

Summary and Conclusion

The biodiversity assessment indicated that there are 402 known angiosperms species in 101 families oc-

curred in different areas. Among this, the family Fabaceae is dominated with 37 members followed by Malvaceae and Apocynaceae with 19 members each. The angiospermic flora has a total of 20

Table 3. Abundance of herbs, shrubs, climbers and trees from various sites (I-IX). (Species with single site location are excluded in the table).

Botanical Name	I	II	III	IV	V	VI	VII	VIII	IX
Herbs									
<i>Ageratum conyzoides</i>	-	1.16	-	1.75	1.5	-	-	-	-
<i>Biophytum sensitivum</i>	-	-	-	2.66	-	-	1.5	1.33	-
<i>Centella asiatica</i>	-	-	1	-	1.25	-	-	-	1
<i>Cleome rutidosperma</i>	-	1.33	1	1	-	-	-	-	-
<i>Curculigo orchioides</i>	-	-	-	1	-	-	1.25	-	-
<i>Dissotis rotundifolia</i>	-	1	-	-	-	1.5	-	1	-
<i>Justicia japonica</i>	1.75	1	1	-	-	-	-	-	-
<i>Mimosa pudica</i>	1.75	-	1	-	1.66	-	-	-	-
<i>Naragamia alata</i>	-	-	-	1.66	-	-	-	1	-
<i>Oldenlandia corymbosa</i>	2.4	-	1	-	-	-	-	-	-
<i>Ophiorrhiza mungos</i>	2	-	-	-	-	-	-	1.33	-
<i>Peperomia pellucida</i>	2	-	1	1.25	1.5	1	-	1.33	1.33
<i>Phyllanthus amarus</i>	1.75	1.25	-	-	-	-	-	-	-
<i>Torenia bicolor</i>	-	-	-	1	-	-	-	1	1.5
<i>Vandellia pedunculata</i>	2	-	1	1	1.33	-	-	-	-
Shrubs and Climbers									
<i>Canthium angustifolium</i>	-	-	1	-	1.33	-	-	-	-
<i>Cayratia pedata</i>	1	1	-	-	-	-	-	1	1.5
<i>Chasalia curviflora</i>	1.5	-	1	-	-	-	1.33	-	-
<i>Gloriosa superba</i>	1.5	-	1	-	-	1.33	1	-	1.5
<i>Glycosmis pentaphylla</i>	1.33	1	1.33	1.75	-	1.2	-	-	1.66
<i>Ixora coccinea</i>	1	-	-	-	-	-	1.5	-	-
<i>Ixora johnsonii</i>	2	1.33	-	2	1.33	-	-	-	2
<i>Leea latifolia</i>	1	-	1	-	-	-	-	-	-
<i>Psychotria flavida</i>	2.66	-	1.33	-	-	-	2	1.25	3
<i>Rauwolfia serpentina</i>	-	-	-	1	1	-	1.5	-	1
<i>Salacia fruticosa</i>	-	-	-	-	-	-	-	1	1
Trees									
<i>Aegle marmelos</i>	-	-	1	-	-	-	1	-	1
<i>Alstonia scholaris</i>	-	1	2	-	-	-	-	-	-
<i>Areca catechu</i>	1.25	1	-	-	1	-	-	-	-
<i>Artocarpus heterophyllus</i>	1	-	-	1.33	-	-	1.5	-	1.5
<i>Artocarpus hirsutus</i>	1.33	1	-	1	-	-	-	-	-
<i>Caryota urens</i>	-	-	-	2	-	-	-	1	-
<i>Citrus maxima</i>	-	1	-	-	-	-	-	1	-
<i>Cocos nucifera</i>	1	-	-	1	-	1	1	-	-
<i>Ficus benghalensis</i>	-	-	-	-	1	-	1	-	-
<i>Garcinia gummi-gutta</i>	1	-	1	1	-	-	1	-	1
<i>Hevea brasiliensis</i>	2.66	-	1.6	2	-	1.2	-	1.75	1.6
<i>Mangifera indica</i>	1.25	1	1	1.25	1	-	-	-	1
<i>Oroxylum indicum</i>	-	-	1	-	-	1	-	-	1
<i>Saraca asoca</i>	-	-	-	1	1	-	-	-	-
<i>Strychnos nux-vomica</i>	1	-	-	-	-	-	-	1.33	-
<i>Tectona grandis</i>	-	1	-	2	-	1.25	-	1.33	1

Table 4. Shannon Weiner diversity index of different sites of Kooroppada gramapanchayath.

Sites	I	II	III	IV	V	VI	VII	VIII	IX
Shannon Weiner Index H'	1.18886	1.22537	1.28259	1.29091	1.31946	1.24074	1.23724	1.36535	1.38273

endemics including 5 RET species. The vegetation profile includes 125 herbs, 98 shrubs, 49 climbers and 118 trees. There are 137 cultivated, 83 deciduous, 75 evergreen, 33 common, 25 degraded, 22 wetland, 18 riparian and 8 grassland species observed from the geographical boundaries. The angiosperm species diversity indicated that the highest distribution frequencies are shown by *Ageratum conyzoides*, *Glycosmis pentaphylla* and *Hevea brasiliensis* in herbs, shrubs and climbers and trees categories respectively. *Oldenlandia corymbosa*, *Psychotria flavida* and *Hevea brasiliensis* showed the highest density values among the herbs, shrubs and climbers and trees categories respectively. The abundance value showed highest in herbs by *Bambusa vulgaris* and *Bulbophyllum sterile*, in shrubs and climbers by *Psychotria flavida* and in among trees by *H. brasiliensis*. This clearly indicated the plantation ecosystem dominance and distribution of natural endemic species with good density, abundance among the plantations.

The area has also recorded that the worst invasive alien species, which are often naturalized and destroyed the native vegetation. However, it was hopeful to observe that among these invasive species, *Ixora johnsonii* and *P. flavida* - two endemic Rubiaceae shrubs still survives. The major threats of the natural flora of the area are land reclamation for buildings in the agricultural field, surface sand mining for roads, buildings, unethical use of agrochemicals and weed infestation. Therefore urgent conservation measures are required to protect the diversity of the study site.

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