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Plant diversity of Keelakurichi vettikaruppar sacred groves from Pudukottai district, Tamil Nadu

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Abstract
The floristic wealth of Keelakurichi Vettikaruppar Sacred Grove of Pudukottai district, Tamil Nadu was analyzed and reported for the first time. It revealed the total number of 168 plant species belonging to 148 genera and 58 families in this grove was documented with Angiosperm Phylogeny Group IV classification. Habit-wise analysis of the herbaceous plants dominated with 66 species followed by trees (36), shrubs (32), climbers (29), and lianas (5) from this grove. The presence of these plant species emphasized the undisturbed status of this grove regarding floristic wealth. In the present scenario, environmental awareness programme should be implemented among the local community to educate them about the ecological significance of sacred groves for the preparation of Conservation and management plan to attain sustainable biological wealth.

Keywords: angiosperm diversity, vettikaruppar sacred grove, Tamil Nadu, APG IV

Introduction

Nature worship has been a key force in shaping human attitudes towards conservation and sustainable utilization of natural resources. Such traditional practices have been invariably operating in different parts of India (Anthwal *et al*. 2006) [1]. Sacred groves are the tracts of virgin forest that were left untouched by the local inhabitants, harbor rich biodiversity, and are protected by the local people due to their cultural and religious beliefs and taboos that the deities reside in them (Gadgil and Vartak, 1975; Khiewtam and Rama krishnan, 1989; Rama krishnan, 1996; Chandra shekara and Sankar 1998, Kanowski *et al*. 1999) [7, 22, 31, 4, 19]. It is believed that these sacred virgin forests date back to thousands of years when human society was in a primitive state. Gadgil and Vartak (1975) [7] have traced the historical link of the sacred groves to the pre-agricultural, hunting, and gathering stage of societies. These virgin forests are believed to be pre-Vedic in origin and the area of sacred groves ranges from few square meters to several hectares. Sacred groves serve as a home for several birds and mammals and indirectly have a symbiotic relationship with other animal species conservation (Islam *et al*. 1998) [14].

Sacred groves are the repositories of rare and endemic species and can be regarded as the remnant of the primary forest left untouched by the local inhabitants and protected then due to the belief that the deities reside in these forests. Many people have described sacred groves in different ways. However, there is an evident fact that wherever sacred groves existed, indigenous traditional societies have spiritual relationships with the existing physical environment that sustained them. The role of sacred groves in the conservation of biodiversity has long been recognized (Kosambi, 1962; Gadgil and Vartak, 1976; Haridasan and Rao, 1985; Khan *et al*. 1997; 2008; Raja *et al*. 2019) [23, 6, 10, 20-21, 30]. In India, several reports have been discussed on the floristic wealth of sacred groves from several states including Tamil Nadu. In this paper, the plant diversity of Keelakurichi Vettikaruppar Sacred Grove from Pudukottai district of Tamil Nadu state was discussed to prepare the conservation and management plan to protect the biodiversity of sacred groves in India.

Materials and Methods

Study area

The study area Keelakurichi Vettikaruppar Sacred Grove is located at Keelakurichivillage and covers an area of about 12 hectares and 5 km away from Irumbaalytown of Ilupur Taluk, Pudukottai district, Tamil Nadu. Geographically it is laying at 78°43.857' E Longitude and 10°29.112' N Latitude. The worshipping deity in this sacred grove is the Vettikaruppar God. Temperature is moderately high and the average temperature during summer is 34°C and fewer less in winter. The average humidity ranges from 31 to 33% from November to December. Annual rainfall is ranging from 850 to 910mm. However, during the two decades, the district has experienced rainfall only below normal. Most of the rains occur during the northeast monsoon. Soil is a ferruginous type with an admixture of limestone. The soil is shallow in rocky areas and deeper in a valley with little or no humus (Envis 2016).

The vegetation of Keelakurichi Vettikaruppar Sacred Grove is a tropical dry evergreen forest type (Champion and Seth, 1968) [3]. The dominant tree species include *Albiziaamara*, *Drypetessepiaria*, *Grewiaoppositifolia*, *Memecylonumbellatum*, *Pterospermumcanescens*, *Wrightiatinctoria*, *Catunaregamspinosa*, etc., shrubs include *Clausenadentata*, *Dodonaeaviscosa*, *Euphorbiaantiquorum*, *Glycosmispentaphylla*, *Tarrenaasiatica*, etc., climbing herbs include *Asparagus racemosus*, *Cocculushisrutus*, *Pergulariadaemia*, etc., herbs include *Euphorbia hirta*,

Indigoferalinnaei, *Ruelliatuberosa*, *Eragrostisviscosa*, *Perotisindica*and *Cynodondactylon*etc.

Plant Collection and Identification

Intensive botanical field visits were made during the year 2019-2020 to explore the floristic composition and the conservation status of the Keelakurichi Vettikaruppar Sacred Grove of Pudukottai district, Tamil Nadu. The coordinates (latitude and longitude) of this study site were recorded by using the GPS (Garmin). All the plant specimens available in the study areas were collected with flower or fruit or both and the herbarium specimens are prepared by following the standard procedure (Jain and Rao1976) [16]. Photographs of the plant species were also taken by digital camera. The herbarium specimens were identified with the help of published regional floras, the *Flora of the Presidency of Madras* (Gamble and Fischer, 1915-1936) [8], *The Flora of British India* (Hooker, 1872 - 1897) [13], and *The Flora of Tamil Nadu Carnatic* (Matthew, 1981). *The Flora of Tamil Nadu* (Henry *et al*. 1987; 1989; Nair and Henry 1983) [11-10, 27] has been referred for the correct identification. The updated nomenclature status was also cross-checked with online resources (POWO 2021; The Plant List 2013; The Herbarium Catalogue 2021) [29, 37, 36]. The herbarium specimen was prepared for all the plants and deposited at the Post Graduate Department of Botany, M.R. Arts and Science College, Mannargudi, for reference.

Results and Discussion

In the present study, a total of 168 plant species including subspecies and varieties taxa belonging to 148 genera and 58 families were recorded from Keelakurichi Vettikaruppar Sacred Grove of Pudukottai district, Tamil Nadu. The arrangement of flora was followed with APG IV (2016) Classification (Table 1). During this observed Fabaceae is a dominant family with 20 species and followed by Apocynaceae with 12 species, Rubiaceae and Malvaceae with 9 species each, Acanthaceae with 8 species, Lamiaceae with seven species, Euphorbiaceae, and Rutaceae with 6 species each (Figure 1). Similarly *Euphorbia* was the dominant genus represented 4plant species followed by *Senna* and *Sida*with 3 species each and *Albizia*, *Barleria*, *Ziziphus*, *Ficus* and with 2 species each respectively. Besides, Habit-wise distribution, herbs were the dominant habit represented by 66 species, followed by woody species such as trees with 36 species, shrubs with 32 species, climbers with 29 species, and Lianas with 5 species (Figure 2). In this study, we recorded two insectivore plants species *viz*. *Drosera indica* and *D. burmanii*. Also, we observed stem parasitic plants such as *Dendrophthoe falcata* and *Cuscuta reflexa* from the trees of *Vachellia* and *Azadirachta*. In this study we recorded *Chloroxylon swietenia, Drosera burmanni, D. indica*, Cyperus rotundus, *Aegle marmelos*, *Ziziphus mauritiana*, *Commelina benghalesis*, and *Centella asiatica* are threatened plants they are assed by IUCN (2021) [15].

A similar type of work was reported by various authors such as Mani and Parthasarathy (2006) [25] reported 77 species of tree diversity in 61 genera and 30 families from four sacred groves of the Coromandel Coast of Peninsular India. Sridhar Reddy and Parthasarathy (2006) [35] enumerated 35 tree species, 32 genera, and 22 families from four sacred groves of the Pudukottai district. Ramanujam and Praveen Kumar Cyril (2003) [33] reported 47 tree species from four sacred groves in the Pondicherry region of South India. Upadhaya *et al*., (2003) [38] reported 82 species, 59 genera, and 39 families from along and Raliang sacred groves of the Jaintia Hills in Meghalaya, northeast India. Ramanujam *et al*., (2007) [34] recorded 423 flowering plants from 37 SG sites in and around the Pondicherry region. John Britto *et al*., (2001a) [17] recorded 260 plant species belonging to 176 genera and 62 families from Malliganatham, and John Britto *et al.,* (2001b) [18] recorded 224 plant species belonging to 175 genera and 63 families from Vamban sacred grove of Pudukottai district. While Ganesan *et al*., (2007) recorded 133 plant species from SGs around and around Pallipatty village of Madurai district. Similarly the insectivorous plant, *Drosera burmannii* has been reported at Olagapuram SG (Ramanujam and Kadamban, 2001) [32], Marakkanam forest (Balasubramanian, 1977) [2].

Conclusion

From the present study, it is concluded that the sacred groves play a vital role in the Protection of biodiversity in society. Today this grove is important as banks of genetic diversity that have to be preserved and sustained. There is an utmost necessity in preserving, restoring, and proper management plan due to its high ecological significance. In addition, environmental awareness programmes on the importance of sacred groves in Conservation biology should be implemented to the public for sustainable conservation.

Table 1: Enumeration of plant species from Keelakurichi vettikaruppar sacred grove of pudukottai district, Tamil Nadu.

S. No.	Botanical Name	Family	Habit
1.	*Aristolochia indica* L.	Aristolochiaceae	Climber
2.	*Cassytha filiformis* L.	Lauraceae	Climber
3.	*Dioscorea oppositifolia* L.	Dioscoreaceae	Climber
4.	*Gloriosa superba* L.	Colchicaceae	Herb
5.	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Herb
6.	*Aloe vera* (L.) Burm.f.	Asphodelaceae	Herb
7.	*Agave americana* L.	Asparagaceae	Herb
8.	*Asparagus racemosus*Willd.	Asparagaceae	Climber
9.	*Sansevieria roxburghiana* Schult. &Schult.f.	Asparagaceae	Herb
10.	*Borassus flabellifer* L.	Arecaceae	Tree
11.	*Commelina benghalensis* L.	Commelinaceae	Herb
12.	*Cyperus rotundus* L.	Cyperaceae	Herb
13.	*Cymbopogon martini* (Roxb.) W.Watson	Poaceae	Herb
14.	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb
15.	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Herb

16.	*Eragrostis viscosa* (Retz.) Trin.	Poaceae	Herb
17.	*Perotis indica* (L.) Kuntze	Poaceae	Herb
18.	*Cissampelos pareira* L.	Menispermaceae	Climber
19.	*Cocculus hirsutus* (L.) W.Theob.	Menispermaceae	Climber
20.	*Tiliacora acuminata*(Lam.) Hook.f. &Thoms.	Menispermaceae	Climber
21.	*Tinospora cordifolia* (Willd.) Hook.f.	Menispermaceae	Climber
22.	*Cissus quadrangularis* L.	Vitaceae	Climber
23.	*Cyphostemma setosum* (Roxb.) Alston	Vitaceae	Climber
24.	*Tribulus terrestris* L.	Zygophyllaceae	Herb
25.	*Abrus precatorius* L.	Fabaceae	Climber
26.	*Albizia amara* (Roxb.) B.Boivin	Fabaceae	Tree
27.	*Albizia lebbeck* (L.) Benth.	Fabaceae	Tree
28.	*Alysicarpus monilifer* (L.) DC.	Fabaceae	Herb
29.	*Bauhinia racemosa* Lam.	Fabaceae	Tree
30.	*Derris scandens* (Roxb.) Benth.	Fabaceae	Climber
31.	*Dichrostachys cinerea* (L.) Wight &Arn.	Fabaceae	Shrub
32.	*Indigofera aspalathoides*Vahl ex DC.	Fabaceae	Herb
33.	*Indigofera linnaei* Ali	Fabaceae	Herb
34.	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree
35.	*Mimosa pudica* L.	Fabaceae	Herb
36.	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree
37.	*Prosopi sjuliflora* (Sw.) DC.	Fabaceae	Tree
38.	*Pterolobium hexapetalum* (Roth) Santapau&Wagh	Fabaceae	Liana
39.	*Senna auriculata* (L.) Roxb.	Fabaceae	Shrub
40.	*Senna occidentalis* (L.) Link	Fabaceae	Herb
41.	*Senna tora* (L.) Roxb.	Fabaceae	Herb
42.	*Tamarindus indica* L.	Fabaceae	Tree
43.	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Herb
44.	*Vachellia nilotica* (L.) P.J.H. Hurter &Mabb. subsp. *indica* (Benth.) Kyal. &Boatwr.	Fabaceae	Tree
45.	*Scutia myrtina* (Burm.f.) Kurz	Rhamnaceae	Shrub
46.	*Ventilago maderaspatana*Gaertn.	Rhamnaceae	Liana
47.	*Ziziphus jujuba* Mill.	Rhamnaceae	Tree
48.	*Ziziphus oenopolia* (L.) Mill.	Rhamnaceae	Shrub
49.	*Holoptelea integrifolia* Planch.	Ulmaceae	Tree
50.	*Ficus benghalensis* L.	Moraceae	Tree
51.	*Ficus religiosa* L.	Moraceae	Tree
52.	*Streblus asper* Lour.	Moraceae	Tree
53.	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Climber
54.	*Cassine glauca* (Rottb.) Kuntze	Celastraceae	Tree
55.	*Gymnosporia emarginata* (Willd.) Thwaites	Celastraceae	Shrub
56.	*Loeseneriella obtusifolia* (Roxb.) A.C.Sm.	Celastraceae	Liana
57.	*Reissantia indica* (Willd.) N.Halle	Celastraceae	Liana
58.	*Drypetes sepiaria* (Wight &Arn.) Pax&K.Hoffm.	Putranjivaceae	Tree
59.	*Hybanthus enneaspermus* (L.) F.Muell.	Violaceae	Herb
60.	*Flacourtia indica* (Burm.f.) Merr.	Salicaceae	Shrub
61.	*Acalypha indica* L.	Euphorbiaceae	Herb
62.	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb
63.	*Euphorbia antiquorum*L.	Euphorbiaceae	Shrub
64.	*Euphorbia hirta* L.	Euphorbiaceae	Herb
65.	*Euphorbia hypercifolia* L.	Euphorbiaceae	Herb
66.	*Euphorbia tortilis*Rottler ex Ainslie	Euphorbiaceae	Shrub
67.	*Hugonia mystax* L.	Linaceae	Shrub
68.	*Breyniavitis-idaea* (Burm.f.) C.E.C.Fisch.	Phyllanthaceae	Shrub
69.	*Flueggea leucopyrus*Willd.	Phyllanthaceae	Shrub
70.	*Phyllanthus amarus*Schumach. &Thonn.	Phyllanthaceae	Herb
71.	*Phyllanthus maderaspatensis* L.	Phyllanthaceae	Herb
72.	*Combretum ovalifolium*Roxb.	Combretaceae	Liana
73.	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree
74.	*Memecylon umbellatum*Burm. f.	Melastomataceae	Tree
75.	*Cardiospermum halicacabum* L.	Sapindaceae	Climber
76.	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Climber
77.	*Lepisanthes tetraphylla*Radlk.	Sapindaceae	Shrub
78.	*Sapindus emarginatus*Vahl	Sapindaceae	Tree
79.	*Aegle marmelos* (L.) Correa	Rutaceae	Tree
80.	*Atalantia monophylla* DC.	Rutaceae	Tree
81.	*Chloroxylon swietenia* DC.	Rutaceae	Tree
82.	*Clausena dentata* (Willd.) Roem.	Rutaceae	Shrub
83.	*Glycosmis mauritiana* (Lam.) Tanaka	Rutaceae	Shrub

84.	*Toddalia asiatica* (L.) Lam.	Rutaceae	Climber
85.	*Azadirachta indica*A.Juss.	Meliaceae	Tree
86.	*Abutilon indicum* (L.) Sweet	Maalvaceae	Herb
87.	*Grewia bracteata* Roth	Maalvaceae	Shrub
88.	*Grewia carpinifolia*Juss.	Maalvaceae	Shrub
89.	*Pavonia procumbens* (Wight &Arn.) Walp.	Maalvaceae	Herb
90.	*Sida acuta*Burm.f.	Maalvaceae	Herb
91.	*Sida cordata* (Burm.f.) Borss.Waalk.	Maalvaceae	Herb
92.	*Sida cordifolia* L.	Maalvaceae	Herb
93.	*Pterospermum canescens* Roxb.	Maalvaceae	Tree
94.	*Thespesia populnea*(L.) Soland. ex Correa	Maalvaceae	Tree
95.	*Azima tetracantha* Lam.	Salvadoraceae	Shrub
96.	*Cadaba fruticosa* (L.) Druce	Capparaceae	Shrub
97.	*Capparis divaricata* Lam.	Capparaceae	Shrub
98.	*Crateva adansonii* subsp. *odora* (Buch.-Ham.) Jacobs	Capparaceae	Tree
99.	*Cleome viscosa* L.	Cleomaceae	Herb
100.	*Dendrophthoe falcata* (L.f.) Ettingsh.	Loranthaceae	Shrub
101.	*Antigonon leptopus* Hook. &Arn.	Polygonaceae	Climber
102.	*Drosera burmannii* Vahl	Droseraceae	Herb
103.	*Drosera indica* L.	Droseraceae	Herb
104.	*Aerva lanata* (L.) Juss.	Amaranthaceae	Herb
105.	*Gomphrena serrata* L.	Amaranthaceae	Herb
106.	*Boerhavia diffusa* L.	Nyctaginaceae	Herb
107.	*Glinus oppositifolius* (L.) Aug.DC.	Molluginaceae	Herb
108.	*Trigastrotheca pentaphylla* (L.) Thulin	Molluginaceae	Herb
109.	*Alangium salviifolium* (L.f.) Wangerin	Cornaceae	Tree
110.	*Madhuca longifolia* (J.Koenig ex L.) J.F. Macbr.	Sapotaceae	Tree
111.	*Mimuso pselengi* L.	Sapotaceae	Tree
112.	*Diospyros ebenum*J.Koenig ex Retz.	Ebenaceae	Tree
113.	*Diospyros montana*Roxb.	Ebenaceae	Tree
114.	*Benkara malabarica* (Lam.) Tirveng.	Rubiaceae	Shrub
115.	*Catunaregam spinosa* (Thunb.) Tirveng.	Rubiaceae	Shrub
116.	*Ixorapavetta* Andrews	Rubiaceae	Shrub
117.	*Mitragyna parvifolia* (Roxb.) Korth.	Rubiaceae	Tree
118.	*Morinda coreia*Buch.-Ham.	Rubiaceae	Tree
119.	*Oldenlandia umbellata* L.	Rubiaceae	Herb
120.	*Pavetta indica* L.	Rubiaceae	Shrub
121.	*Spermacoce hispida* L.	Rubiaceae	Herb
122.	*Tarenna asiatica* (L.) Kuntze ex K.Schum.	Rubiaceae	Shrub
123.	*Strychnosnux-vomica* L.	Loganiaceae	Tree
124.	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	Shrub
125.	*Caralluma adscendens* var. *attenuata*(Wight) Grav. &Mayur.	Apocynaceae	Herb
126.	*Carissa carandas* L.	Apocynaceae	Shrub
127.	*Carissa spinarum* L.	Apocynaceae	Shrub
128.	*Gymnema sylvestre* (Retz.) R.Br. ex Sm.	Apocynaceae	Climber
129.	*Hemidesmus indicus* (L.) R. Br. ex Schult.	Apocynaceae	Climber
130.	*Ichnocarpus frutescens* (L.) W.T.Aiton	Apocynaceae	Climber
131.	*Leptadeni areticulata* (Retz.) Wight &Arn.	Apocynaceae	Climber
132.	*Pergulari adaemia* (Forssk.) Chiov.	Apocynaceae	Climber
133.	*Vincetoxicum indicum* (Burm.f.) Mabb.	Apocynaceae	Climber
134.	*Wattakaka volubilis* (L.f.) Stapf	Apocynaceae	Climber
135.	*Wrightia tinctoria* R.Br.	Apocynaceae	Tree
136.	*Coldenia procumbens* **L.**	Boraginaceae	Herb
137.	*Ehretia microphylla* Lam.	Boraginaceae	Shrub
138.	*Heliotropium indicum* L.	Boraginaceae	Herb
139.	*Cuscuta reflexa*Roxb.	Convolvulaceae	Climber
140.	*Evolvulus alsinoides* (L.) L.	Convolvulaceae	Climber
141.	*Rivea hypocrateriformis* Choisy	Convolvulaceae	Climber
142.	*Xenostegia tridentata* (L.) D.F.Austin& Staples	Convolvulaceae	Climber
143.	*Solanum torvum* Sw.	Solanaceae	Shrub
144.	*Solanum virginianum* L.	Solanaceae	Herb
145.	*Jasminium angustifolium*(L.) Willd.	Oleaceae	Climbar
146.	*Bacopa monnieri* (L.) Wettst.	Plantaginaceae	Herb
147.	*Pedalium murex* L.	Pedaliaceae	Herb
148.	*Andrographis echioides* (L.) Nees	Acanthaceae	Herb
149.	*Barleria cuspidata*F.Heyne ex Nees	Acanthaceae	Herb
150.	*Barleria prionitis* L.	Acanthaceae	Herb
151.	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Acanthaceae	Herb

152.	*Justicia glauca*Rottler	Acanthaceae	Herb
153.	*Justicia tranquebariensis*L.f.	Acanthaceae	Herb
154.	*Rostellularia diffusa* var.*prostrata* (Roxb. ex C.B. Clarke) J.L. Ellis	Acanthaceae	Herb
155.	*Ruellia prostrata*Poir.	Acanthaceae	Herb
156.	*Leucas aspera* (Willd.) Link	Lamiaceae	Herb
157.	*Mesosphaerum suaveolens* (L.) Kuntze	Lamiaceae	Herb
158.	*Ocimum americanum* L.	Lamiaceae	Herb
159.	*Ocimum tenuiflorum* L.	Lamiaceae	Herb
160.	*Premna corymbosa*Rottler&Willd.	Lamiaceae	Shrub
161.	*Vitex negundo* L.	Lamiaceae	Tree
162.	*Volkameria inermis* L.	Lamiaceae	Shrub
163.	*Acanthospermum hispidum* DC.	Asteraceae	Herb
164.	*Ageratum conyzoides* (L.) L.	Asteraceae	Herb
165.	*Sphaeranthus indicus* L.	Asteraceae	Herb
166.	*Tridax procumbens* (L.) L.	Asteraceae	Herb
167.	*Vicoa indica* (L.) DC.	Asteraceae	Herb
168.	*Centella asiatica* (L.) Urb.	Apiaceae	Herb

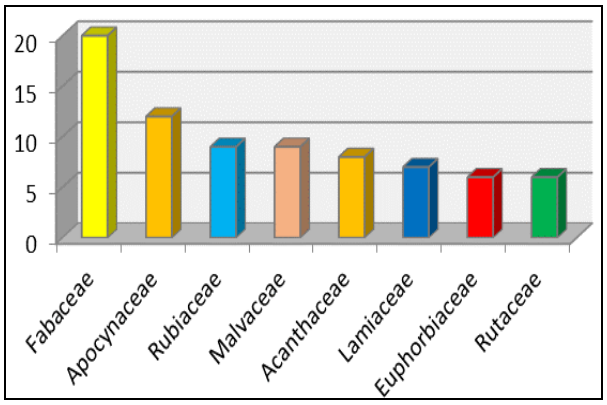

Fig 1: Dominant families of Keelakurichi vettikaruppar sacred grove

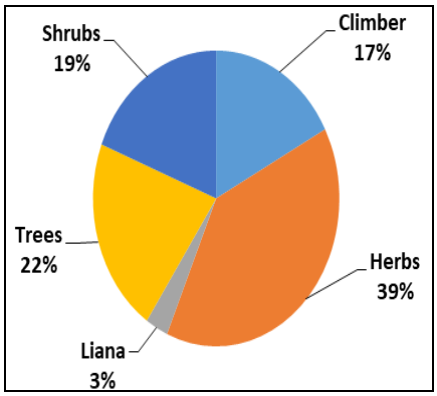

Fig 2: Habit-wise distribution of plants from Keelakurichi vettikaruppar sacred grove.

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