

# Eco-restoration: A case study conducted at Mannur Siva Temple and Vadayil Kavu Pachathuruthu areas of Kozhikode District, Kerala State

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## Abstract

Received: 09.07.2023

Revised and Accepted: 8.10.2023

**Key Words:** Eco-restoration, biodiversity, floristic studies, Mannur Shiva Temple, Vadayil Kavu, Pachathuruthu, Haritha Keralam Mission, Kadalundi, Kozhikode, Kerala.

A detailed floristic survey of Mannur Shiva Temple (MST) and Vadayil Kavu (VDK) 'Pachathuruthu' eco-restoration areas established by the Haritha Keralam Mission, in Kadalundi Grama Panchayath of Kozhikode district, Kerala state, India was attempted. In total, 171 species were reported from both the study areas, out of which 41 species were common to both. In both the locations, majority of the plants enumerated were having Indo-malesian distribution. Second and third were either Tropical American or Pantropical distributions. There were 25 endemics and 68 medicinal plants at MST, while at VDK, there were 9 endemics and 49 medicinal plants. About 25 species enumerated from MST and 17 from VDK were not found represented in the *Flora of Calicut*. The conservational importance of such 'Pachathuruthu' areas of the state, need for conducting detailed biodiversity studies and continuous monitoring, finding solutions for proper funding for the maintenance and development of these eco-restoration areas etc. are also discussed.

## 1. Introduction

Biodiversity is the variety of different forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem they form. Relative to the range of habitats, biotic communities and ecological processes in the biosphere, biodiversity is vital in a number of ways including promoting the aesthetic value of the natural environment, contribution to our material well-being through utilitarian values by providing food, fodder, fuel, timber and medicine (Rawat & Agarwal, 2015). The effective

conservation of biodiversity is essential for human survival and the maintenance of ecosystem processes (Paoliet al, 2010). Thousands of species are threatened with extinction as a result of human activities. Future population growth and economic development are forecasted to impose unprecedented levels of extinction risk on many more species worldwide (Tilman *et al.*, 2017). Recent extinction rates are 100 to 1000 times their pre-human levels in well-known, but taxonomically diverse groups from widely different environments. If all species currently deemed "threatened" become extinct in the next century,

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then future extinction rates will be 10 times of the recent rates (Pimm et al, 1995). It is in this context, the concept of Ecological restoration gains attention worldwide.

### **Ecological restoration:**

It was on 1 March 2019, the United Nations (UN) General Assembly (New York) declared 2021-2030 as the 'UN Decade on Ecosystem Restoration' (Waltham et al, 2020; Singh et al, 2021). This call to action has the purpose of recognizing the need to massively accelerate global restoration of degraded ecosystems, to fight the climate heating crisis, enhance food security, provide clean water and protect biodiversity on the planet. Our state Kerala, has also initiated a mission of ecorestoration, named as 'Pachathuruth' (which means 'Green Islands'), implemented by the *Haritha Kerala Mission* of Kerala Government.

### **Pachathuruthu:**

'Pachathuruthu' is Kerala's creative and purposeful initiative in ecological restoration activities. This project aims to find and conserve barren areas including in public areas and create and preserve natural biodiversity groves by including unique trees and indigenous plants. It is implemented with the cooperation of local self-governing bodies, Mahatma Gandhi Deshiya Rural Employment Guarantee Scheme, Ayyangali Urban Employment Scheme, Social Forestry Division of Forest Department, Agriculture Department, Biodiversity Board and Biodiversity Monitoring Committees at local government level, environmental organizations,

educational institutions and people's representatives.

This project was planned to get implemented in 500 acres of land spread across 250 village panchayats. Saplings of indigenous trees and plants are planted in fallow lands and vacant spots available in public places as part of the scheme. The land area is identified by local bodies. The land owned by government departments and institutions, 'puramboku' land, vacant land in cities are covered under this project. So far 1683 'Pachathuruthus' have been established in 658 local self-government bodies in the state till the month of November 2020. Out of this, 1493 *Pachathuruthu* are in grama panchayats, 159 in municipalities and 31 in municipal corporations. Kasargod district is leading in number with 431 *Pachathuruthu*. Thiruvananthapuram district is in the second place with 276 nos. Idukki district with 32 panchayaths has the least number (Seema, 2019, 2020, 2022).

In Kozhikode district, there are 117 *Pachathuruths* in 68 local government bodies. They are spread over a total area of 30.594 acres. 11,752 saplings are being planted as part of the *Pachathuruths* in Kozhikode. Among these, *Kallikkunnu Pachathuruth* situated near Calicut Medical college is the one having largest area (200 cents) followed by *Haritham Aranyam Pachathuruth* situated at Atholi panchayath (150 cents) and *Ponnundamala Pachathuruth* situated at Koorachundu panchayath (100 cents). There are areas such as *Makkootam* (Kunnamangalam) and *Kollolath Thazham* (Perumanna) which are having only one cent area. Some of

these conservation areas, as in the case of both these study areas, are located in well protected Sacred groves (Seema, 2020).

### Why this study?

We could learn that after the establishment of the various *Pachathuruth* areas in Kerala mostly in 2019, only a single survey was conducted to understand their status after their formation. This was conducted in 2021, at the beginning of summer season when majority of the herbaceous plants dried off. Hence a detailed picture about the biodiversity was lacking in the report published after that (Seema, 2022). In Kozhikode district, this survey was conducted in February 2021 by the first author in selected *Pachathuruth* of the district, which includes both the study sites, viz. Mannur Shiva temple and Vadayil Kavay.

It was in this context, that we planned to conduct a detailed biodiversity exploration in these areas, during the monsoon and winter seasons also, so that this paucity of information is resolved. It will also form a voluntary service from our side to help the *Haritha Kerala Mission* in this regard. Hence, we know that the present study conducted in two areas which are actually sacred groves, will turn helpful to bring out the biodiversity potential of these areas. We are sure that, if such studies are carried out in all the *Pachathuruth* areas of the state, they will yield wonderful

information on these ecorestoration areas, thereby helping the authorities to plan environmentally sustainable policies and programmes for their conservation and management.

## 2. Materials and Methods

### 2.1 Study Area

Both the *Pachathuruth* are as where the studies were conducted are located in the Kadalundi Grama panchayath of Kozhikode district, Kerala State.

#### Kadalundi Grama Panchayath:

Kadalundi grama panchayat is situated in the Kozhikode taluk of Kozhikode district. The area is 11.83 square kilometers. It is bounded by Feroke Municipality and Beypore Panchayats in the North, Chelembra Panchayat in Malappuram District in the East, Arabian Sea in the West and Vallikunnu Panchayat in Malappuram District in the South. According to the 2011 census, the population of the panchayat is 42,516. There are altogether 22 wards, viz. Chaliyam Beach North, High School, Chaliyam Angadi, Murukallingal West, Murukallingal East, Vadakkumbad, Karakali, Mannur North, Prabodhini, Mannur Valavu, Alunkal, Keezhkkod, Kaithavalappu, Kadalundi East, Edachira, Mannur Central, Pazhanchannur, Kadalundi West, Vakkadavu, Kappalangadi, Kadukka Bazar and Chaliyam Kadukka Bazar (Ref: <https://dop.lsgkerala.gov.in>).

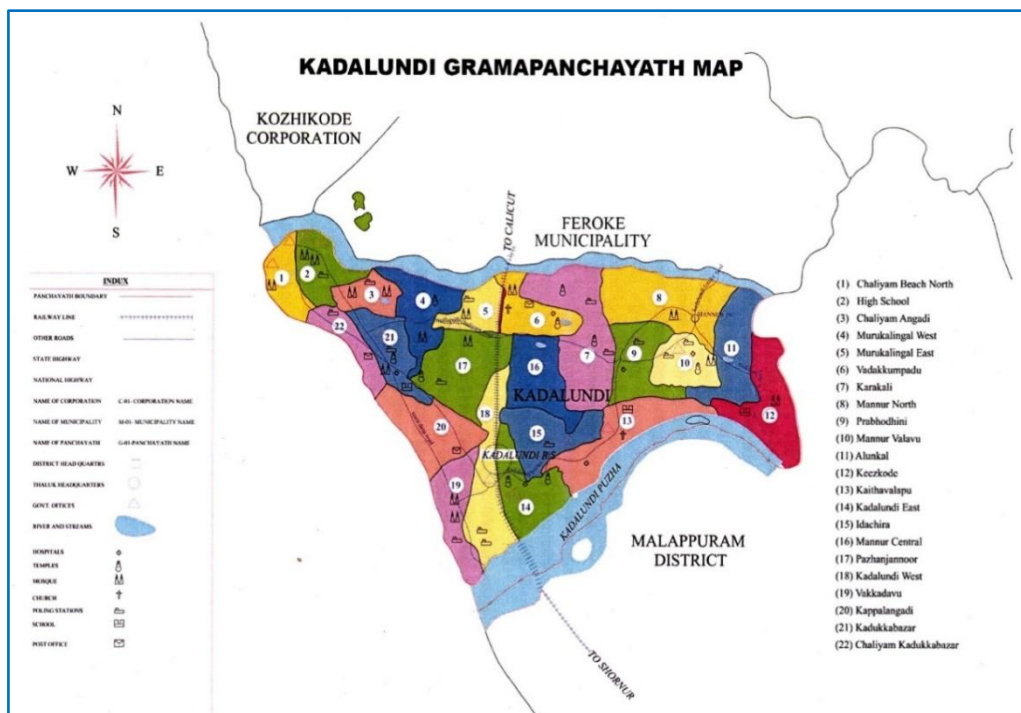


Fig. 1. Map of the Kadalundi Grama Panchayath

### Mannur Siva temple Pachathuruth

It is located at the entrance of the Mannur Shiva temple, on its left side. It is having a unique 'gaja prishta sreekovil' – sanctum sanctorum in the shape of backside of an elephant. It is about 5 km away from the Feroke Railway station and 18 km away from Calicut Airport. It is located at an altitude of 11.58 m above sea level within the geo-coordinates of 11.152°N Latitude and 75.833°E Longitude.

The Pachathuruth which was established on 25/09/2019 is situated in the Ward - 6 (Vadakkumbad. It consists of 20 cents of land and about 55 seedlings comprising of various species were planted here during 2019. During the survey conducted on 13/02/2021, a total of 37 species which included 2 herbs, 6 shrubs, 3 climbers and 26 trees were

enumerated (Kishore Kumar, 2022 - pers. comm., Seema, 2022).

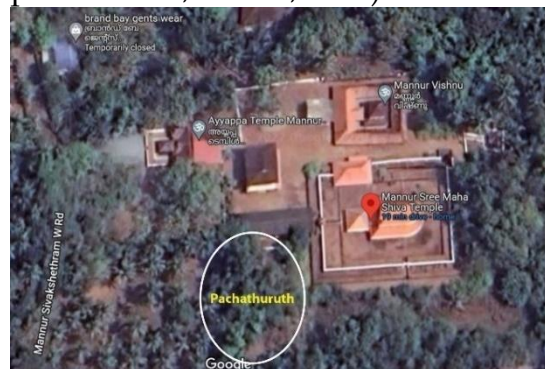


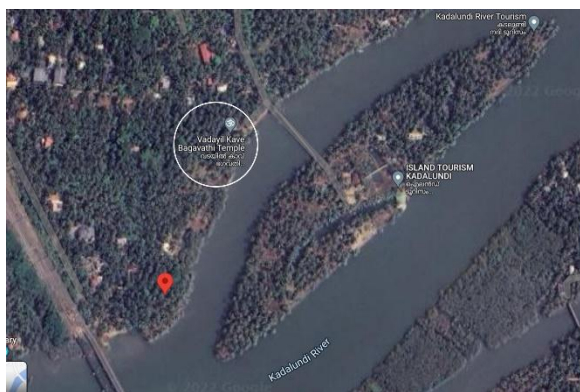
Fig. 2. Mannur Siva Temple Pachathuruth - location photos

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### Vadayil Kavu Pachathuruth

This Pachathuruth is located less than 1 km away from the Kadalundi Railway gate. It is actually the premises of the Vadayilkavu Bhagavathy temple. Towards the south it is bordered by the Kadalundi River with lot of mangrove species on the shores. During monsoon, the area near the shores remain flooded. It is located at an altitude of 11.52 m above sea level in the geo-coordinates of 11.132°N Latitude and 75.830°E Longitude.



The Pachathuruth which was established on 07/09/2020 is situated in the Ward - 14 (Kadalundi East) of the Panchayath. It consists of 50 cents of land and about 180 seedlings comprising of various species were planted here in the premises of the temple. During the survey conducted on 13/02/2021, a total of 22 species which included 4 herbs, 2 shrubs, 1 climber and 15 trees were enumerated (Kishore Kumar, 2022 - pers. comm., Seema, 2022).



**Fig. 3. Vadayil Kavu Pachathuruth- location photos**

### 2.2 Methods

Field trips were conducted to the study area during 2 seasons - monsoon and winter (summer survey being already conducted in 2021). The Haritha Kerala Mission authorities, ward members etc were interviewed to learn the history of the locality and to collect other information. The plants were identified using the floras such as, *Flora of Calicut* (Manilal & Sivarajan, 1982), *Flowering plants of Kerala* (Sasidharan, 2004), *Flora of the Presidency of Madras* (Gamble & Fischer, 1915-1936) etc and their world distribution statuses were collected

from the websites such as [powo.science.kew.org](http://powo.science.kew.org), [keralaplants.in](http://keralaplants.in),

[eflorakerala.com](http://eflorakerala.com), [indiabiodiversity.org](http://indiabiodiversity.org), etc. the RET and Endemic plants were evaluated using publications such as Henry *et al* (1979), Ahmedulla & Nayar (1987), Basha & Nair (1991), Karunakaran *et al* (1991), Environmental Information System (ENVIS) etc. The medicinal plants were analyzed using the book, *Oushadha Sasyangal* (Neshamani, 1985) and *Flowering plants of Kerala* available in the interactive DVD format (Sasidharan, 2011).

### 3. Results and Discussion

#### 3.1. Documentation

Since there were 2 study sites, details regarding the both are given under separate headings. The species collected are enumerated in the alphabetic order of family names under which the species names are given in the alphabetic order. The most recent taxonomic nomenclature

is adopted (Sasidharan, 2014; ICN, 2017). The phenology and world distribution of the species is also provided. The study areas, *Mannur Siva Temple Pachathuruth* and *Vadayil Kavu Pachathuruth* are often abbreviated as MST and VDK respectively.

**Table 1: Details regarding the flora of Mannur Siva Temple and Vadayil Kavu Pachathuruth**

No	Scientific name	Habit	Family	Fl. & Fr.	World Distribution	MST	VDK	Remarks
1	<i>Acanthus ilicifolius</i>	S	Acanthaceae	Dec - Jul	Indo-Malesia and Australia		√	
2	<i>Andrographis paniculata</i>	H	Acanthaceae	Mar - Dec	Peninsular India and Sri Lanka	√		M, E
3	<i>Asystasia dalzelliana</i>	H	Acanthaceae	Sep - Jan	Tropical Asia and Africa	√	√	
4	<i>Dipterocanthus prostratus</i>	H	Acanthaceae	Oct - Apr	India	√		E
5	<i>Justicia procumbens</i>	H	Acanthaceae	Jun - Dec	Indo-Malesia and Australia	√	√	NR
6	<i>Rhinacanthus nasutus</i>	S	Acanthaceae	Nov - Feb	India, Sri Lanka, Java and Madagascar	√		M
7	<i>Achyranthes aspera</i>	H	Amaranthaceae	Oct - Mar	Pantropical	√		M
8	<i>Alternanthera bettzickiana</i>	H	Amaranthaceae	Oct - Feb	Native of Tropical America; now getting naturalised in Asia	√	√	NR
9	<i>Pancratium triflorum</i>	H	Amaryllidaceae	Mar - May	India and Sri Lanka	√		M, E
10	<i>Anacardium occidentale</i>	T	Anacardiaceae	Nov - Apr	Native of South America; now widely cultivated in Asia and Africa	√		M
11	<i>Holigarna arnottiana</i>	T	Anacardiaceae	Jan - Jul	Southern Western Ghats	√	√	M, E
12	<i>Alstonia scholaris</i>	T	Apocynaceae	Oct - Feb	South and South East Asia to Australia	√		M



13	<i>Cerbera odollam</i>	T	Apocynaceae	Jul - Nov	Indo-Malesia		√	M
14	<i>Ichnocarpus frutescens</i>	C	Apocynaceae	Aug - Mar	Indo-Malesia and Australia	√	√	M
15	<i>Tabernaemontana divaricata</i>	S	Apocynaceae	TTY	Native of Southern Himalayas	√		
16	<i>Thevetia peruviana</i>	S	Apocynaceae	TTY	Native of tropical Peru, widely naturalized.	√		
17	<i>Arisaema leschenaultii</i>	H	Araceae	Jul - Sep	Southern western Ghats	√		M, E, NR
18	<i>Colocasia esculenta</i>	H	Araceae	May - Oct	Pantropical	√	√	M
19	<i>Pothos scandens</i>	C	Araceae	Oct - Nov	India to Malesia and Madagascar	√	√	
20	<i>Areca catechu</i>	T	Arecaceae	TTY	Cultivated from India to the Solomon Islands and less commonly in Africa and Tropical America		√	M
21	<i>Caryota urens</i>	T	Arecaceae	Jan - Apr	Indo-Malesia	√		
22	<i>Cocos nucifera</i>	T	Arecaceae	TTY	Cultivated throughout the tropic,		√	M
23	<i>Ageratum conyzoides</i>	H	Asteraceae	Aug - Dec	Pantropical	√	√	M
24	<i>Blumea axillaris</i>	H	Asteraceae	Jan - Nov	Indo-Malesia to Australia and Africa	√		
25	<i>Blumea oxyodonta</i>	H	Asteraceae	Oct - May	Indo-Malesia and South China	√		
26	<i>Chromolaena odorata</i>	S	Asteraceae	Nov - May	November-May	√		
27	<i>Eclipta prostrata</i>	H	Asteraceae	TTY	Pantropical	√	√	M
28	<i>Elephantopus scaber</i>	H	Asteraceae	Jan - Oct	Pantropical	√	√	M
29	<i>Eleutheranthera ruderalis</i>	H	Asteraceae	May - Nov	Native of Tropical America; now established in several Asian countries		√	NR
30	<i>Emilia sonchifolia</i>	H	Asteraceae	Jul - Dec	Tropical and Subtropical Africa and Asia	√		M



31	<i>Sphaeranthus indicus</i>	H	Asteraceae	Jan - Apr	Indo-Malesia, Australia and Africa	√		M
32	<i>Synedrella nodiflora</i>	H	Asteraceae	TTY	Native of West Indies	√		
33	<i>Tridax procumbens</i>	H	Asteraceae	TTY	Native of Tropical America; now widespread throughout tropics and subtropics	√	√	
34	<i>Vernonia cinerea</i>	H	Asteraceae	TTY	Pantropics	√	√	M
35	<i>Wedelia trilobata</i>	H	Asteraceae	Jun - Sep	Native of Tropical America		√	NR
36	<i>Avicennia officinalis</i>	T	Avicenniaceae	Apr - Nov	Indo-Malesia to Pacific Oceans		√	M
37	<i>Impatiens flaccida</i>	H	Balsaminaceae	Jul - Oct	South India and Sri Lanka	√		E
38	<i>Tecoma stans</i>	S	Bignoniaceae	Dec - Apr	Native of South America; now widely cultivated	√		
39	<i>Cleome burmannii</i>	H	Capparaceae	Feb - Aug	Indo-Malesia	√		
40	<i>Carica papaya</i>	T	Caricaceae	TTY	Native of Tropical America cultivated in the tropics and subtropics	√	√	M
41	<i>Calycotris floricunda</i>	C	Combretaceae	Jan - May	Indo-malesia	√		M
42	<i>Terminalia bellirica</i>	T	Combretaceae	Dec - Jan	Indo-Malesia	√	√	M
43	<i>Terminalia catappa</i>	T	Combretaceae	Mar - Jan	Malaysia to North Australia and in the tropic		√	
44	<i>Terminalia chebula</i>	T	Combretaceae	Feb - Aug	South Asia		√	M, NR
45	<i>Terminalia cuneata</i>	T	Combretaceae	Nov - Jun	India and Sri Lanka	√		M, E, NR
46	<i>Commelina paludosa</i>	H	Commelinaceae	Nov - Dec	Himalayas and India	√		NR
47	<i>Cyanotis arachnoidea</i>	H	Commelinaceae	Aug - Nov	Peninsular India and Srilanka	√		E, NR
48	<i>Connarus wightii</i>	S	Connaraceae	Mar - May	Western Ghats	√		E, NR





49	<i>Costus speciosus</i>	H	Costaceae	Jul - Oct	Indo-Malesia	√	√	M
50	<i>Cyperus iria</i>	H	Cyperaceae	Nov - Dec	Tropical Asia and East Africa; introduced in U.S.A and West Indies	√	√	
51	<i>Cyperus tenuispica</i>	H	Cyperaceae	TTY	Tropical and Subtropical Africa and Asia		√	
52	<i>Fimbristylis dichotoma</i>	H	Cyperaceae	Mar - Dec	Pantropical		√	
53	<i>Kyllinga nemoralis</i>	H	Cyperaceae	Jul - Nov	Pantropical	√		M
54	<i>Dioscorea alata</i>	C	Dioscoreaceae	TTY	India	√		M, E, NR
55	<i>Dioscorea bulbifera</i>	C	Dioscoreaceae	Sep - Oct	Paleotropics	√		M
56	<i>Dioscorea spicata</i>	C	Dioscoreaceae	Aug - Dec	India and Sri Lanka,		√	E, NR
57	<i>Elaeocarpus serratus</i>	T	Elaeocarpaceae	Apr - Sep	Indo-Malesia	√		NR
58	<i>Antidesma montanum</i>	T	Euphorbiaceae	Jan - Dec	Indo-Malesia and East Himalayas	√	√	
59	<i>Briedelia retusa</i>	T	Euphorbiaceae	Aug - Dec	Indo-Malaya	√		
60	<i>Euphorbia hirta</i>	H	Euphorbiaceae	TTY	Native of Tropical America; now Pantropical		√	M
61	<i>Macaranga peltata</i>	T	Euphorbiaceae	Jan - Feb	India, Sri Lanka and Andamans	√	√	M
62	<i>Mallotus philippensis</i>	T	Euphorbiaceae	Oct - Mar	Indo-Malesia and Australia	√		M
63	<i>Microstachyschae maelea</i>	H	Euphorbiaceae	Jul - Dec	Indomalesia to Australia	√		M, NR
64	<i>Phyllanthus emblica</i>	T	Euphorbiaceae	Jul - Feb	Throughout the tropics	√		M
65	<i>Phyllanthus urinaria</i>	H	Euphorbiaceae	Jul - Oct	Native of Tropical East Asia; now a Circumtropical weed	√		M
66	<i>Tragia involucrata</i>	H	Euphorbiaceae	Jul - Dec	India and Sri Lanka		√	M, E
67	<i>Saraca asoca</i>	T	Fabaceae	Feb - Aug	India and Myanmar	√		



68	<i>Bauhinia variegata</i>	T	Fabaceae (Caesalpinioideae)	Sep - May	Possibly native of China; wild in the sub Himalayan and India	√		NR
69	<i>Cassia fistula</i>	T	Fabaceae (Caesalpinioideae)	Feb - Sep	Indo-Malesia	√	√	M
70	<i>Saraca asoca</i>	T	Fabaceae (Caesalpinioideae)	Feb - Aug	India and Myanmar		√	M
71	<i>Abrus precatorius</i>	C	Fabaceae (Faboideae)	Oct - May	Pantropical		√	M NR
72	<i>Centrosema molle</i>	C	Fabaceae (Faboideae)	Sep - Jan	Native of America, introduced in India	√		
73	<i>Dalbergia latifolia</i>	T	Fabaceae (Faboideae)	Aug - Sep	Indo-Malesia		√	NR
74	<i>Derris trifoliata</i>	C	Fabaceae (Faboideae)	Jan - Oct	Paleotropic		√	M
75	<i>Desmodium triflorum</i>	H	Fabaceae (Faboideae)	Jul - Dec	Indo-Malesia and Australia	√		M
76	<i>Galactia tenuiflora</i>	C	Fabaceae (Faboideae)	Oct - Feb	Indo-Malesia, Australia and Africa	√		NR
77	<i>Gliricidia sepium</i>	T	Fabaceae (Faboideae)	Mar - May	Native of South America; Introduced and now widely grown in India	√		
78	<i>Pongamia pinnata</i>	T	Fabaceae (Faboideae)	Apr - Dec	Indo-Malesia	√	√	M
79	<i>Pterocarpus marsupium</i>	T	Fabaceae (Faboideae)	Sep - Oct	India and Sri Lanka	√	√	M, E, NR
80	<i>Vigna umbellata</i>	C	Fabaceae (Faboideae)	Oct - Dec	Indo-Malesia	√		NR
81	<i>Adenanthera pavonina</i>	T	Fabaceae (Mimosoideae)	Jan - Sep	Sri Lanka, North East India, Myanmar, Thailand, Malesia and China	√	√	
82	<i>Mimosa pudica</i>	H	Fabaceae (Mimosoideae)	Jul - Jan	Native of South America; now Pantropical	√	√	M
83	<i>Canscora pauciflora</i>	H	Gentianaceae	Oct - Nov	Endemic to Western ghats	√		M, E
84	<i>Rhynchoglossum notonianum</i>	H	Gesneriaceae	Jul - Dec	South West India and Sri Lanka	√		E
85	<i>Curculigo orchoides</i>	H	Hypoxidaceae	Jun - Dec	Indo-Malesia		√	M



86	<i>Hyptis suaveolens</i>	S	Lamiaceae	Aug - Feb	Originally from America now Pantropical	√		
87	<i>Leucas aspera</i>	H	Lamiaceae	Sep - Jan	Indo-Malesia	√		M
88	<i>Leucas lavandulifolia</i>	H	Lamiaceae	Jul - Oct	Indo-Malesia and East Asia	√		M, NR
89	<i>Ocimum tenuiflorum</i>	S	Lamiaceae	TTY	Palaeotropic	√	√	M
90	<i>Platostoma hispidum</i>	H	Lamiaceae	Sep - Dec	Indo-Malesia	√		
91	<i>Pogostemon atropurpureus</i>	S	Lamiaceae	Feb - May	Southern Western Ghats	√		M, E, NR
92	<i>Careya arborea</i>	T	Lecythidaceae	Feb - Jul	Tropical Areas	√		M
93	<i>Asparagusracemosus</i>	C	Liliaceae	Jul - Aug	Paleotropic		√	M
94	<i>Gloriosa superba</i>	C	Liliaceae	Jul - Dec	Paleotropic		√	M
95	<i>Hugonia mystax</i>	C	Linaceae	Aug - Oct	India and Sri Lanka	√		M, E
96	<i>Strychnos nuxvomica</i>	T	Loganiaceae	Mar - Dec	Indo-Malesia		√	M
97	<i>Lagerstroemia speciosa</i>	T	Lythraceae	Mar - Nov	Indo-Malesia	√		M
98	<i>Hibiscus rosa-sinensis</i>	S	Malvaceae	TTY	Native of Pacific Islands; cultivated in Tropical and Subtropical countries	√	√	M
99	<i>Malvaviscus penduliflorus</i>	S	Malvaceae	TTY	Native of Tropical America	√		
100	<i>Sida cordata</i>	H	Malvaceae	Jan - Apr	Pantropical	√		M
101	<i>Thespesia populnea</i>	T	Malvaceae	Mar - Jun	Pantropical		√	M
102	<i>Azadirachta indica</i>	T	Meliaceae	Feb - Sep	Indo-Malesia	√		M
103	<i>Swietenia macrophylla</i>	T	Meliaceae	Apr - Mar	Native of Central America		√	NR
104	<i>Anamirta cocculus</i>	C	Menispermaceae	Aug - Dec	Indo-Malesia	√	√	M



105	<i>Cyclea peltata</i>	C	Menispermaceae	Apr - May	India and Sri Lanka	√		M, E
106	<i>Tiliacora acuminata</i>	C	Menispermaceae	Apr - Dec	India, Sri Lanka and South East Asia		√	M
107	<i>Artocarpus heterophyllus</i>	T	Moraceae	Nov - Apr	Widely cultivated in the tropics, origin probably South India	√		
108	<i>Artocarpus incisus</i>	T	Moraceae	Jan - Jun	Native of Pacific Islands		√	
109	<i>Ficus religiosa</i>	T	Moraceae	Nov - Feb	East Himalayas; planted and naturalised in India and neighbouring countries	√	√	M
110	<i>Musa paradisiaca</i>	H	Musaceae	TTY	Cultivated throughout the tropic		√	M
111	<i>Syzygium cumini</i>	T	Myrtaceae	Dec - Apr	Indo-Malesia	√	√	M
112	<i>Jasminum angustifolium</i>	C	Oleaceae	Nov - Mar	Peninsular India and Sri Lanka		√	M, E
113	<i>Jasminum malabaricum</i>	S	Oleaceae	Mar - Nov	Western Ghats	√		E
114	<i>Olea dioica</i>	T	Oleaceae	Nov - Apr	India	√	√	M, E
115	<i>Cansjera rheedei</i>	C	Opiliaceae	Nov - Feb	India through Malaya to Hong Kong and North Australia	√		
116	<i>Bulbophyllum sterile</i>	H	Orchidaceae	Dec - Jan	Peninsular India		√	E, NR
117	<i>Vanda testacea</i>	H	Orchidaceae	Apr - May	India, Myanmar and Sri Lanka	√		M, NR
118	<i>Biophytum sensitivum</i>	H	Oxalidaceae	Feb - Sep	Peninsular India and Sri Lanka	√		M, NR
119	<i>Peperomia pellucida</i>	H	Piperaceae	Sep - Dec	Native of Tropical America; now Pantropical	√		
120	<i>Piper nigrum</i>	C	Piperaceae	Jul - Mar	Peninsular India and Sri Lanka		√	M, E
121	<i>Alloteropsis cimicina</i>	H	Poaceae	Jul - Nov	Paleotropic		√	
122	<i>Axonopus compressus</i>	H	Poaceae	TTY	Tropics and subtropics	√		NR





123	<i>Bambusa bambos</i>	S	Poaceae	Jul - Feb	India and Sri Lanka	√		M, E
124	<i>Brachiaria miliiformis</i>	H	Poaceae	Jul - Oct	Indo-Malesia		√	NR
125	<i>Cynodon dactylon</i>	H	Poaceae	Mar - Oct	Tropical and warm temperate regions of the world	√	√	M
126	<i>Cyrtococcum trigonum</i>	H	Poaceae	Sep - Oct	South East Asia, Sri Lanka and Peninsular India		√	
127	<i>Dactyloctenium aegyptium</i>	H	Poaceae	TTY	Native of South America, naturalized in Paleotropics	√	√	M
128	<i>Eleusine indica</i>	H	Poaceae	TTY	Pantropical	√	√	
129	<i>Eragrostis tenella</i>	H	Poaceae	Jul - Nov	Paleotropic, introduced in America		√	
130	<i>Eragrostis unioloides</i>	H	Poaceae	TTY	South East Asia, India and Africa	√	√	
131	<i>Isachne miliacea</i>	H	Poaceae	TTY	India, China and South East Asia		√	NR
132	<i>Oplismenus burmannii</i>	H	Poaceae	Sep - Nov	Pantropical	√	√	
133	<i>Pennisetum polystachyon</i>	H	Poaceae	Apr - Dec	Paleotropics	√		
134	<i>Sacciolepis indica</i>	H	Poaceae	Jun - Feb	Tropical Asia, Australia and introduced in Africa and America		√	
135	<i>Setaria pumila</i>	H	Poaceae	Jul - Oct	Paleotropics	√	√	
136	<i>Ziziphus oenoplia</i>	S	Rhamnaceae	Nov - Mar	Tropical Asia and Australia. Throughout the hotter parts of India	√		M
137	<i>Bruguiera cylindrica</i>	T	Rhizophoraceae	Dec - Oct	Indo-Malesia		√	NR
138	<i>Carallia brachiata</i>	T	Rhizophoraceae	Oct - Apr	Indo-Malesia and Australia	√	√	
139	<i>Chassalia curvifloravar. ophioxylodes</i>	S	Rubiaceae	Jul - Feb	Indo-Malesia	√	√	NR
140	<i>Ixoracoccinea</i>	S	Rubiaceae	TTY	Peninsular India and Sri Lanka		√	M, E



141	<i>Knoxia sumatrensis</i>	H	Rubiaceae	Aug - Sep	Indo-Malesia and Australia	√	√	NR
142	<i>Mitracarpus hirtus</i>	H	Rubiaceae	Jul - Dec	Tropical Africa and America	√		
143	<i>Morinda citrifolia</i>	Ss	Rubiaceae	Jul - Nov	Indo malesia		√	M
144	<i>Oldenlandia corymbosa</i>	H	Rubiaceae	Apr - Sep	Pantropical	√		M, NR
145	<i>Spermacoce latifolia</i>	H	Rubiaceae	Aug - Oct	Native of Tropical America; now established in Tropical Africa and Asia	√		
146	<i>Spermacoce ocymoides</i>	H	Rubiaceae	Nov - Dec	Indo-Malesia and Tropical Africa	√		
147	<i>Aegle marmelos</i>	T	Rutaceae	Mar - May	India and Sri Lanka; widely cultivated in South East Asia	√		M, E
148	<i>Zanthoxylum rhetsa</i>	T	Rutaceae	Mar - Nov	Indo-Malesia	√		M
149	<i>Santalum album</i>	T	Santalaceae	Nov - Dec	Peninsular India and Malesia	√		M
150	<i>Allophylus subfalcatulus</i> var. <i>di stachyus</i>	S	Sapindaceae	Nov - Mar	India, Bangladesh and Indo-Malaya	√		NR
151	<i>Cardiospermum halicacabum</i>	C	Sapindaceae	Jul - Feb	Pantropical	√		M
152	<i>Chrysophyllum cainito</i>	T	Sapotaceae	Jul - Sep	Native of West Indies		√	
153	<i>Mimusops elengi</i>	T	Sapotaceae	Dec - Aug	Indo-Malesia		√	M
154	<i>Lindernia anagallis</i>	H	Scrophulariaceae	Jul - Dec	Indo-Malesia	√	√	
155	<i>Lindernia ciliata</i>	H	Scrophulariaceae	Jun - Oct	Indo-Malesia	√		
156	<i>Lindernia crustacea</i>	H	Scrophulariaceae	Aug - Nov	Africa, America and Tropical and Subtropical Asia	√		
157	<i>Scoparia dulcis</i>	H	Scrophulariaceae	TTY	Native of Tropical America; now Pantropical	√		M
158	<i>Helicteres isora</i>	Ss	Sterculiaceae	Sep - Mar	Indo-Malesia, China and Australia		√	M



159	<i>Melochia corchorifolia</i>	H	Sterculiaceae	Jul - Apr	Pantropical	√		
160	<i>Sterculia guttata</i>	T	Sterculiaceae	Sep - Mar	Indo-Malesia	√		M
161	<i>Grewia nervosa</i>	S	Tiliaceae	Aug - Apr	Tropical Asia	√		M
162	<i>Trema orientalis</i>	T	Ulmaceae	Sep - Dec	Tropical Africa, Asia and Australia	√		
163	<i>Pouzolzia zeylanica</i>	H	Urticaceae	Aug - Dec	Tropical Asia	√	√	M
164	<i>Clerodendrum inerme</i>	S	Verbenaceae	Nov - Dec	Coastal India, Sri Lanka; now naturalised on the shores of Myanmar, Australia, China		√	
165	<i>Clerodendrum infortunatum</i>	S	Verbenaceae	Dec - Feb	Indo-Malesia	√	√	M
166	<i>Gmelina arborea</i>	T	Verbenaceae	Jan - Jun	Indo-Malesia		√	M, NR
167	<i>Vitex negundo</i>	T	Verbenaceae	Feb - Jul	Indo-Malesia and China, cultivated in the tropics	√		M
168	<i>Ampelocissus indica</i>	C	Vitaceae	Mar - Sep	Peninsular India and Sri Lanka	√		M, E
169	<i>Cissus glyptocarpa</i>	C	Vitaceae	Apr - Oct	Peninsular India and Sri Lanka	√		E, NR
170	<i>Leea indica</i>	Ss	Vitaceae	Mar - Aug	Indo-Malesia, China and Australia		√	M
171	<i>Zingiber nimmonii</i>	H	Zingiberaceae	Jul - Oct	Western Ghats	√		M, E, NR

## B. GYMNOSPERMS

No	Scientific name	Habit	Family	World Distribution	MST	VDK	Remarks
1	<i>Cycas circinalis</i>	T	Cycadaceae	Indo-Malesia and Tropical East Africa	√		E

### C. PTERIDOPHYTES

No	Scientific name	Habit	Family	World Distribution	M S T	V D K	Remarks
1	<i>Adiantum philippense</i>	H	Adiantaceae	Tropics and sub tropics	√		
2	<i>Drynaria quercifolia</i>	H	Polypodiaceae	Asia, Papua New Guinea, Fiji, Polynesia and tropical Australia	√		
3	<i>Pteris confusa</i>	H	Pteridaceae	Tropics and sub tropics of the world	√		
4	<i>Pteris quadriaurita</i>	H	Pteridaceae	Tropics and sub tropics	√		
5	<i>Selaginella delicatula</i>	H	Selaginellaceae	Widely cultivated in India	√		
6	<i>Acrostichum aureum</i>	H	Pteridaceae	Tropics of the world		√	M
7	<i>Stenochlaena palustris</i>	C	Blechnaceae	Australia, Myanmar, Fiji, Malaysia, Polynesia and China		√	

# Abbreviations uses in the table: **H** - Herb, **S** - Shrub, **T** - Tree, **C** - Climber, **M** - Medicinal, **E** - Endemic, **MST** - Mannur Siva Temple Pachathuruth, **VDK** - Vadayil Kavu Pachathuruth

#### 3.2 Habit and family status

At Mannur Siva Temple Pachathuruth, there were 59 herbs, 18 shrubs, 15 climbers and 34 small or medium trees while at Vadayil Kavu, there were 36 herbs, 11 shrubs, 10 climbers and 29 small or medium trees.

We could enumerate 126 flowering plant species from Mannur Shiva Temple, which belonged to 118 genera under 52 families. There were 105 dicots and 21 monocots. The most dominant dicot family was *Fabaceae*, represented by 12 species, followed by *Asteraceae* (11), *Poaceae* (10) and *Euphorbiaceae* (7), while the most dominant genera were *Lindernia*, *Blumea*, *Dioscorea*, *Leucas*, *Phyllanthus*, *Spermacoce* and *Terminalia*. Among the monocots, there were 8 families, the dominant ones being *Poaceae* (10 spp.),

*Araceae* (3 spp.) and *Commelinaceae* (2 spp.). There were Five pteridophyte species and one gymnosperm (*Cycas circinalis*) also.

At Vadayil Kavu Pachathuruth, we could enumerate 86 flowering plant species from the area which belonged to 81 genera under 37 families. There were 61 dicots and 25 monocots. The most dominant family was *Poaceae*, represented by 12 species, followed by *Fabaceae* (9), *Asteraceae* (7) and *Euphorbiaceae* (4), while the most dominant genera were *Terminalia*, *Clerodendrum*, *Cyperus* and *Eragrostis*. Two pteridophyte species (*Stenochlaena palustris*, *Acrostichum aureum*) were also there.

#### 3.3 Distributional status of the species and Endemism

At Mannur Siva Temple Pachathuruth, the majority of the



plants studied were having Indo-malesian distribution (25 nos./20% of the total). Sixteen species (12.7%) were having Tropical American distribution and Thirteen (10.3%) species had Pantropical distribution.

At Vadayil kavu Pachathuruth, the majority of the plants were having

Indo-malesian *Distribution* (20 nos./23 %of the total). Ten species (11.6%) were having Pantropical distribution and Eight (9.3%) species were having Tropical American distribution. For details see Tables1 & 2.

**Table 2. Distributional statuses of the species enumerated from the two study areas**

No	Mannur Siva Temple			Vadayil Kavu		
	Distributional status	No of species	%	Distributional status	No of species	%
1	India	3	2.4	East Himalayas	1	1.2
2	India and Sri Lanka	7	5.6	India	1	1.2
3	<b>Indo-Malesia</b>	<b>25</b>	<b>19.8</b>	India and Myanmar	1	1.2
4	Indo-Malesia and Australia	8	6.3	India and Sri Lanka	3	3.5
5	Indo-Malesia and China	3	2.4	India to Malesia and Madagascar	1	1.2
6	Indo-Malesia to Australia and Africa	5	4.0	India, China and South East Asia	2	2.3
7	Native of China	1	0.8	<b>Indo-Malesia</b>	<b>20</b>	<b>23.3</b>
8	Native of Himalayas	2	1.6	Indo-Malesia and Australia	6	7.0
9	Native of Pacific Islands	1	0.8	Indo-Malesia, China and Australia	2	2.3
10	<b>Native of Tropical America</b>	<b>16</b>	<b>12.7</b>	Native of Pacific Islands	2	2.3
11	Paleotropics	4	3.2	<b>Native of Tropical America</b>	<b>8</b>	<b>9.3</b>
12	<b>Pantropics</b>	<b>13</b>	<b>10.3</b>	Paleotropics	7	8.1
13	Peninsular India and Srilanka	5	4.0	<b>Pantropics</b>	<b>10</b>	<b>11.6</b>
14	South and South East Asia to Australia	2	1.6	Peninsular India	1	1.2
15	South India and Sri Lanka	3	1.6	Peninsular India and Sri Lanka	3	3.5
16	Southern Western Ghats	3	2.4	South East Asia, Sri Lanka and Peninsular India	3	3.5
17	Throughout the tropics	3	2.4	Southern Western Ghats	1	1.2
18	Tropical Asia	2	1.6	Tropics	3	3.5
19	Tropical Asia and Africa	3	2.4	Tropical Asia	3	3.5
20	Tropics and subtropics	1	0.8	Others	8	9.3
21	Western Ghats	4	3.2			
22	Others	13	10.3			
	<b>TOTAL</b>	<b>126</b>	<b>100</b>	<b>TOTAL</b>	<b>86</b>	<b>100</b>

At Mannur Siva Temple Pachathuruth, out of the total 126 species, 25 were endemics. Three species were endemic to our country (*Dipteracanthus prostratus*, *Dioscorea alata* & *Olea dioica*), while 7 species had an extended distribution to Srilanka also. About 6 species had distribution extending from Peninsular India to Srilanka. When 4 species had distribution restricted to Western Ghats, another 3 endemic species are found only in the Southern Western Ghat region.

At Vadayil kavu Pachathuruth, out of the total 86 species, 9 were endemics. Only one species is endemic to our country (*Olea dioica*), while 3 species had an extended distribution to Srilanka also. When one species (*Bulbophyllum sterile*) is a Peninsular endemic, about 3 species had distribution extending from Peninsular India to Srilanka. A single species (*Holigarna arnottiana*) is found only in the Southern Western Ghat region (Ahmedullah and Nayar, 1987). For details see Tables 1 & 2. The species are marked as E (Endemics) in the remarks column.

It was also interesting to learn that when the list of the species collected was compared with the district flora available (*Flora of Calicut* - Manilal and Sivarajan, 1982) 25 species

enumerated from Mannur Siva Temple were not reported in it. Similarly 17 species enumerated from Vadayil Kavu were also not represented in this flora. We believe that these species would have been remained overlooked in this study, or may be recently introduced to this areas. For details see Table 1. The species are marked as NR (Not Reported) in the remarks column.

### 3.4 Phenological status

It could be learned that in both the study areas, the majority of the species studied (nearly 30%) started flowering with the onset of the south-west monsoon period (June – August) and continued to bear flowers during the entire monsoon period.

At Mannur Siva temple, 25 species (~20%) started flowering during the North-East monsoon period while at Vadayil kavu, 10 species (~12%) behaved like that. This shows that 40 - 50 percentages of the species start and often complete their reproductive cycles during the monsoon period, before the area dries up. In both areas, nearly 20% of species started flowering during the summer months and 16 species each were found to bear flowers throughout the year. For details see the Table 3.

**Table 3: Phenological status of the species (adapted from Sasidharan, 2011)**

Sl. No.	Flowering months/ periods	Mannur Siva Temple		Vadayil Kavu	
		No of species	%	No of species	%
1	June – August (South – West monsoon)	35	27.8	26	30.2

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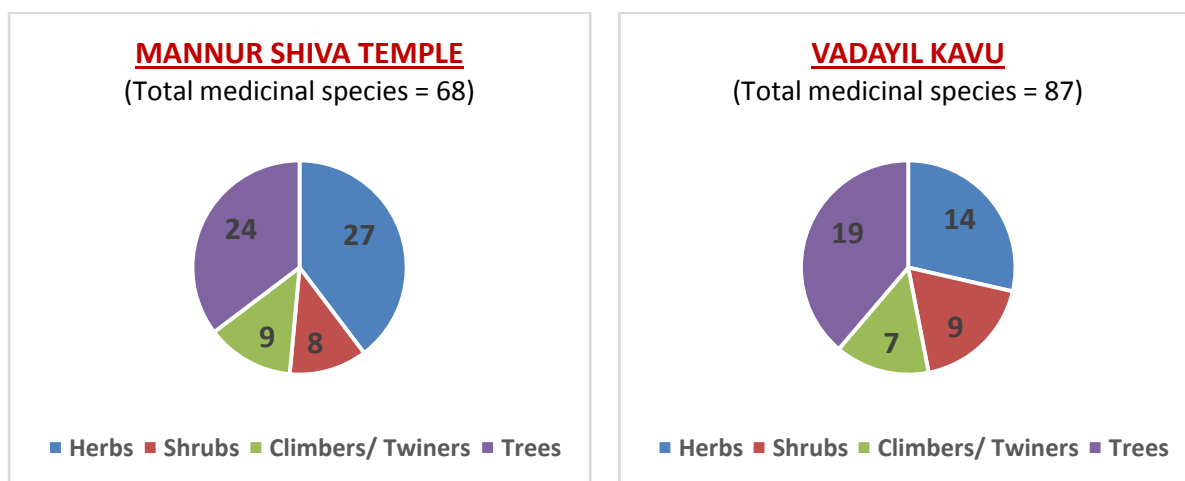
2	<b>September</b> (Light rain, mild weather)	11	8.7	4	4.7
3	<b>October – November</b> (North – East monsoon)	<b>25</b>	<b>19.8</b>	<b>10</b>	<b>11.6</b>
4	<b>December – January</b> (Winter)	13	10.3	14	16.3
5	<b>February – May</b> (Summer)	<b>26</b>	<b>20.6</b>	<b>16</b>	<b>18.6</b>
6	<b>Throughout the year</b>	16	12.7	16	18.6
	<b>TOTAL</b>	<b>126</b>	<b>100</b>	<b>86</b>	<b>100</b>

### 3.5 Medicinal uses

It is a known fact that in Kerala, out of the 5646 reported species about 862 plants are made use for some or other medicinal purposes (Ref.: [www.eflorakerala.com](http://www.eflorakerala.com)). This is why Ayurveda system of medicine is so flourished in this state. With regard to the Pachathuruth areas studied, it was found that at Mannur Siva temple, about 68 species out of the 126 enumerated (54%) were medicinal plants (Ref: Sasidharan, 2011). Similary, at Vadayil kavu, about 49 species out of the 86 enumerated (57%) come under the category of

medicinal plants. This underlines the importance of the conservation of the area.

At Mannur Siva temple, family Asteraceae and Fabaceae had the highest number of medicinal plants (6 species each), followed by Euphorbiaceae (5) and Lamiaceae (4). But at Vadayil kavu, family Fabaceae had the highest number of medicinal plants (7 species), followed by Asteraceae (4) and Euphorbiaceae (3). For details see Table1(marked as M (Medicinal) in the remarks column) and Fig.4.



**Fig 4. Habits of the Medicinal plants enumerated from the two study areas**

### Biodiversity threats and conservation issues:

From the study conducted, it became evident that the study areas, Mannur Shiva temple and Vadayil KavU

being temple premises are considered highly sacred and have not much conservation issues.

It was told by the authorities of the *Mannur Shiva temple* that there is a lack of proper funding for the maintenance and development, which poses problems in the conservation. Here, due to negligence in maintenance, many weeds have invaded into the area, thereby restricting the growth of the planted seedlings. Improper maintenance, by cutting away the so called '*unwanted plants*' may destroy the diversity, since we could notice a lot of

medicinal plants (>50% of the total species) growing in the area.

In contrast, at *Vadayil Kavu*, due to regular cleaning and maintenance activities, there is a great loss in the number of planted seedlings and other species. Since this Pachathuruth is located at the bank of Kadalundi river, saline water intrusion is taking place during monsoon and during high tides thereby posing threats to the plants.

#### PLATE 1- Some endemic plants reported from the study areas



*Impatiens flaccida*



*Terminalia cuneata*



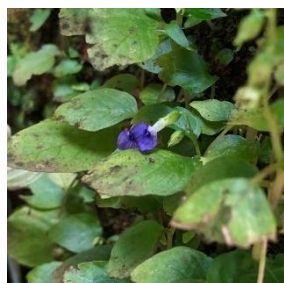
*Cyanotis arachnoidea*



*Dioscorea alata*



*Canscora pauciflora*



*Rhynchosyris notonianum*



*Hugonia mystax*



*Andrographis paniculata*



*Olea dioica*



*Aegle marmelos*



*Zingiber nimmonii*



*Bulbophyllum sterile*



## PLATE 2- Some medicinal plants reported from the study areas



*Rhinacanthus nasutus*



*Ichnocarpus frutescens*



*Vernonia cinerea*



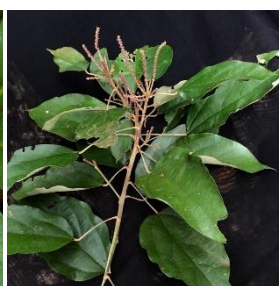
*Calcyopteris floribunda*



*Terminalia bellirica*



*Costus speciosus*



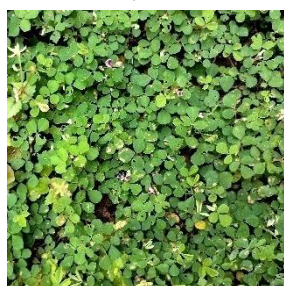
*Mallotus philippensis*



*Phyllanthus emblica*



*Saraca asoca*



*Desmodium triflorum*



*Sida cordata*



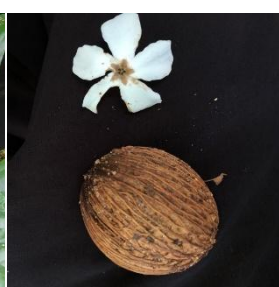
*Cardiospermum  
halicacabum*



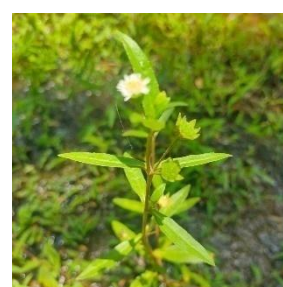
*Scoparia dulcis*



*Sterculia guttata*



*Cerbera odollam*



*Eclipta prostrata*

### 4. Conclusion

A detailed floristic survey of Mannur Shiva Temple(MST) and Vadayil Kavu (VDK) 'Pachathuruthu'eco-restoration areas established by the Haritha Keralam

Mission, in Kadalundi Grama Panchayath of Kozhikode district, Kerala state, India was attempted. In this study, in addition to the trees, we concentrated more on the herbaceous and shrubby flora, which were neglected in the earlier surveys

conducted during February 2021 by the *Pachathuruth* authorities. It was assumed that the data gathered will turn helpful for the authorities in the conservation and management of the areas. In total, 171 species were reported from both the study areas, out of which 41 species were common to both the areas.

At Mannur Siva Temple (MST) *Pachathuruth*, a total of 126 flowering plants were enumerated, which belonged to 118 genera under 52 families, and comprising of 59 herbs, 15 climbers and 34 trees. There were 105 dicots and 21 monocots. At Vadayil kavu (VDK) *Pachathuruth*, which comprises mangrove and riverside areas also, the 86 flowering plant species enumerated belonged to 81 genera under 37 families, which included 36 herbs, 12 shrubs, 9 climbers and 29 trees. There were 61 dicots and 25 monocots.

At MST, the most dominant family was *Fabaceae*, followed by *Asteraceae*, *Poaceae* and *Euphorbiaceae*. While at VDK, the most dominant family was *Poaceae*, represented by 12 species, followed by *Fabaceae*, *Asteraceae* and *Euphorbiaceae*. In both the locations, majority of the plants enumerated were having Indo-malesian distribution (MST - 25nos./20%; VDK - 20 nos./23 %). Second and third were either Tropical American or Pantropical distributions. The presence of high percentages of Tropical American species in these two sacred groves, mostly as weeds shows how the exotic weeds have invaded these areas, often replacing many of the endemics. There were 25 endemics at MST and 9 endemics at VDK, some of which are rare and threatened. It

could be learned that in both the study areas, the majority of the species studied (nearly 30%) started flowering with the onset of the South-West monsoon period (June - August) and continued to bear flowers during the entire monsoon. With regard to the medicinal uses of the plants, it was found that at MST, about 68 species (54%) come under this category. Similarly, at VDK, about 49 species (57%) were found to be medicinal. This underlines the importance of the conservation of the area.

It was learned that about 25 species enumerated from MST and 17 species from VDK were not represented in the *Flora of Calicut*. We believe that these species would have been remained overlooked in this study, or may be recently introduced to this areas.

It was understood that there is a lack of proper funding for the maintenance and development, which poses problems in the conservation of these areas. Due to the negligence in maintenance, many weeds have invaded into the area, thereby restricting the growth of the planted seedlings. Improper maintenance, by cutting away the so-called '*unwanted plants*' may destroy the diversity, since we could notice a lot of medicinal plants (>50%) growing in the area.

We are sure that, if similar studies are carried out in all the *Pachathuruth* areas of the state, covering at least the monsoon, winter and summer seasons, they will yield fantastic information on these eco-restoration areas, thereby helping the authorities to plan better environmentally sustainable policies



and programmes for their conservation and management.

## 5. Acknowledgements

We owe our indebtedness to Dr. T.N. Seema, Executive Vice Chairperson, Haritha Kerala Misson and Mr. Prakash P., District Co-ordinator, Haritha Kerala Misson, Kozhikode for their constant encouragement and support. We thank Mr. Shibin K., Resource Person, HKM for guiding us during the field works. Mr. Vijayan M., our 1969-72 batch alumnus who is a resident near Mannur Siva temple accompanied us during our field trip. We thank him for his generous helps and hospitality. We also extend our gratitude to Dr. N. Sasidharan, Former Scientist, Kerala Forest Research Institute (KFRI), Peechi, Thrissur and Dr. Jomy Augustine, former HoD St. Thomas college, Pala, Kottayam for their helps in confirming the identification of some specimens. Identity of the grass specimens were confirmed by Dr. P. Dileep, HSST (Botany), RGMHSS, Mokeri, Kannur and that of the pteridophyte specimens were confirmed by Dr. Rajesh K.P., Assistant Professor, ZG College, Kozhikode to whom we are indebted. We are also obliged to our former Principal, Dr. K.M. Naseer for the facilities provided, and the faculty members of the Department of Botany, Mrs. Naseeha C.P., Dr. Adnaan Farook V. and Dr. Swetha Thilak T. who have made many valuable suggestions and helps for this project work.

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