



## Indigenous uses of ethnomedicinal plants among Malayali tribals in siriya Kalvarayan Hills, Eastern Ghats, India

Annadurai Pushparaj<sup>1</sup>, Gideon Daniel Andrew<sup>2</sup>, Annadurai Vinothkanna<sup>3</sup>, Ganesan Mohan<sup>4</sup>, Dhandayuthapani Kandavel<sup>1\*</sup>

<sup>1</sup> Department of Botany, Periyar E.V.R. College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli, Tamil Nadu, India

<sup>2</sup> Department of Biotechnology, Bishop Heber College (Autonomous), Tiruchirappalli, Tamil Nadu, India

<sup>3</sup> School of Food and Biological Engineering, Jiangsu University, Zhenjiang, PR China

<sup>4</sup> Department of Plant Science, Central University of Kerala, Kasaragod, Kerala, India

### Abstract

The Eastern Ghats of India are rich in biodiversity and contain several flora and fauna. We surveyed the Siriya Kalvarayan hills from Puliyanakottai to Serapattu. The study area is ~20 km lengthwise and 10 km breadth wise and is located ~55 kilometers away from Kallakurichi in Villupuram district. We identified nearly 90 genera containing close to 100 species, which belong to over 46 families. The Periya (large) and Siriya (small) Kalvarayan hills form an integral part of the Eastern Ghats of India with an elevation of 2500-4000 feet above sea level. These hills contain several angiosperms, gymnosperms, shrubs as well as trees, which have long been considered to have tremendous potential for use in ethnomedicine, as per traditional ethnobotanical literature. We document the ethnobotanical uses and phytochemical constitution of some novel, and as yet, little explored plant species (totally 61/100 surveyed) and discuss the potential uses of these plants in treating a range of health issues. We surveyed the local population (mostly Malayalis) through a questionnaire-based interview to assess their knowledge of traditional medicine. Also, we checked the dependence of residents of 8 villages upon different forms of traditional medicine (Ayurveda, Siddha and Naturopathy). When plant photographs were shown to the respondents, they identified them and shared the local names by which those plants are called. Also, we identified the extent of inclination/dependence of the respondents towards allopathic medicine for treating a range of ailments. The specific plant parts and the species used by the tribals were identified through a survey to assess the ethnobotanical awareness of the Malayali people. Quantitative indices such as Information Consent Factor (ICF), Fidelity Level (FL) as well as Use Value (UV) were also measured. Our study led us to identify 10 species which are not listed in the National Medicinal Plants Board website. Also, we came across a few plant species which are either endangered or threatened, as per the IUCN red list. We wish to study the secondary metabolites of all the plants for which, little or no published literature exists.

**Keywords:** siriya Kalvarayan hills, ethnobotany, tribal medicine, rare plants and malayalis

### Introduction

Ethnic medicine has been in use since time immemorial, and has historically been utilized by village shamans for treating a wide array of human diseases, ranging from the common cold to serious illnesses such as cancer <sup>[1]</sup>. Custodians of these ancient secrets are adept at the art of identification and utilization of either the whole plant or specific parts thereof for various medicinal purposes <sup>[2]</sup>. Extracts (which would contain particular active principles) are usually prepared in a specified manner and these crude medicinal formulations are administered in the form of churna (powder), water-based concoctions and raw concentrates produced by squeezing plant parts using mortar and pestle. Traditionally, this knowledge (of the plant parts used and the specific methodologies of preparation and mode of administration) has been passed on from one generation to the next <sup>[3]</sup>. Shrubs, herbs and trees and their constituent active principles (from different plant parts thereof) have been extracted using a range of methods that are common in ayurvedic, siddha and unani traditions of Indian ethnomedicine. The government of India has integrated the alternative medicine fronts and created the ministry of

AYUSH (Ayurveda, Unani, Siddha and Homeopathy) <sup>[4]</sup>. The market value for traditional medicine was estimated to be 6 billion dollars at the end of the year 2018 <sup>[5]</sup>. The basis of traditional ayurvedic medicine is to balance the body humors to treat vatha, pitta and kapha, which are three distinct prakriti types <sup>[6]</sup>. Siddha is another form of traditional medicine which is practised in Tamil Nadu. It involves certain aphorisms which were advocated by 18 Siddha Rishis of ancient Tamil culture and comprises of an array of techniques such as mind concentration, mastery over the senses, meditation, exercise, controlled breathing (yoga) and other medicinal formulations which together combined, bring about the restoration of psychosomatic harmony <sup>[7]</sup>. Naturopathy also is practiced by some members of the community in the study area. This form of medicine integrates traditional medicine with scientific advancements/research by which, the practitioner recognizes the innate healing capacity, identifies the patient's underlying cause(s) of disease and corrects the identified maladies using a range of treatment modalities such as herbal medicine, minor surgery, hydrotherapy, exercise, counseling and dietary-lifestyle changes <sup>[8]</sup>.

Allopathic medicinal formulations typically rely on the use of extracts obtained from medicinal plants, which are purified from natural sources or synthesized *in vitro*. These chemicals specifically target receptors/biomolecules (usually enzymes/proteins) in the human body. An estimated 50% of compounds used in allopathic medicine are derived from plant sources [9].

The Siriya Kalvarayan hills of the Eastern Ghats are home to several (as many as 61) rare plants (identified in this survey alone and not an exhaustive number), for which, very little or no published material was found (Table 1). This paper would act as a catalyst in the search for potential compounds of therapeutic value and also to accelerate the quest to find lead compounds for treating specific illnesses, thus accentuating the value of India's rich biodiversity. Also, advancements in knowledge pertaining to the mechanisms of isolated compounds' action would validate our ancestors' knowledge and reveal exactly which compounds act as the active principles responsible for alleviation of specific conditions.

## Materials and methods

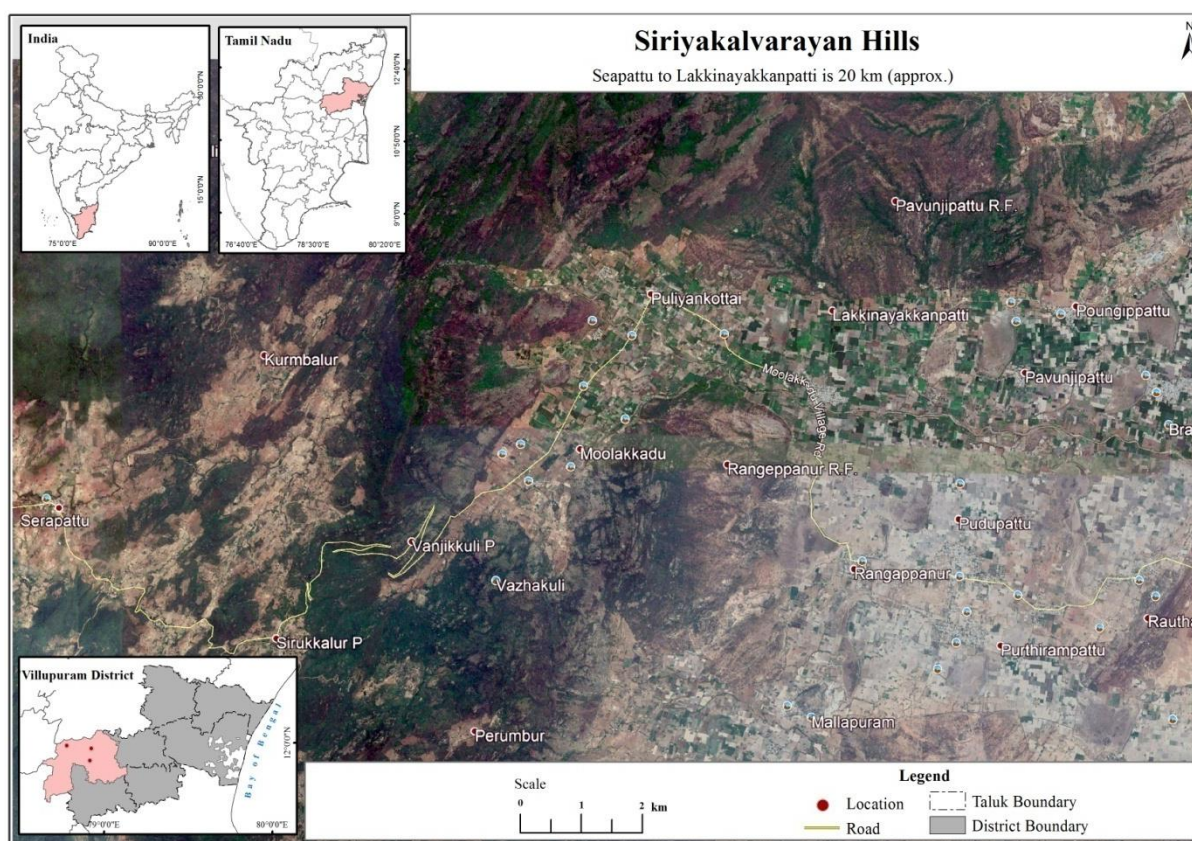
### Survey region

The present floristic studies were carried out in the Siriya Kalvarayan hills, Eastern Ghats, Kallakurichi district (just

months ago, the study area belonged to Villupuram district). The location of the study area is shown in Fig. 1. The survey was conducted between January 2017 and November 2019. We used a questionnaire to conduct a survey among Malayali (meaning in Tamil - mountain dwellers) tribals and other residents (total number of respondents = 105) of 8 villages in the study area – specifically, Sirukkalur, Edappattu, Vazhakuli, Athikkuzhi, Vanjikkuli, Moolakkadu, Aanaimaduvu, and Puliyanakottai (in order of high-low altitude).

### Study area

The Siriya Kalvarayan hills start with a road beginning at Moolakkadu, which winds up to Serappattu, which is roughly 800 m above sea level. To reach this point, the road consists of five large hair-pin bends winding through the terrain (a map of the study area is given in Fig. 1). While this survey focuses on specific plants that have been identified in the region, it is not exhaustive. Whenever possible and when different species of flora were located, photographs were captured using a high-resolution phone camera (13 MP, Xiaomi Mi4i). The images were collated using Microsoft Office PowerPoint and refined using GIMP (ver. 2.10.6). The graphs were plotted using GraphPad Prism (v.5.02).



**Fig 1:** A close-up map of the study area – The study region from Serappattu to Puliyanakottai is shown in this map, covering a distance of ~20 km lengthwise and a breadth of 10 km. The study area is indicated on the map by the dotted yellow oval marking.

### Photography and botanical identification

The plants were photographed using a digital camera and the taxonomic identification of these species was carried out at the Rapinat Herbarium, St. Joseph's College, Tiruchirappalli. The photographs of the surveyed species have been arranged in alphabetical order and presented in Fig. 4-8 and the total number of plants surveyed is 100

species (Table 1). The binomial names of these plants were verified by cross-checking the entire list with the names given on the plant list website (<http://www.theplantlist.org>). Information pertaining to the plant species which were identified by most of the people (and which they used regularly for specific ailments), the local names of the plants as well as the plant parts used by the Malayali tribals are

given in Table 2. After this, the species endemic to the region and the IUCN classification of the plants was also scrutinized to identify any critically endangered or threatened species. This information is provided in Table 4.

### Ethnobotanical survey

A total of 105 subjects from eight villages (as mentioned before) which lie within the study area shown in the map (marked by a yellow dotted line, Fig. 1) Sirukkalur, Edapattu, Vazhakuli, Athikkuzhi, Vanjikkuli, Moolakkadu, Aanaimaduvu, and Puliyanakottai. A questionnaire comprising of 7 critical questions was used to interview the residents (informants). Using a non-probabilistic method of sampling [10], the residents of these villages who were willing to talk were interviewed. We explained the aim of the study to the residents and showed them all the photographs of the plants that had been surveyed. While some of the traditional uses of nearly 40% of the plants are known (from citations/references to those particular plants in ancient medicinal literature such as the Charaka Samhita) as well as the National Medicinal Plants Board (Government of India) website, information pertaining to the medicinal uses of the remaining 60% of the plants is either obscure or completely absent both in ancient texts and in published scientific works (when searching for publications/reports using Google Scholar). Hence, locals were asked for the medicinal uses of each of the plants, and in particular, about those plants whose medicinal properties were hitherto unknown to us. A few medicine men

(shamans) of these villages who expressed willingness to share their knowledge with us were also interviewed. Photographs of the plants (Fig. 4-8) were shown to them and they were interviewed regarding the plants (and the parts thereof), their traditional medicinal uses and if applicable, ritualistic/other uses. Based on the survey findings, it is realized that the residents had an appreciable (if not thorough) extent of knowledge regarding most of the plants and their medicinal uses. Based on the information that was gained, the species' names and their traditional uses were presented in Table 2. The distribution of the flora (herbs, shrubs, climbers, lianas, succulents and trees) are presented in table S1 and in Fig. 9. The demographics of the local population in 8 villages of the study area (age, sex and the dependence level of these residents on natural medicine) are given in Fig. 2. Also, it is indicated which of the plants have been used in ancient Indian as well as Tamil Nadu folk medicine (Supporting information table S1). Particular attention is also given to the specific uses of these plants by the local population. Demographics such as age, sex and their dependence on allopathic medicine is presented in Fig. 2. The percentage of subjects (total n=105) who use traditional medicinal formulations (ayurveda & siddha) and other streams of medicine such as allopathy and naturopathy to cater to their healthcare needs is given in Fig. 3. The informants' responses were recorded through a questionnaire-based inquiry approach and the responses were tabulated and counted. Using the numbers obtained through the survey, the following were calculated:

**Table 1:** Families, genera and species identified in the study The names of various families, genera, species and the plant types (based on morphology) are presented in the table below

S. No.	Name of the family	No. of genus/genera	No. of species	Herb	Shrub	Climber	Lianas	Succulents	Tree	Common plants	Rare plants	Total no. of plants
1	Acanthaceae	3	4	4	-	-	-	-	-	4	-	4
2	Apocynaceae	5	5	-	1	3	-	1	-	1	4	5
3	Aponogetonaceae	1	1	1	-	-	-	-	-	-	1	1
4	Amaryllidaceae	1	1	1	-	-	-	-	-	-	1	1
5	Anacardiaceae	2	3	-	-	-	-	-	3	1	2	3
6	Arecaceae	1	1	-	-	-	-	-	1	1	-	1
7	Asclepiadaceae	1	1	-	-	1	-	-	-	-	1	1
8	Asparagaceae	1	1	-	-	-	-	1	-	1	-	1
9	Asteraceae	2	2	2	-	-	-	-	-	1	1	2
10	Boraginaceae	1	1	-	-	-	-	-	1	-	1	1
11	Burseraceae	1	1	-	-	-	-	-	1	-	1	1
12	Caesalpiniaceae	2	3	2	-	-	-	-	1	2	1	3
13	Capparaceae	1	1	-	-	-	-	-	1	-	1	1
14	Celastraceae	2	2	-	-	2	-	-	-	-	2	2
15	Colchicaceae	1	1	1	-	-	-	-	-	1	-	1
16	Comaceae	1	1	-	-	-	-	-	1	-	1	1
17	Combretaceae	2	5	-	-	-	-	-	5	1	4	5
18	Convolvulaceae	1	1	1	-	-	-	-	-	1	-	1
19	Dioscoreaceae	1	1	1	-	-	-	-	-	-	1	1
20	Euphorbiaceae	4	5	3	1	-	-	-	1	2	3	5
21	Fabaceae	6	6	-	-	1	1	-	5	4	3	7
22	Hernandiaceae	1	1	-	-	-	-	-	1	-	1	1
23	Lamiaceae	4	4	2	1	-	-	-	1	2	2	4
24	Linaceae	1	1	-	-	-	1	-	-	-	1	1
25	Malvaceae	4	4	1	1	-	-	-	2	1	3	4
26	Meliaceae	4	4	-	1	-	-	-	3	2	2	4
27	Melastomataceae	1	1	-	1	-	-	-	-	-	1	1
28	Moraceae	1	1	-	-	-	1	-	-	-	1	1
29	Oleaceae	1	1	-	1	-	-	-	-	-	1	1
30	Oleaceae	2	3	-	1	2	-	-	-	-	3	3
31	Opiliaceae	1	1	-	-	1	-	-	-	-	1	1
32	Phyllanthaceae	2	2	-	1	-	-	-	1	-	2	2
33	Poaceae	4	4	4	-	-	-	-	-	3	1	4
34	Proteaceae	1	1	-	-	-	-	-	1	-	1	1
35	Pteridaceae	1	1	1	-	-	-	-	-	-	1	1
36	Rhamnaceae	2	3	-	-	1	-	-	2	1	2	3

37	Rubiaceae	7	7	1	2	-	-	-	4	4	3	7
38	Rutaceae	2	2	-	1	-	-	-	1	1	1	2
39	Salicaceae	1	1	-	-	-	-	-	1	-	1	1
40	Salvadoraceae	1	1	-	1	-	-	-	-	-	1	1
41	Sapindaceae	4	4	1	1	1	-	-	1	2	2	4
42	Symplocaceae	1	1	-	-	-	-	-	1	-	1	1
43	Tiliaceae	1	1	-	-	-	-	-	1	1	-	1
44	Verbinaceae	1	1	-	1	-	-	-	-	1	-	1
45	Violaceae	1	1	1	-	-	-	-	-	1	-	1
46	Vitaceae	1	1	1	-	-	-	-	-	-	1	1
No.	46	90	99	28	15	12	3	2	40	39	61	100

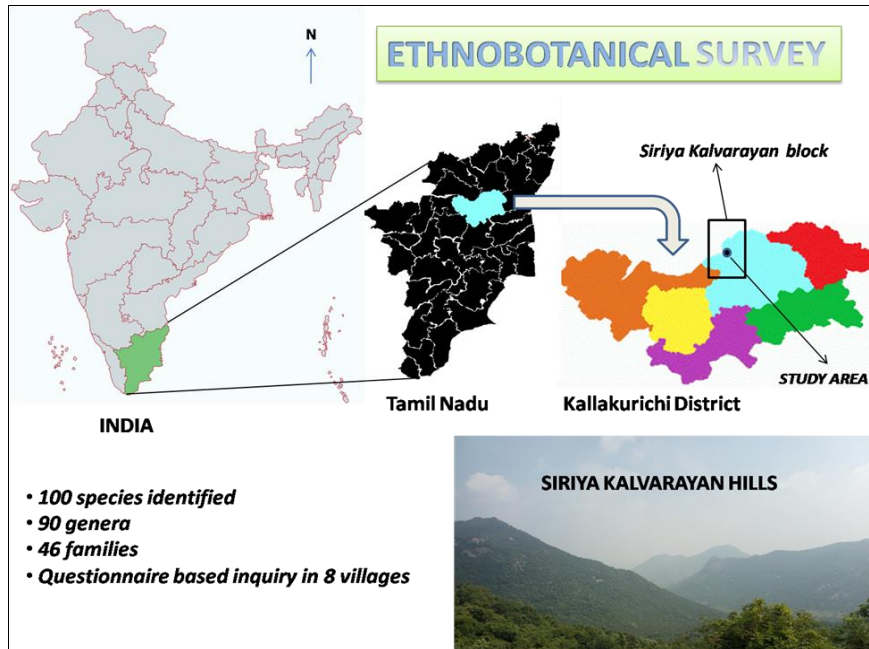


Fig 2

**Informant Consensus Factor (ICF)**

ICF was developed and first described by Trotter and Logan (2019) and then redefined by Heinrich [11]. This parameter is an indicator of the homogeneity of ethnobotanical information and is defined by the formula:

$$ICF = Nur - Nt / Nur - 1$$

Where,

Nur- Number of use reports present in each ailment category  
 Nt- Number of species which are used

ICF accurately describes the ethnopharmacological/ ethnobotanical importance of each plant species and high ICF values (1.0 or closer to 1.0) point to agreement/consensus among informants regarding the plant species and the specific ailment for which it is used.

**Fidelity Level (FL)**

The FL index is an estimate of the most preferred plant species for a particular ailment category. FL was proposed by Trotter *et al.* (2019) and it is an index which refers to the % of informants who name a particular species as ethnic medicine for a particular disease/ailment category [11]. The formula for FL (%) is:

$$FL(\%) = (Np / N) \times 100$$

Where, Np pertains to the number of informants who claim to use a particular plant species for treating a particular illness and N describes the number of informants who rely

on ethnomedicine for treating any given illness (among the list of illnesses identified in this survey).

**Use Value (UV)**

This index was proposed in the 2019s and has been used widely used to highlight the ethnobotanical importance of a given plant species among the local population [11]. Among a local population of informants, the Use Value (UV) is an index of the relative importance of a plant and the formula used for UV estimation is

$$UV = \sum Ui / N$$

Where, Ui – number of use reports mentioned by an informant for a particular taxon and N refers to the total number of informants.

**Results**

**Demographics of the population**

The villages at the foot of the Siriya Kalvarayan hills were surveyed and mainly, those which are part of the hilly regions (confined to the study area), as shown in the map in Fig. 1. The respondents answered various questions based on the questionnaire and most of them were young (left panel, age category of 20-40). Most of the respondents were male (centre panel) and majority of the subjects, despite the popularity of allopathic medicine nowadays, stated that they either never visited an allopathic doctor, or did so only very rarely during medical emergencies (right panel). These data are presented in Fig. 2.

**Reliance of the respondents on siddha, ayurveda, naturopathy and allopathy**

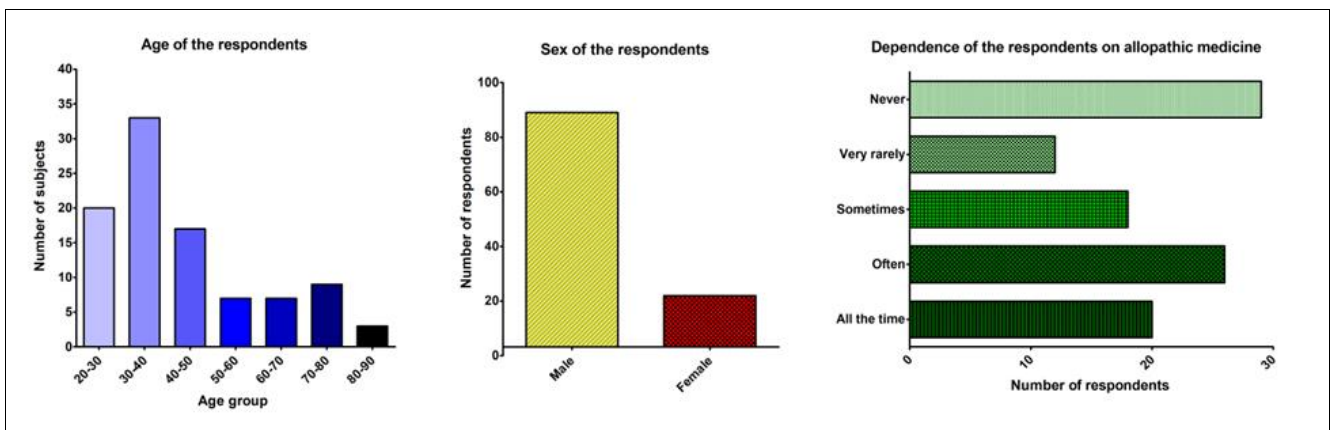
Information was gathered from 105 residents of 8 villages - Sirukkalur, Edapattu, Athikkuzhi, Vazhakuli, Vanjikkuli, Moolakadu, Aanaimaduvu, and Puliyanakottai which are either part of the Siriya Kalvarayan hills (the first 6 villages) or located in the vicinity of the hills (Moolakadu, Aanaimaduvu and Puliyanakottai) using a questionnaire. The number of residents of these villages who were interviewed was as follows: Sirukkalur – 16, Edapattu – 18, Athikkuzhi - 3, Vazhakuli – 2, Vanjikkuli – 30, Moolakadu – 6, Aanaimaduvu – 5 and Puliyanakottai – 25. Among those who were interrogated, 86 were male and 19 were female. The percentage of respondents in villages of the study area who follow different kinds of medicinal systems (siddha, ayurveda, naturopathy, allopathy and combinations thereof) was assessed. The percentage of respondents (total n=105) who came under each category is mentioned within the pertinent categories on the pie chart. These respondents were not the same as those who acted as informants (also n = 105).

Ethnopharmacological survey of the plants revealed that among the 100 plants surveyed, uses of 52 plants were identified from local population (Table 2). 32 unique disease/ailments were identified as health problems- against which, the locals used plants as medicine. Quantitative indices such as ICF, FL and UV were analyzed. FL and UV

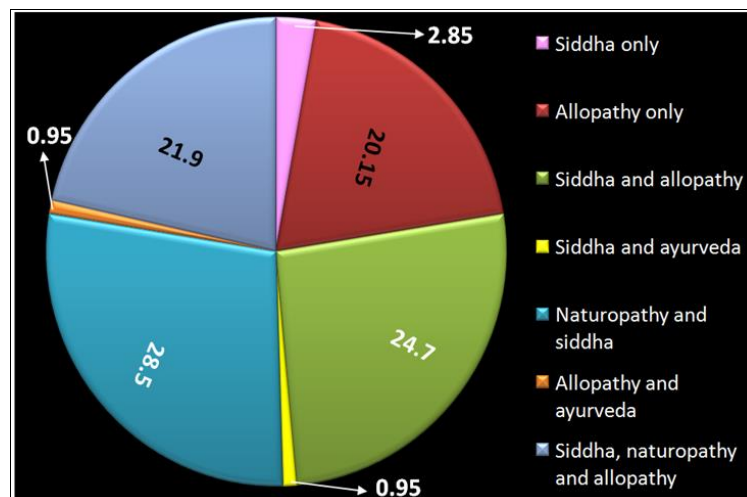
values for each of the plants with known ethnic medicinal usages (confined to the study area alone) are shown in Table 2 and ICF values are presented in Table 3.

The study led to identification of 100 different species belonging to 46 families and 90 genera. The rare plants in the study (for which very little published material was found) were close to 61 species which have not been studied hitherto and moreover, their phytochemical constituents are as yet unknown. All the plants mentioned in Table 1 are numbered accordingly in the plate photographs (Fig. 4-8) in which, 20 plant photographs are presented per image.

The total number of families (which the 100 species belonged to) in the survey were 46 and we studied 100 species. Among these, there were 28 herbs, 15 shrubs, 12 climbers, 3 lianas, 2 succulents and 40 trees. The distribution of the various genera, species and the types of flora (based on morphological characteristics) is given in Fig. 9 and supplementary table S1. While searching the IUCN red list, we found that 17 plants were found to be of least concern (see table 4), while 2 were endangered (*Jatropha curcas* and *Borassus flabellifer* L.), 2 were vulnerable [*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f. and *Psydrax dicoccos* Gaertn.], 1 was near threatened (*Pterocarpus marsupium* Roxb.) and “data was deficient” for 1 plant (*Mangifera indica* L.). One plant was critically endangered [*Hildegardia populifolia* (Roxb.) Schott & Endl.].



**Fig 3:** Overview of the respondents in the villages surveyed (Sirukkalur, Edapattu, Vazhakuli, Athikkuzhi, Vanjikkuli, Moolakadu, Aanaimaduvu and Puliyanakottai)



**Fig 4:** Medicine systems followed by residents of the study area

**Floristic Study in Siriya Kalvarayan Hills.**



**Fig 5:** Photographs of plants 1-20 presented in Table 1.



**Fig 6:** Photographs of plants 21-40 presented in Table 1.



Fig 7: Photographs of plants 41-60 presented in Table 1.



Fig 8: Photographs of plants 61-80 presented in Table 1.



Fig 9: Photographs of plants 81-100 presented in Table 1.

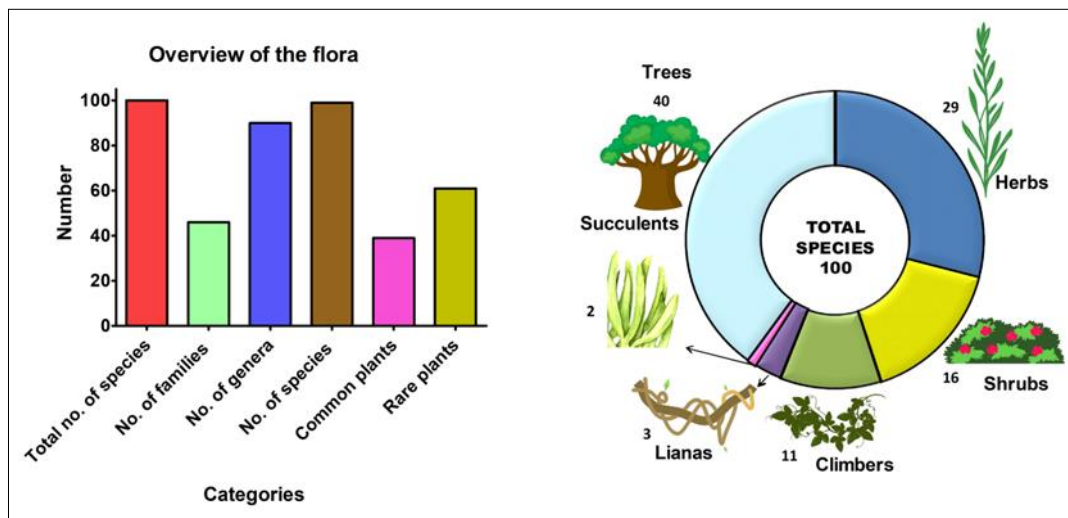


Fig 10: Flora of the Siriya Kalvarayan hills

Table 2: Identification of the different species and their medicinal uses (numbers given in this table correspond to the numbering for the photographs of the plants given in the photo plates, in Fig. 4-8).

S. no	Botanical name	Family name	Common name	Vernacular (Tamil) name	Part used	Medicinal uses
1	<i>Acalypha ciliata</i> Forssk.	Euphorbiaceae	-	-	Leaves and roots	Female sterility, antioxidant, antimicrobial, sores and Schistosomiasis
2	<i>Acalypha fruticosa</i> Forssk.	Euphorbiaceae	Brich leaved acalypha	Chinni chedi.	Leaves	Antioxidant, anti-inflammatory and antifeedant.
3	<i>Aganosma cymosa</i> (Roxb.) G. Don	Apocynaceae	-	Sellakkodi	Whole plant	Anthelmintic, emetic and bronchitis
4	<i>Agave sisalana</i> Perrine	Asparagaceae	Sisal hemp	Aanai Kathalai	Whole plant	Syphilis, antiseptic, jaundice, pulmonary tuberculosis, laxative, toothache, skin disease and lower blood pressure

5	<i>Allophylus cobbe</i> (L.) Raeusch.	Sapindaceae	Indian allophylus	Siruvalli	Whole plant	Diarrhoea, colic and bruises
6	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. & Perr.	Combretaceae	Axelwood	Vellainagai	Heart wood, exudates and bark	Wound healing, diarrhoea, bleeding piles, diabetes, scorpion bites, spider bites, skin disease and jaundice
7	<i>Andrographis echinoides</i> (L.) Nees	Acanthaceae	False water willow	Gopuram thangi	Leaves and root	Hair fall, ring worm and muscular fitness
8	<i>Alangium salviifolium</i> (L.f.) Wangerin	Comaceae	Sage leaved alangium	Azhinjil	Leaves, fruits, bark and root	Herpes, rodent bites, dog bites, diabetes, epilepsy, pain disorder and inflammatory disease
9	<i>Aponogeton natans</i> (L.) Engl. & K.Krause	Aponogetonaceae	Floating lace plant	Kottikizhangu	Tuber and leaves	Wound healing and dandruff
10	<i>Atalantia monophylla</i> DC.	Rutaceae	Indian atalantia	Kattu elumichai	Fruits	Chronic rheumatism
11	<i>Azima tetracantha</i> Lam.	Salvadoraceae	Needle brush	Sugam cheddi	Leaves, root and milky juice	Rheumatism, toothache, dropsy and chronic diarrhoea
12	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Margosa	Vembu	Bark, leaves and seeds	Wound healing, fever, asthma, sore throat, tuberculosis, jaundice, stomach ulcer, diabetes, rheumatism, rashes, chicken pox, night blindness, ring worm and skin problems
13	<i>Barleria longiflora</i> L. f.	Acanthaceae	Long flowered barleria		Root, leaves, seeds and bark	Toothache, abscess, acid reflux and anaemia
14	<i>Bambusa arundinacea</i> Willd.	Poaceae	Bamboo	Moongil	Stem, leaves and root	Cough, wound, skin disease, nausea, digestive disorder and fever
15	<i>Borassus flabellifer</i> L.	Arecaceae	Palmyra palm	Panai maram	Leaves, stem, male flower, root and fruit coat	Anti-oxidant, anti-inflammatory, cytotoxic and anti-diabetics
16	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch.	Phyllanthaceae	Mountain coffee bush	-	Leaves	Postpartum remedy, boils, skin disease and bleeding
17	<i>Buchanania axillaris</i> (Desr.) Ramamoorthy	Anacardiaceae	Cuddapah almond	Mudama	Leaves	Diarrhoea, skin disease, cough, asthma and haemorrhage
18	<i>Buchanania latifolia</i> Roxb.	Anacardiaceae	Chirauli nut	Murala	Stem bark, nut and seed kernel	Anaemia, inflammation, oxidative stress, ulcer and diabetes
19	<i>Canthium coromandelicum</i> (Burm. f.) Alston	Rubiaceae	Coromandal canthium	Karai	Leaves and fruits	Intestinal worms
20	<i>Capparis sepiaria</i> L.	Capparaceae	Wild caper bush	Karintu	Fruit, bark, leaves and root	Fever, liver disorder and diarrhea
21	<i>Carissa carandas</i> L.	Apocynaceae	Karanda	Kalakkai	Leaves, fruits, root and dried stem bark	Anaemia, acid reflux, anorexia and anxiety
22	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Blloon vein	Mudakathan	Whole plant	Constipation, cough, dyspnoea, rat bites, spider poisoning, diarrhoea and dandruff
23	<i>Caralluma umbellata</i> Haw.	Apocynaceae	Umbelled caralluma	Kallimuliyaan	Fleshy stem	Hyperglycaemia and wound healing
24	<i>Cassia fistula</i> L.	Caesalpinaceae	Indian laburnum	Sarakkonrai	Bark and fruits	Inflammation, ulcer wounds, antiseptic and laxative
25	<i>Cassia occidentalis</i> L.	Caesalpinaceae	Coffee senna	Nattam takarai	Leaves and Flowers	Cough, cold, eczema and asthma
26	<i>Cipadessa baccifera</i> (Roth) Miq.	Meliaceae	Ranabili	Pulipanchedi	Leaves and root	Indigestion and cobra bites
27	<i>Cissus vitiginea</i> L.	Vitaceae	South Indian Treebine	Cembirantai	Leaves	Bone problems
28	<i>Chloris barbata</i> Sw.	Poaceae	Finger grass	Mayirkondai pul	Leaves	Rheumatism, fever, skin disease, diarrhoea and diabetes
29	<i>Chionanthus ramiflorus</i> Roxb.	Oleaceae	South indian olive	Perumsithudakki	Root, leaves and bark	Liver and gallbladder disorder
30	<i>Clausena dentata</i> (Willd.) Roem.	Rutaceae	Agbasa	Nanachedi	Leaves and root	Body ache, anorexia and burns
31	<i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook.f.	Euphorbiaceae	-	Oduvan	Leaves	Poisonous plant
32	<i>Clitoria ternatea</i> L.	Fabaceae	Butterfly pea	Sangu poo	Leaves, flower, stem and root	Brain related health problems, chronic headache, digestive problems and respiratory problems
33	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	Ban tulsi	Rail poondu	Whole plant	Anti-tumour, Swelling, asthma and constipation
34	<i>Crinum asiaticum</i> L.	Amaryllidaceae	Poison bulb	Vishamoongil	Leaves, bulb and rhizome	Bloating, ascites and arthritis

35	<i>Cymbopogon citratus</i> (DC.) Stapf.	Poaceae	Lemon grass	Elumichai pul	Whole plant	Anti-oxidant, anti-inflammatory, digestive disorders, fever, menstrual disorders, ringworm and rheumatism
36	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Bermuda grass	Arugam pul	Whole plant	Menstrual problems, acidity, diabetes, immunity, constipation and control obesity
37	<i>Dalbergia lanceolaria</i> L.f.	Fabaceae	Takoli	Kattupachilai	Seed and bark	Indigestion, skin disease, leprosy, rheumatism, arthritis, burns and constipation
38	<i>Dalbergia paniculata</i> Roxb.	Fabaceae	-	Pachchalan maram	Leaf, bark and root	Bleeding piles, cough, diarrhoea, epigastria, epistaxis, gonorrhoea, leprosy, malaria, scabies, syphilis and ulcers
39	<i>Dioscorea oppositifolia</i> L.	Dioscoreaceae	-	Kavalakizhangu	Leaf, root and seed	Herbal tonic, asthma, diabetes, diarrhoea, uncontrolled urination, snake & scorpion bites and arthritis
40	<i>Dodonaea viscosa</i> Jacq.	Sapindaceae	Broad leaf hopbush	Virali	Leaves, seed, fruits, wood and bark	Bruises, aphthous and ulcers
41	<i>Ehretia anacua</i> (Teran & Berland.) I.M.Johnst.	Boraginaceae	Anacua	Kalvirasu	Unknown	Unknown
42	<i>Erythrina indica</i> Lam.	Fabaceae	Indian coral tree	Kalyana murungai	Bark, root, leaves and Fruits	Fever, liver ailment, rheumatism, relive joint pain, to kill tapeworm, roundworm, and threadworm
43	<i>Evolvulus alsinoides</i> (L.) L.	Convolvulaceae	Dwarf morning glory	Vishnukranthi	Leaves, root and stem	Fever, memory power, hair growth, reduce stress and wound healing
44	<i>Flacourtia indica</i> (Burm. f.) Merr.	Salicaceae	Indian plum	Cimaikottaikala	Leaves, root, bark	Snakebites, arthritis, cough, pneumonia, diarrhea and throat infection
45	<i>Garuga pinnata</i> Roxb.	Burseraceae	Garuga	Karivembu	Leaves, bark, stem and fruits	Anti-bacterial, anti-cancer, anti-oxidant, anti-ulcer and wound healing activity
46	<i>Gloriosa superba</i> L.	Colchicaceae	Glory lily	Senkanthal	Rhizomes and stem	Rheumatism and gout
47	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	Proteaceae	Southern silky oak	Malai savukku	Unknown	Unknown
48	<i>Grewia carpinifolia</i> Juss.	Tiliaceae	Bailleul	Panripputukkan	Leaves	Wounds and cuts
49	<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Sm.	Apocynaceae	Cow plant	Sirukurinjan	Leaves	Diabetes, ulcer, reduce body heat, digestion problems, cough, heavy fever, liver problems and animal bites
50	<i>Gyrocarpus americanus</i> Jacq.	Hernandiaceae	Helicopter tree	Thanakku	Bark and root	Cancer, kidney pain, wounds, diarrhoea and scabies
51	<i>Haldina cordifolia</i> (Roxb.) Ridsdale	Rubiaceae	Haldu	Mannakkatambu	Root, bark of stem and heartwood	Chronic cough, jaundice, stomach ache, diarrhea and dysentery
52	<i>Helicteres isora</i> L.	Malvaceae	Indian screw tree	Valamburi	Root, stem, bark and fruits	Diarrhoea, dysentery, abdominal colic, intestinal parasites
53	<i>Hemionitis arifolia</i> (Burm. f.) T. Moore	Pteridaceae	Heart fern	Soikkosaniainen	Leaves	Anti-diabetes
54	<i>Hildegardia populifolia</i> Schott & Endl.	Malvaceae	-	Malai arasu	Unknown	Unknown
55	<i>Hugonia serrata</i> Lam..	Linaceae	Climbing flax	Mothirakanni	Roots	Fever, viper bite, verminosis, anti – inflammation
56	<i>Hybanthus enneaspermus</i> (L.) F.Muell.	Violaceae	Spade flower	Orithal thamarai	Whole plant	Hypolipidaemic, anti-oxidant, anti-diabetes and anaemia
57	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton.	Apocynaceae	Black creeper	Udarkodi	Leaves and flower	Rheumatism, asthma, cholera, and fever
58	<i>Ixora pavetta</i> Andr.	Rubiaceae	Torchwood tree	Sulunthu.	Flower and bark	Whooping cough, anaemia and general weakness
59	<i>Jasminum angustifolium</i> (L.) Willd.	Oleaceae	Wild jasmine	Kuruvilankodi	Root and leaves	Skin disease, ulcer and eye disease
60	<i>Jasminum multipartitum</i> Hochst.	Oleaceae	Starry wild jasmine	Kattu malli	Unknown	Unknown
61	<i>Jatropha curcas</i> L.	Euphorbiaceae	Physic nut	Kattukattai	Leaves and seeds oil	Cholera, diarrhoea, skin disease and gingivitis
62	<i>Justicia betonica</i> L.	Acanthaceae	Squirrel tail	Velimoongil	Root, leaves and flower	Constipation, malaria, snake bites, vomiting, stomach ache and swelling
63	<i>Justicia glauca</i> Rottler	Acanthaceae	Gulf sandmat	Thavasi murungai	Leaves	Backache
64	<i>Kleinia grandiflora</i> (Wallich ex DC.) N.Rani	Asteraceae	Large-flower kleinia	Attukaalchedi	Root, stem, flower, leaves and fruits	Pimples and hydrophobia

65	<i>Lantana camara</i> L.	Verbinaceae	Lantana	Unnichi	Leaves, root and flowers	Asthma, ulcers, cancers, leprosy, skin itches, rabies and chicken pox
66	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Common leucas	Thumbai	Whole plants	Scorpion bites, insect bites, jaundice, liver disease and fever
67	<i>Loeseneriella obtusifolia</i> (Roxb.) A.C.Sm.	Celastraceae	-	Menthakkodi	Unknown	Unknown
68	<i>Mangifera indica</i> L.	Anacardiaceae	Mango tree	Maamaram	Bark, seed, kernel, flower, leaves and fruits	Digestion, skin disorders, bleeding disorder, chronic fever, eye disorder, constipation and bloating
69	<i>Melia azedarach</i> L.	Meliaceae	China berry	Malai vembu	Leaves, fruits and bark	Anti-malarial and skin disease
70	<i>Memecylon umbellatum</i> Burm.f.	Melastomataceae	Ironwood	Anjani	Leaf and root	Antimicrobial, antipyretic, antidiabetic and anti-obesity
71	<i>Mimosa hamata</i> Willd.	Fabaceae	Hooked mimosa	Indiri	seed, stem, root and leaves	Diarrhoea, jaundice, dysentery, wounds, piles and blood purifier
72	<i>Oldenlandia umbellata</i> L.	Rubiaceae	Chay root	Saya	Root and leaves	External bleeding, snake bites, heavy menstrual bleeding and bronchitis
73	<i>Olex scandens</i> Roxb.	Olacaceae	Parrot olax	Kataliranci	Leaves and bark	Anemia, constipation, diabetes and fever
74	<i>Opilia amentacea</i> Roxb.	Opiliaceae	Fragrant opilia	-	Root, leaves and bark	Fever, headache, Stomach problem, coughs, toothache and malaria
75	<i>Orthosiphon thymiflorus</i> (Roth.) Sleseen	Lamiaceae	-	Cilannipattum	Whole leaves	Anti-inflammatory, diabetes, kidney stone, hepatitis, hypertensive, jaundice, oedema and leaf juice used by tribes as a lotion
76	<i>Pavetta indica</i> L.	Rubiaceae	White pavetta	Kattukkarantai	Root, bark and leaves	Relieving the pain of piles and haemorrhoids
77	<i>Pavonia zeylanica</i> (L.) Cav.	Malvaceae	Ceylon swamp mallow	Sevagan	Root and leaves	Haemorrhage, dysentery and inflammation
78	<i>Phyllanthus lawii</i> J. Graham	Phyllanthaceae	Laws gooseberry	-	Unknown	Unknown
79	<i>Psydrax dicoccos</i> Gaertn.	Rubiaceae	Ceylon boxwood	Nanjul	Unknown	Unknown
80	<i>Plecosperrum spinosum</i> Trecul	Moraceae	-	-	Latex	Toothache
81	<i>Premna tomentosa</i> Willd.	Lamiaceae	Woolly leaved fire brand Teak	Cummotakam	Root and leaves	Anaemia, diabetes, rabies, liver disease, stomach ache and diarrhea
82	<i>Pterocarpus marsupium</i> Roxb.	Fabaceae	Indian kino tree	Vengai	Heartwood, leaves and flower	Diabetes, inflammation and bleeding
83	<i>Reissantia indica</i> (Willd.) N. Halle	Celastraceae	Mopane Paddle – Pod	Odangod	Root bark, stem and leaves	Respiratory troubles, febrifuge, sores and wounds
84	<i>Sapindus emarginatus</i> Vahl	Sapindaceae	Soapnut	Boonthi kottai	Fruit	Asthma, colic and dysentery
85	<i>Scutia myrtina</i> (Burm.f.) Kurz	Rhamnaceae	Cat-thorn	Sodali chedi	Root, bark, leaves and fruits	Fever, malaria, bilharzias, intestinal worms, ointment to hasten childbirth
86	<i>Sterculia urens</i> Roxb.	Malvaceae	Gum karaya	Kavalam	Tree gum	Laxative
87	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore	Symplocaceae	Laurel sapphire berry	Kambalivettai	Bark and stem	Biliousness, haemorrhages, diarrhoea, gonorrhoea and eye disease
88	<i>Senna hirsuta</i> (L.) H.S.Irwin & Barneby	Caesalpiniaceae	Woolly cassia	Malaiyavaram poo	Leaves and roots	Kidney disorders, herpes, skin disease, and cracked nipples
89	<i>Tamarindus indica</i> L.	Fabaceae	Tamarind tree	Malai puliyamaram	Leaves, fruits, bark, root and seeds	Scurvy, common cold, fever, dysentery, burns and sore throats
90	<i>Tarenna asiatica</i> (L.) Kuntze ex K.Schum.	Rubiaceae	Asiatic tarenna	Tharani	Leaf-bud, leaves	Antibacterial, antiviral, antioxidant, wound healing and cytotoxicity.
91	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjun tree	Neermaruthu	Bark and leaves	Reliving heart disease, fever, stop bleeding, kidney stone, wound, asthma diarrhoea and dysentery
92	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Behda	Thandrikai	Bark, fruit, seed, whole plant	Anaemia, hoarseness, weak eyesight and abdominal disease
93	<i>Terminalia chebula</i> Retz.	Combretaceae	Chebulic myrobalan	Kadukkai	Fruits, bark, leaves	Digestive disorder, irregular fever, ulcer, colic, haemorrhoids, ascites, piles, worms, colitis and food poisoning
94	<i>Terminalia paniculata</i> Roth	Combretaceae	Ada maruthu	Poo maruthu	Bark	Fever, inflammation, wound healing and bone fracture
95	<i>Tridax procumbens</i> (L.) L.	Asteraceae	Coat buttons	Vettukaya poondur	Stem and leaves	Wound healing and skin disease
96	<i>Tylophora asthmatica</i> (L.f.) Wight & Arn.	Asclepiadaceae	Indian ipecac	Nayppalai	Whole plants	Asthma, bronchitis and cough

97	<i>Vitex negundo</i> L.	Lamiaceae	Chaste tree	Nocchi	Dried leaf, root, fruits, flower and seed	Muscle relaxant, pain relieving, anti asthma, amnesia and eye diseases
98	<i>Walsura trifoliolata</i> (A.Juss.) Harms	Meliaceae	Tree leaf walsura	Kanjimaram	Bark	Stimulant, expectorant, emmenagogue, emetic and also used to kill vermin in the hair
99	<i>Ziziphus oenoplia</i> (L.) Mill.	Rhamnaceae	Jackal jujube	Sooraimullu	Root, stem and leaves	Anaemia, diarrhoea, bronchitis, stomach ache and wounds
100	<i>Ziziphus xylopyrus</i> (Retz.) Willd.	Rhamnaceae	Katber, kottai elandai.	Unknown	Fruit, bark, seed and root	Diabetes, diarrhoea, urinary disorders, digestive disorders and bladder stone

**Table 3:** Ethnopharmacological uses of some species clearly identified by the local population (n = 105)

S.No	Botanical name	Local name	Part used	Ethnopharmacological uses	Fidelity level (FL%)	Use value (UV)
1	<i>Acalypha fruticosa</i> Forssk.	Oosi chedi	Leaf and root	Skin disease	21.90	0.21
2	<i>Agave sisalana</i> Perrine	Malai kathalai	Leaf	Jaundice	15.23	0.15
3	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. & Perr.	Naga maram	Leaf	Wound healing	7.61	0.07
4	<i>Andrographis echiodides</i> (L.) Nees	Kopuram thangi	Leaf	Body pain	39.04	0.39
5	<i>Alangium salviifolium</i> (L.f.) Wangerin	Azhinjil	Leaf	Animal bites and ritualistic use	19.04	0.19
6	<i>Atalantia monophylla</i> DC.	Kuruthan	Leaf and root	Swelling	20	0.2
7	<i>Azima tetracantha</i> Lam.	Sokka mul	Leaf	Rheumatism	9.52	0.09
8	<i>Azadirachta indica</i> A. Juss.	Veppa maram	Leaf and fruit	Leaf - mumps, anthelmintic and antimicrobial, Fruit – edible	44.76	0.17
9	<i>Bambusa arundinacea</i> Willd.	Moongil	Seed (bamboo rice)	Diabetes	24.76	0.24
10	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch.	Sirumani chedi	Fruit	Edible	-	-
11	<i>Canthium coromandelicum</i> (Burm. f.) Alston	Karakkai	Fruit	Edible	-	-
12	<i>Carissa carandas</i> L.	Kalakai	Fruit	Pickle	-	-
13	<i>Cardiospermum halicacabum</i> L.	Mudakuthan keerai	Fruit	Hair fall and reduce body heat	37.14	0.37
14	<i>Cassia fistula</i> L.	Konnai maram	root	Snake bites	30.47	0.30
15	<i>Cassia occidentalis</i> L.	Peiavarai	Leaf	Cough and cold	26.66	0.26
16	<i>Cipadessa baccifera</i> (Roth) Miq.	Thamatan chedi	Leaf	Stomach pain	22.85	0.22
17	<i>Cissus vitiginea</i> L.	Cembiratai	Leaf	Bone health	11.42	0.11
18	<i>Chloris barbata</i> Sw.	Mayirkondai pul	Whole plant	Skin disease	40	0.11
19	<i>Clausena dentata</i> (Willd.) Roem.	Aana chedi	Fruit	Body heat	40	0.4
20	<i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook.f.	Ottan maram	Whole plant	Poisonous; used as roofing material to protect against insects	-	-
21	<i>Clitoria ternatea</i> L.	Sangu poo kodi	Leaf	Laxative	19.04	0.19
22	<i>Croton bonplandianus</i> Baill.	Rail poondu	Leaf and root	Skin disease and jaundice	29.52	0.29
23	<i>Cymbopogon citratus</i> (DC.) Stapf.	Manjam pul	Leaf	Fever	28.57	0.28
24	<i>Cynodon dactylon</i> (L.) Pers.	Arugam pul	Leaf	Laxative	40	0.4
25	<i>Dodonaea viscosa</i> Jacq.	Velleri chedi	Leaf	Throat infection	28.57	0.34
26	<i>Ehretia anacua</i> (Teran & Berland.) I.M.Johnst.	Naruni	Fruit	Edible	-	-
27	<i>Erythrina indica</i> Lam.	Kalliyana murungai	Leaf	Fever and rheumatism	20	0.2
28	<i>Evolvulus alsinoides</i> (L.) L.	Echi thamarai	Leaf	Wound healing	40	0.4
29	<i>Gloriosa superba</i> L.	Senkanthal	Tuber	Ulcer	22.85	0.22
30	<i>Gymnema sylvestre</i> (Retz.)R. Br. ex Sm.	Aattu kodi	Leaf	Diabetes	32.38	0.32
31	<i>Helicteres isora</i> L.	Valamburi kai	Dry fruit	Digestive problems and gas trouble	24.76	0.24
32	<i>Ixora pavetta</i> Andr.	Sulunthi maram	Dry fruit	Cough and generalized weakness	18.09	0.18
33	<i>Justicia betonica</i> L.	Velichedi	Leaf and root	Constipation and stomach pain	15.23	0.15
34	<i>Justicia glauca</i> Rottler	Thavasi keerai	Leaf	Fever and back pain	15.23	0.15
35	<i>Lantana camara</i> L.	Urumpuli chedi	Fruit	Edible	-	-
36	<i>Leucas aspera</i> (Willd.) Link	Thumbai chedi	Leaf and	Cold and laxative	22.85	0.60

			flower			
37	<i>Mangifera indica</i> L.	Maanga maram	Leaf and fruit	Edible	-	-
38	<i>Melia azedarach</i> L.	Malai vembu	Leaf	Skin disease	25.71	0.60
39	<i>Mimosa hamata</i> Willd.	Seengai mul	Leaf	Stomach pain	26.66	-
40	<i>Oldenlandia umbellata</i> L.	Mookuthi chedi	leaf	External bleeding	7.61	0.25
41	<i>Pavetta indica</i> L.	Kattu karanai	Leaf and root	Analgesic for piles	16.19	0.26
42	<i>Pavonia zeylanica</i> (L.) Cav.	Seevagai chedi	Leaf	Inflammation	25.71	0.07
43	<i>Premna tomentosa</i> Willd.	Cumata maram	Leaf	Stomach pain	6.66	0.16
44	<i>Sapindus emarginatus</i> Vahl	Sopukai	Dry fruit	Used like soap	26.66	0.25
45	<i>Scutia myrtina</i> (Burm.f.) Kurz	Sodali chedi	Leaf and fruit	Leaf – fever, fruit – edible	12.38	0.06
46	<i>Tamarindus indica</i> L.	Puliya maram	Leaf, fruit and seed	Leaf – body pain, fruit – edible, seed – fracture	24.76	0.26
47	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Thandi maram	Seed	Piles and making soap	20.95	0.12
48	<i>Terminalia chebula</i> Retz.	Kadukai maram	Seed	Diabetes and piles	18.09	0.24
49	<i>Tridax procumbens</i> (L.) L.	Vettukaya poondu	Leaf	Wound healing	14.28	0.20
50	<i>Tylophora asthmatica</i> (L.f.) Wight & Arn.	Kaattu kodi	Leaf	Asthma and cough	28.57	0.18
51	<i>Vitex negundo</i> L.	Nochi	Leaf	Headache, cold and cough	32.38	0.14
52	<i>Ziziphus oenoplia</i> (L.) Mill.	Soorachedi	Fruit	Edible	-	-

Table 4: Informant Consensus Factor (ICF) values

Ailment	Nur	Nt	Nur-Nt/Nur-1
Skin disease	50	4	0.93
Jaundice	34	2	0.96
Wound healing	65	3	0.96
Body pain	41	2	0.97
Animal bites	21	1	1
Swelling	26	1	1
Rheumatism	31	2	0.96
Mumps	18	1	1
Anthelminthic	35	1	1
Hair fall	39	1	1
Diabetes	79	3	0.96
Snake bites	32	1	1
Stomach pain	59	3	0.96
Cough	94	4	0.96
Cold	86	3	0.97
Body heat	81	2	0.98
Bone health	12	1	1
Laxative	104	3	0.98
Fever	90	4	0.96
Throat infection	36	1	1
Ulcer	24	1	1
Digestive problems	26	1	1
Gastric trouble	24	1	1
Generalized weakness	19	1	1
Constipation	7	1	1
External bleeding	8	1	1
Piles	58	3	0.96
Inflammation	27	1	1
Soap	50	2	0.97
Fracture	35	1	1
Asthma	13	1	1
Headaches	34	1	1

Nur – Number of use reports present in each ailment category

Nt – Number of species which are used

Table 5: Surveying flora in National Medicinal Plants Board database and traditional Indian medicinal literature

S. no	Botanical name	Reported in traditional (ayurvedic/siddha literature) – Indian medicinal plants database of the National Medicinal Plants Board	IUCN Red list
1	<i>Acalypha ciliata</i> Frossk.	+	-
2	<i>Acalypha fruticosa</i> Forssk.	+	Least - concern
3	<i>Aganosma cymosa</i> (Roxb.) G. Don	+	-
4	<i>Agave sisalana</i> Perrine	+	-
5	<i>Allophylus cobbe</i> (L.) Raeusch.	-	-

6	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. & Perr.	+	-
7	<i>Andrographis echioides</i> (L.) Nees	+	-
8	<i>Alangium salviifolium</i> (L.f.) Wangerin	-	-
9	<i>Aponogeton natans</i> (L.) Engl. & K.Krause	+	-
10	<i>Atalantia monophylla</i> DC.	+	-
11	<i>Azima tetracantha</i> Lam.	+	-
12	<i>Azadirachta indica</i> A. Juss.	+	Least - concern
13	<i>Barleria longiflora</i> L. f.	+	-
14	<i>Bambusa arundinacea</i> Willd.	+	-
15	<i>Borassus flabellifer</i> L.	+	Endangered
16	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch.	+	Least - concern
17	<i>Buchanania axillaris</i> (Desr.) Ramamoorthy	+	-
18	<i>Buchanania latifolia</i> Roxb.	+	-
19	<i>Canthium coromandelicum</i> (Burm. f.) Alston	+	-
20	<i>Capparis sepiaria</i> L.	+	-
21	<i>Carissa carandas</i> L.	+	-
22	<i>Cardiospermum halicacabum</i> L.	+	-
23	<i>Caralluma umbellata</i> Haw.	+	-
24	<i>Cassia fistula</i> L.	+	Least - concern
25	<i>Cassia occidentalis</i> L.	+	-
26	<i>Cipadessa baccifera</i> (Roth) Miq.	+	Least - concern
27	<i>Cissus vitiginea</i> L.	+	-
28	<i>Chloris barbata</i> Sw.	+	-
29	<i>Chionanthus ramiflorus</i> Roxb.	-	-
30	<i>Clausena dentata</i> (Willd.) Roem.	+	-
31	<i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook.f.	+	Vulnerable
32	<i>Clitoria ternatea</i> L.	+	-
33	<i>Croton bonplandianus</i> Baill.	+	-
34	<i>Crinum asiaticum</i> L.	-	-
35	<i>Cymbopogon citratus</i> (DC.) Stapf.	+	-
36	<i>Cynodon dactylon</i> (L.) Pers.	+	-
37	<i>Dalbergia lanceolaria</i> L.f.	+	Least - concern
38	<i>Dalbergia paniculata</i> Roxb.	+	-
39	<i>Dioscorea oppositifolia</i> L.	+	-
40	<i>Dodonaea viscosa</i> Jacq.	+	Least - concern
41	<i>Ehretia anacua</i> (Teran & Berland.) I.M.Johnst.	-	Least - concern
42	<i>Erythrina indica</i> Lam.	+	Least - concern
43	<i>Evolvulus alsinoides</i> (L.) L.	+	-
44	<i>Flacourtia indica</i> (Burm. f.)Merr.	+	Least - concern
45	<i>Garuga pinnata</i> Roxb.	+	-
46	<i>Gloriosa superba</i> L.	+	Least - concern
47	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	+	-
48	<i>Grewia carpinifolia</i> Juss.	+	-
49	<i>Gymnema sylvestre</i> (Retz.)R. Br. ex Sm.	+	-
50	<i>Gyrocarpus americanus</i> Jacq.	+	Least - concern
51	<i>Haldina cordifolia</i> (Roxb.) Ridsdale	+	-
52	<i>Helicteres isora</i> L.	+	-
53	<i>Hemionitis arifolia</i> (Burm. f.) T. Moore	+	-
54	<i>Hildegardia populifolia</i> Schott & Endl.	+	Critically endangered
55	<i>Hugonia serrata</i> Lam..	+	-
56	<i>Hybanthus enneaspermus</i> (L.) F.Muell.	+	-
57	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton.	+	-
58	<i>Ixora pavetta</i> Andr.	+	-
59	<i>Jasminum angustifolium</i> (L.) Willd.	+	-
60	<i>Jasminum multipartitum</i> Hochst.	-	-
61	<i>Jatropha curcas</i> L.	+	Endangered
62	<i>Justicia betonica</i> L.	+	-
63	<i>Justicia glauca</i> Rottler	-	-
64	<i>Kleinia grandiflora</i> (Wallich ex DC.) N.Rani	+	-
65	<i>Lantana camara</i> L.	+	-
66	<i>Leucas aspera</i> (Willd.) Link	+	-
67	<i>Loeseneriella obtusifolia</i> (Roxb.) A.C.Sm.	+	-
68	<i>Mangifera indica</i> L.	+	Data deficient
69	<i>Melia azedarach</i> L.	+	Least - concern
70	<i>Memecylon umbellatum</i> Burm.f.	-	-

71	<i>Mimosa hamata</i> Willd.	+	-
72	<i>Oldenlandia umbellata</i> L.	+	-
73	<i>Oxalis scandens</i> Roxb.	+	-
74	<i>Opilia amentacea</i> Roxb.	+	-
75	<i>Orthosiphon thymiflorus</i> (Roth.) Sleesen	+	-
76	<i>Pavetta indica</i> L.	+	-
77	<i>Pavonia zeylanica</i> (L.) Cav.	+	-
78	<i>Phyllanthus lawii</i> J. Graham	-	-
79	<i>Psydrax dicoccos</i> Gaertn.	-	Vulnerable
80	<i>Plecosperrum spinosum</i> Trecul	+	-
81	<i>Premna tomentosa</i> Willd.	+	Least - concern
82	<i>Pterocarpus marsupium</i> Roxb.	+	Near - threatened
83	<i>Reissantia indica</i> (Willd.) N. Halle	+	-
84	<i>Sapindus emarginatus</i> Vahl	+	-
85	<i>Scutia myrtina</i> (Burm.f.) Kurz	+	Least - concern
86	<i>Sterculia urens</i> Roxb.	+	-
87	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore	+	-
88	<i>Senna hirsuta</i> (L.) H.S.Irwin & Barneby	+	-
89	<i>Tamarindus indica</i> L.	+	Least - concern
90	<i>Tarenna asiatica</i> (L.) Kuntze ex K.Schum.	+	-
91	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	+	-
92	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	+	-
93	<i>Terminalia chebula</i> Retz.	+	-
94	<i>Terminalia paniculata</i> Roth	+	-
95	<i>Tridax procumbens</i> (L.) L.	+	-
96	<i>Tylophora asthmatica</i> (L.f.) Wight & Arn.	+	-
97	<i>Vitex negundo</i> L.	+	Least - concern
98	<i>Walsura trifoliolata</i> (A.Juss.) Harms	+	-
99	<i>Ziziphus oenoplia</i> (L.) Mill.	+	-
100	<i>Ziziphus xylopyrus</i> (Retz.) Willd.	+	-

Least-concern – 17, endangered – 02, critically endangered – 01, vulnerable – 02, near-threatened – 01, data-deficient – 01.

The names of the various species surveyed in this paper was searched in the database of National Medicinal plants and found that some of the plants (10 species) have not been reported in that database.

## Discussion

In the ages past, our ancestors used the adage, “eat this root”<sup>[12]</sup>, and pointed to specific plants or their parts, which had the potential to cure specific ailments. Then, advancements in medicine led humankind to identify, isolate and administer active principles which were responsible for specific medicinal properties. *In silico* methods have aided in broadening our understanding of how plant compounds interact with their receptors<sup>[13]</sup>; with the aid of receptor-ligand docking and molecular simulation/dynamics tools, our understanding has improved significantly. Chemotherapy became popular because of this and many embraced the western system of medicine; concomitantly, there also has been a steep rise in cases of accidental drug poisoning and dosage-related emergencies, especially among the elderly<sup>[14]</sup>. Death due to poisoning is also one of the inevitable consequences, albeit at rare instances. Also, polymorphisms in the target genes (especially the liver microsomal CYP450s) among the populations have key implications in the pharmacokinetics and pharmacodynamics of drugs<sup>[15]</sup>. Due to high rate of drug-mediated damage to key organs, patients are turning to alternative healthcare systems, even for treatment of terminal illnesses such as cancer<sup>[16]</sup>. Isolated compounds are sometimes considered to be toxic and known to cause adverse effects in some people. Crude isolates of medicinal plants are deemed to have little or no toxicity in humans; to the contrary, isolated (pure) compounds are often presumed

to exert toxicity<sup>[17]</sup>. There is an urgent need to identify novel compounds/metabolites from plants of forests, which are nature’s repertoires of medicinal compounds<sup>[18]</sup>, to treat illnesses which do not exhibit toxicity or cause organ dysfunction/failure that is associated with chemotherapy.

Our age is characterized by the unprecedented rise of superbugs (multi- and extensively-drug resistant pathogens); hence, the quest for bioactive molecules with bacteriostatic and bactericidal potential against clinically relevant pathogens<sup>[19]</sup> and other human diseases such as cancer, ulcer, obesity, cardiovascular disease and neurodegenerative diseases (and the entire spectrum of diseases, both communicable and non-communicable) are underway. In order to augment this search for newer classes of bioactive principles, we need to identify unexplored plant genera (and species) and investigate their chemical constituents for bioactivity. Several poisonous plants are known to produce metabolites which bind to particular cellular targets and block different pathways that are responsible for the manifestation of a disease [20, 21]. In the recent century, an unprecedented growth in the field of ethnobotany has revolutionized our understanding of pharmacology and pharmacognosy. The Chipko movement<sup>[22]</sup> which began in the 1970s, sparked several campaigns worldwide for forest conservation and aimed at preventing anthropogenic activities such as deforestation. In this movement, people embraced trees and prevented them from being felled, by arguing that forests provide fuel, fodder, food, fibre and fertilizer. Anthropogenic activities have led to a steady decline in forest cover and caused the destruction of endemic species, which are now rare, threatened or have gone completely extinct<sup>[23, 24]</sup>. Therefore, biological conservation efforts have been proposed to save the

destruction of endangered as well as rare species through *in vitro* propagation and other plant tissue culture approaches. It is our earnest desire that some of the rare species that have been identified in the study area would be preserved from becoming endangered or altogether extinct through concerted efforts from Botanists who are interested in *in vitro* propagation [25].

### **Ethnic background of the residents and population demographics**

The Kalvarayan hills were not officially part of independent India until the year 1976 (June 25). Before that period, these hills were ruled by emperor Krishnadevaraya (1500s) and were occupied by the ethnic locals who were known as the Vedars (hunters) until 1901. Another community known as the Karlars (warriors) moved from Kanchipuram and settled in the Kalvarayan hills. Since Krishnadevaraya allowed the Vedars to occupy the Kalvarayan hills, they settled from the plains in these mountainous regions. However, as the Karlars expanded, they ethnically cleansed the region of the Vedars and took their women and girls as wives and subsequently, became known as the 'Malayalis' (mountain dwellers). They began referring to themselves as 'Goundars'. Subsequently, three Jagirdhars (Poligars) ruled the Kalvarayans and each of these lords had several villages under their control. Currently, the descendants of the Karlars (who call themselves as Malayalis/Malayalis) are the local residents of the villages in the Periya and Siriya Kalvarayan hills [26]. Currently, the chief occupation of the residents is farming/agriculture, goat-herding and cattle rearing. In this survey of the residents for their reliance on traditional as well as western medicine, most of the respondents (total n=105) exhibited strong belief in plant-based formulations and only residents of the villages which were located closer to the plain stated that they relied more on allopathy than on ethnic medicine.

### **Questionnaire and response of the surveyed residents**

Most of the responded village people were young (below age 30) and some of them were >70 years old. This data is presented in Fig. 2, panels A and B. Their preferred medicine system was also enquired (ayurveda, siddha, unani, homeopathy, allopathy and naturopathy) and most of the residents of the villages in the hilly areas stated that they depended primarily on plant-based medicine (ethnic medicine, esp. siddha and ayurveda) and seldom opted for any allopathic medicine. Some of them were >70 years old and most of them stated that they had never been to an allopathic doctor in their life (Fig. 2). In Fig. 3, results for the of query regarding their choice of medicine system is showed and found that 2.8% of the residents strictly followed siddha medicine, while 28.5% utilized both naturopathy and siddha medicine, 20% of the interviewed subjects strictly took allopathic medicine, while 26.6% took both siddha and allopathic medicine. Another group of residents (~22%) embraced three different forms of medicine-siddha, naturopathy and allopathy. As we went down the mountain, we noticed that the residents gravitated towards modern forms of medicine such as allopathy and did not exhibit much belief in traditional medicine.

### **Ethnobotanical survey of the plants of the Siriya Kalvarayan hills and their uses**

The Western Ghats of India has been surveyed thoroughly and several reports focusing on the medicinal plants (and their specific uses) of those regions have been published in

the past few decades [27, 28]. However, the number of taxonomic surveys pertaining to medicinal plants of the Eastern Ghats is limited. The Siriya Kalvarayan hills from this zone contain many rare plants (close to 60% in our survey). In Fig. 1, the geographical location of the study area has been represented. The outcomes of this study would lead us to find new lead molecules which could serve as potential drug candidates to treat diseases. Ethnomedicine has a rich heritage dating back to several millennia. Each of the plant and their parts used for alleviation of specific medical conditions is mentioned in Table 1. The corresponding botanical names of those plants, their family names, the name of the author (nomenclature) and the traditional uses of those plants (and their parts thereof) in Indian folk medicine have been provided in Table 1. In Fig. 9, a bar chart to represent the types of genera, species and the distribution of those plants (according to plant type) is presented.

### **ICF, FL% and UV**

The ICF values of the plants was very high (0.93-1.0) for almost all of 32 different ailments. While the UV values were considerably high (0.6) for some of the plant species (*L. aspera* and *M. azedarach*), it was low for most of the plants because a very large proportion of the population (all the 105 informants) reported that they used plant-based medicines for treating various ailments and opted for other forms of medicine such as allopathy only when they had medical emergencies. From the FL% values obtained, though 44.76% was the highest value (for *Azadirachta indica*), we were able to assess from the knowledge of the localites and villagers that they had sufficient confidence while citing a given species for an illness. However, since not all of the informants may have in-depth ethnobotanical knowledge, the FL levels are low. This reveals an important fact that not all of the informants knew all of the possible ethnobotanical uses of all of the plants. This trend reveals that only the village shamans or medicine men (who were interviewed separately), knew all of the traditional uses as they conserve their ethnomedicinal secrets. Knowledge pertaining to ethnic medicine is passed on among the tribals by word of mouth tradition; hence, it is not documented in the form of books or journal articles. Also, the general public in the locale rely on the medicine men for their health needs, they may not need to know everything about all the plant species and may self-medicate themselves whenever necessary and relegate the difficult bits to the 'specialist' medicine men/shamans. These shamans deem that their service to their villagers would be offered free of cost and therefore, do not divulge too many secrets to strangers, who they feel, might misuse this knowledge. We had seen this first-hand in our survey; when we approached the medicine men; at first, they refused to share any information. After introduction by a friend (also a local resident), we gained their confidence and the medicine men agreed to speak to us. The reported FL% values in our survey may be deemed to be low, but the number of plants for which most of the informants admitted to using (on a regular basis) was 52 (among the 100 plants identified earlier). Also, since most of these species were used for just one or two ailments, we obtained low FL% values. These data indicate that while most of the informants used traditional medicine on a daily basis, their knowledge of the medicinal plants in the Siriya Kalvarayan hills is on the decline. The ethnobotanical

survey pertaining to specific plants (by showing them photographs) was conducted separately, on another day subsequent to the questionnaire study which focused on residents of 8 different villages. Hence, both these surveys (both with n =105 participants) were conducted on separate days and involved different individuals. For the survey of ethnobotanical uses of particular medicinal plants (52), the informants were carefully chosen based on their reliance on traditional forms of medicine.

### Botanical diversity of the species

Upon surveying the National Medicinal Plants Board database, it is found that around 10 species were not mentioned in the flora of different states (all states given on the website) - Tamil Nadu, Kerala, Karnataka, Andhra Pradesh (& Telangana), West Bengal, Sikkim, Odisha, Chattisgarh, Rajasthan and Maharashtra. These ten plants are arguably endemic to the Sriya Kalvarayan hills and further studies are needed to identify the ecological traits (both biotic and abiotic factors) of this region and how these ecological conditions can be mimicked in *in vitro* conditions when considering *in vitro* plant tissue culture. *Hildegardia populifolia* (Roxb.) Schott & Endl. was found to be a critically endangered species. We have collected the seeds of this critically endangered species (and other parts) and are exploring tissue culture and *in vitro* propagation with an aim to conserve this plant. The rest of the species (76) were not found in the IUCN red list, which signifies that they are common varieties of plants.

### Conclusion

It is our sincere desire to study each of these plants (especially, the 61 plants that we had identified, for which little or no medicinal uses have been documented) for their phytochemical constituents. We are currently exploring the biological effects of crude extracts of some of these plants and are in the process of identifying molecules which can serve as potential candidates for specific cellular receptors through bioinformatics studies (work in progress). We have already carried out GC-MS studies, preliminary phytochemical analysis and antioxidant activity assay for 6 of the ~61 plants that have been identified in this region and which are poorly characterized.

### Acknowledgements

AP wishes to thank Mr. Bala, a PhD student of the Department of Geography of the Bharathidasan University Campus, Tiruchirappalli, for his help in drawing the map of the study area.

### Conflict of Interests

The authors declare that they have no conflicts of interest to disclose.

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