Medicinal practices of sacred natural sites: a socio-religious approach for successful implementation of primary healthcare services

Rajasri Ray and Avik Ray

Review

Abstract

Background: Sacred groves are model systems that have the potential to contribute to rural healthcare owing to their medicinal floral diversity and strong social acceptance.

Methods: We examined this idea employing ethnomedicinal plants and their application documented from sacred groves across India. A total of 65 published documents were shortlisted for the preparation of database and statistical analysis. Standard ethnobotanical indices and mapping were used to capture the current trend.

Results: A total of 1247 species from 152 families has been documented for use against eighteen categories of diseases common in tropical and sub-tropical landscapes. Though the reported species are clustered around a few widely distributed families, 71% of them are uniquely represented from any single biogeographic region. The use of multiple species in treating an ailment, high use value of the popular plants, and cross-community similarity in disease treatment reflects rich community wisdom to explore and apply available natural resources.

Conclusions: Building on the findings, integration of the tradition in primary healthcare policy especially in AYUSH (Ayurveda, Yoga, Naturopathy, Unani, Siddha and Homoeopathy) program has been recommended. This would embrace folk medicinal practices along with sustainable utilization of plant genetic resources in rapidly changing rural landscapes.

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Background

Human-nature interaction has been long entwined in the history of humanity. Apart from deriving natural resources, humans have a deep rooted tradition of venerating nature which is extensively observed across continents (Verschuuren 2010). The tradition has attracted attention of researchers and policy-makers for its impact on local ecological and socio-economic dynamics. Ethnomedicine that emanated from this tradition, deals health issues with nature-derived resources. It offers invaluable benefits to a large section of indigenous, remotely placed, and economically downtrodden people. The age-old system is deeply embedded in local traditions due to strong belief system, time-tested experience, inexpensive, and easily available raw materials; these essentially underlie their high sociocultural acceptance (Currie *et al*. 2018, Ogundele 2007, Pedersen and Baruffati 1985, Rai & Lalramnghinglova 2011, Zank & Hanazaki 2017). Although forests are key resource for medicinal plants (Bhattacharyya *et al*. 2009, Voeks 1996), the role of culturally protected patches or sacred groves

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cannot be underestimated. Sacred groves are part of forests or forest patches protected by religious-cultural beliefs of local communities. They play an active role in providing critical ecosystem services such as water conservation, soil fertility, species conservation, medicinal plants etc. (Blicharska *et al*. 2013, Ray *et al*. 2014).

The grove-based medicinal practices reserve a great potential in primary healthcare improvement especially in rural contexts. It is crucial since successful implementation of primary healthcare program at grass-root level is a serious challenge for many developing and under-developed countries (Hollard & Sene 2016, Hone *et al*. 2018, Pandve & Pandve 2013). The mainstream biomedicinal healthcare often fails to reach geographically isolated and marginalized people despite a plethora of initiatives at national and international levels (e.g., National Health Program in India, Bangladesh, Sri Lanka and African countries, Alma-Ata declaration 1978). In India, several health missions have been introduced at different administrative levels to include people under the national health program. However, the strategy has been re-framed in recent years to make it more inclusive accepting alternative systems of medicine (i.e., codified traditional medicine) (Katoch *et al*. 2017, Rudra *et al*. 2017, Samal 2015) because of the prevalence of plurality in healthcare practices (Anonymous 2017, Minocha 1980, Sheehan 2009).

Traditional medicine, be it codified (e.g., Ayurveda, Unani, Siddha) or not (e.g., ethnomedicine) has a strong support base among rural and indigenous societies due to cost effectiveness, success rate, availability, and social compatibility. Ethnomedicine, compared to codified medical system, is relatively widespread and culturally embedded in the communities who are remotely located and predominantly dependent on natural resources (Albert & Porter 2015, Albert *et al*. 2015). Largely owing to the informal status of its treatment procedure and knowledge transmission, it has not been formally recognized as a part of the alternative healthcare system at government level, but the documentation is in full swing across the country. Maintaining this connection, sacred groves, tend to play a pivotal role in rural healthcare system (Anyinam 1999, Innocent 2016, Unnikrishnnan 2010, Young 1983).

In India, studies on medicinal plants from sacred groves emphasize on plant diversity and use, application procedure, and an infrequent quantitative estimation of reliability and consensus of plant use (Khumbongmayum *et al*. 2005, Venkatesh & Mahammad 2015). Albeit local in character, the volume of documentation clearly indicates its widespread acceptance, capacity in local resource management, and beliefs of local communities. However, there is a conspicuous lack in the country-wide assessment of resource diversity, cross-cultural practices, possibilities of knowledge sharing, uniqueness in plant use and diseases, etc (see Jain 2004 for ethnomedicinal perspective only) which impedes exploration and tapping of unrealized potential of sacred groves in rural health-care. In this backdrop, we sought answers to the following questions 1) how diverse are the medicinal plant resources in the sacred groves and their distribution pattern, 2) what are the prevalent diseases treated currently and remedial measures and 3) possibilities to identify few hotspots with greater assemblage of frequently used species to link them with rural healthcare network. The answers would not only enable generation of a primary level information pool to reinforce grove based healthcare, but can also be invoked in policy and execution.

Methods

Data Collection

Our dataset was built using available information extracted from the published studies. The primary criterion was to capture indigenous medicinal knowledge associated with the sacred groves. Here the term ‘indigenous medicinal knowledge’ means the use of medicinal plants by indigenous communities and are commonly known as ‘ethnomedicine’, ‘folk medicine’ or ‘local health tradition (LHT)’ (Holley & Cherla 1998, Mishra *et al*. 2018). The objective was to analyze ethnomedicinal information from the sacred groves, therefore reports on Ayurvedic usage of plants (even from sacred groves) have been objectively excluded. We have collected information on medicinal plants availability, their usage, plant parts use, and geographic location. Our search activities comprised internet-based search engines (Google, Web of Science), databases on scientific literature (e.g., Science Direct, Scopus), and international and national level ecology and conservation journals using keywords such as ‘medicinal plants sacred grove’, ‘ethnomedicine India’, “sacred medicinal plants”, “Maharashtra sacred grove medicinal plants” and similar searches with other states, “traditional medicine sacred site”. The second major criterion was to ensure a fair coverage of geographic expanse of the country and we were able to accumulate information from 18 out of 28 states and 9 union territories. Our primary search returned a total of 104 documents but many were discarded owing to a mention of ayurvedic usage and inadequate information, so the final list consisted of 65 studies (Table 1).

Table 1. Studies used for the analysis

S.No.	Title	Author	Journal/Thesis/Project Report
1	Sacred plants and their Ethno-botanical importance in central India: A mini review	Sahu *et al*. (2013)	International Journal of Pharmacy & Life Science, 4(8): 2910-2914
2	Assessment of status and role of sacred groves in conservation of biodiversity at different levels in Madhya Pradesh	Shrivastava and Masih (2008-09)	Project report
3	Role of Sacred Plants in Religion and Health-care system of local people of Almora district of Uttarakhand State (India)	Sharma and Joshi (2010)	Academia Arena, 2(6): 19-22
4	Biodiversity conservation through a traditional beliefs system : a case study from Kumaon Himalaya, India	Singh *et al*.(2012)	International Journal of Conservation Science, 3(1):33-40
5	An ethnobotanical study of medicinal plants used in sacred groves of Kumaon Himalaya,Uttarakhand, India	Singh *et al*. (2014)	Journal of Ethnopharmacology, 154:98-108
6	Sacred Grove in conservation of plant biodiversity in Mahendergarh district of Haryana	Yadav *et al*. (2010)	Indian Journal of Traditional Knowledge, 9(4):693-700
7	Local deities in conservation -A conservation practice in Banju Nami Tok sacred grove in Tehri Garhwal ,Uttarkhand	Pala *et al*. (2012)	The Indian Forester, 138(8): 710-713
8	Patalbhuvneshwar: a new sacred grove from Kumaon Himalaya	Agnihotri *et al*. (2012)	Current Science, 102(6):830-831
9	Traditional knowledge and biodiversity conservation in the sacred groves of Meghalaya	Jeeva *et al*. (2006)	Indian Journal of Traditional Knowledge, 5(4) 563-568
10	Ethnomedicinal plants in the sacred groves of Manipur	Khumbongmayum *et al*. (2005)	Indian Journal of Traditional Knowledge, 4(1):21-32
11	Distribution and conservation status of sacred groves (SGs) in Garo Hills, Meghalaya	Mohanta *et al*. (2009)	The Indian Forester, 135(12):1627-1649
12	Sacred Groves :An analysis made in the cultural perspective within BTC Assam,India	Brahma *et al*. (2014)	Journal of Biological & Scientific Opinion, 2(5):320-323
13	Status of medicinal plants in the disturbed and the undisturbed sacred forests of Meghalaya, northeast India:population structure and regeneration efficacy of some important species	Laloo *et al*. (2006)	Current Science, 90(2):225-232
14	Geo environmental appraisal of sacred groves and its releated traditional practices in West Bengal	Pal (2013)	Ph. D. Thesis. Department of Geography, Visva-Bharati, Santiniketan
15	Role of sacred groves in the conservation and management of medicinal plants	Behera *et al*. (2015)	Journal of Medicinal Plants Research, 9(29):792-798
16	Ethnomedicinal plant conservation through sacred groves	Bhakat and Sen (2008)	Tribes And Tribals, Special Volume (2):55-58
17	Differences in tree species diversity and soil nutrient status in a tropical sacred forest Ecosystem on Niyamgiri Hill Range, Eastern Ghats, India	Sahu *et al*. (2012)	Journal of Mountain Science, 9:492-500
18	An ethnobotanical study of medicinal plants used in sacred groves of Ambaji forest, Gujarat, India	Patel (2015)	International Journal of Advanced Technology in Engineering and Science, 3(1):285-295

19	Floristic and ethnobotany of sacred groves of Kheda District (Gujarat) and their significance in conserving biodiversity	Patel (2015)	Hemchandracharya North Gujrat University,Patan
20	Flora of sacred groves at Sriharikota Island, Andhra Pradesh, India	Kumar (2010)	Ethnobotanical Leaflets, 14:420-426
21	Some ethno medicinal plants of Parnasala sacred grove area Eastern Ghats of Khammam District, Telangana, India	Rao *et al*. (2015)	Journal of Pharmaceutical Sciences & Research, 7(4):210-218
22	Sacred groves of Parinche valley of Pune district of Maharashtra, India and their importance	Chandrakant *et al*. (2006)	Anthropology & Medicine, 13(1):55-76
23	Validation of indigenous knowledge of Yanadi tribe and local villagers of Veyilingalakona- A sacred grove of Andhra Pradesh, India.	Savithramma *et al*. (2014)	Journal of Pharmaceutical Science & Research, 6(11):382-388
24	Studies on the phytodiversity of a sacred grove and its traditional uses in Karaikal District, U.T. Puducherry	Sambandan and Dhatchanamoorthy (2012)	Journal of Phytology, 492):16-21
25	Role of sacred groves in consevation of ethno medicinal plants in Dapoli tehsil of Ratnagiri district, Maharashtra(India)	Ghalme and Deokule (2014)	The Indian Forester, 140(7):701-706
26	Medicinal plant resources of Rudrakod sacred grove in Nallamalais, Andhra Pradesh, India	Rao and Sunitha (2011)	Journal of Biodiversity, 2(2):75-89
27	Ethno-floristic survey in sacred groves, Pudukottai district, Tamil Nadu- India	Anbarashan *et al*. (2011)	Journal of Medicinal Plants Research, 5(3):439-443
28	Floristic composition and practices on the selected sacred groves of Pallapatty village (Reserved forest),Tamil Nadu	Ganesan *et al*. (2009)	Indian Journal of Traditional Knowledge, 8(2):154-162
29	Studies on the plant diversity of Muniandavar sacred groves of Thiruvaiyaru, Thanjavur, Tamil Nadu, India	Jayapal *et al*. (2014)	Hygeia journal for drugs and medicines, 6(12):48-62
30	Phytodiversity of ethnomedicinal plants in sacred groves and its traditional uses in Kabirdham district of Chhattisgarh	Rahangdale *et al*. (2014)	The Indian Forester, 140(1):86-92
31	Studies on the sacred groves of Kannur District	Deepamol P.C. (2011)	Ph. D Thesis. Kannur University
32	Ethnobotanical plants used by the tribes of R.D.F. Poshina forest range of Sabarkantha District, North Gujarat, India	Patel and Patel (2013)	International Journal of Scientific and Research Publications, 3(2):1-8
33	Medicinally valuable plants from sacred groves of Jabalpur forest division (Madhya Pradesh)	Duggal *et al*. (2017)	Asian Journal of Plant Science and Research, 7(2):37-44
34	Ethnobotanical studies on Japali Hanuman Theertham- A Sacred Grove of Tirumala hills, Andhra Pradesh, India.	Savithramma *et al*. (2014)	Journal of Pharmaceutical Sciences and Research, 6(2):83-88
35	Ethno-Medicinal plants in sacred groves in East Godavari District, Andhra Pradesh, India	Venkatesh and Mahammad (2015)	European Journal of Medicinal Plants, 9(4):1-29
36	Phytodiversity and conservation of Nithypooja Kona sacred grove of Nallamala Hill Range,Eastern Ghats,Andhra Pradesh	Basha *et al*. (2015)	International Journal of Environment, 4(2):271-288
37	Sacred and medicinal plant diversity of Vandiol sacred grove of Sabarkantha District(N.G)	Parmar and Patel 2013	Life Sciences Leaflets, 5:34-49
38	Ethnobotanical study of sacred groves of Poshina forest of Sabarkanth district,North Gujarat	Mehta and Jain (2011)	International Journal of Plant Sciences, 6(2):362-366
39	Role of traditional conservation practice: highlighting the importance of Shivbari sacred grove in biodiversity conservation	Jaryan *et al*. (2010)	Environmentalist, 30:101-110

40	Ethnobotanical studies of Sada Shiv sacred grove,district Kangra ,Himachal Pradesh	Sharma *et al*. (2014)	Life Sciences Leaflets, 53:89-96
41	Sacred groves as ethnobotanical gene pools in tribal area of the western Himalaya, India	Thaplyal *et al*. (2012)	The Indian Forester, 138(1):70-78
42	Enumeration of angiosperm medicinal plants of Gavisiddalingeshwara sacred grove,Chintanpalli of Yadgir District,Karnataka	Modi and Mathad (2016)	Journal of Global Biosciences, 5(1):3539-3558
43	Medicinal plants in the selected sacred groves of Kodungallur, Thrissur district, Kerala	Deepa *et al*. (2016)	Journal of Medicinal Plants Studies, 4(3):149-155
44	Floristic composition and ethanobotanical practices of the sacred groves of Nemmara, Palakkad District, Kerala	Divya and Manonmani (2013)	International Journal of Pharmaceutical Sciences and Business Management,1(1):9-17
45	Ethnobotanical documentation of a sacred Grove- Palakurumba temple, Olavanna in Kozhikode district, Kerala	Reshma and Indulekha (2016)	Journal of Medicinal Plants Studies, 4(4):296-298
46	An Ethnopharmacological survey on medicinal plants from sacred grove of Sree Puthiya Bhagavathi temple, Kalloori, Kannur (dist), Kerala	Poovathur and Joseph (2016)	International Journal of Advanced Science and Research, 1(8):24-35
47	Ethno-Medico-Botanical studies on Katei Baba sacred grove and nearby area of Adhalwadi from Akole taluka ,Ahmednagar district(Maharashtra)	Waghchaure *et al*. (2011)	International Journal of Pharma and Bio Sciences, 2(3):393-398
48	Observation of medicinal importance of sacred plants of Chitrakoot region Satna (M.P.)	Bala and Singh (2015)	International Journal of Science and Research, 4(8):1783-1787
49	Inventory of ethnobotanicals and other systematic procedures for regional conservation of medicinal and sacred plants	Wagh and Jain (2015)	Environment Systems and Decisions, 35:143-156
50	An ethnomedicinal survey of medicinal plants from a sacred forest of western Odisha, India.	Pradhan *et al*. (2016)	International Journal of Phytomedicine, 8(3):325-332
51	Ethno-Medicinal plants in five sacred groves in Cuddalore district, Tamilnadu, India	Anbarashan and Anbarashan (2010)	Ethnobotanical Leaflets, 14:774-780
52	Medicinal plants conservation through sacred forest by ethnic tribals of Virudhunagar district,Tamil Nadu	Rajendran and Agarwal (2007)	Indian Journal of Traditional Knowledge, 6(2):328-333
53	Ethnomedicinal studies on important medicinal plants in two sacred groves at Pudukottai district Tamil Nadu	Vani *et al*. (2016)	Advances in Applied Science Research, 7(2):123-127
54	Medicinal plants and their uses :A study of twelve sacred groves in Cuddalore and Villupuram districts, Tamil Nadu, India	Karthik *et al*. (2016)	International Education and Research Journal, 2(5):95-102
55	Medicinal plants of sacred groves in Kanyakumari district southern Western Ghats	Sukumaran & Raj(2010)	Indian Journal of Traditional Knowledge, 9(2)294-299
56	Ethno botanical study of medicinal plants of Sri Pancha Narasimha Swamy and Sri Matsyagiri Narasimha Swamy	Rao (2015)	Journal of Medicinal Plants Studies, 3(3):37-42
57	Socio-cultural and ethnobotanical value of a sacred forest,Thal ke Dhar,Central Himalaya	Negi (2005)	Indian Journal of Traditional Knowledge, 4(2):190-198
58	Medicinal plant diversity in newly reported sacred grove of Pithoragarh District, Uttarakhand	Singh *et al*. (2011)	The Indian Forester, 137(8):1005-1008
59	Sacred groves: traditional plant conservation through deities	Bhakat and Sen (2016)	Plants the natural wonder: Challenges and Avenues, (eds.) Sumita Bandopadhyay,

			Dipak Kumar Hens, Partha Sarathi De, Damodar Group, Burdwan, West Bengal, India. Pp 212-223.
60	Sacred groves of West Midnapore district in West Bengal	Bhakat and Sen (2011)	Recent Advances in Plant Science ,Diversity and Conservation(Proceeding of UGC National Seminar 2011), Pp 37-43
61	An invetory of medicinal plants of some sacred groves of Purulia district ,West Bengal	Bhakat and Pandit (2004)	The Indian Forester, 130(1):37-44
62	Biodiversity and ethnobotany of sacred groves In Bakura district,West Bengal	Basu R. (2009)	The Indian Forester, 135(6): 765-777
63	Role of sacred grove in conservation of medicinal plants	Bhakat and Pandit (2003)	The Indian Forester, 129(2):224-232
64	Plants of ethnobotanical importance in the sacred groves of Jaintia Hills of Meghalaya	Upadhya *et al*. (2005)	The Indian Forester, 131(6):812-828
65	Deogudi' sacred grove -A tribal concept of conservation of plants in Bastar district ,Chattisgarh	Rai and Tripathi (2008)	The Indian Forester, 134(12):1686-1695

Dataset preparation

We selected angiosperm members for detail analysis due to their dominant presence in all the studies, and verified the binomial with 'World Flora Online (www.worldfloraonline.org). For disease categorization and standard nomenclature, we have followed the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (World Health Organization 2004).

Statistical analysis

Summary statistics, such as taxonomic diversity, species used for treating different diseases, and plant part use were determined for the whole dataset. Disease prevalence was determined based on number of species use against specific organ system as per ICD-10 classification. We used relative frequency of citation (RFC) for shortlisting fifty most frequently used species. They were further analyzed through standard ethnobotanical indices [use value (UV), consensus value for plant parts (CPP) and fidelity level (FL)] for their distribution, use details, part use, and reliability against specific ailments to capture the major trends in ethnomedicinal practices. All indices were calculated using MS-Excel software.

Grove prioritization

To search for candidate members for implementation in rural healthcare, we attempted to identify grove or grove clusters as hotspots. The selection was made based on the assemblage of greater than fifty percent (50%) of the prioritized species. We recognized that frequently cited species may not represent the true status of medicinal practices and information about the rare plants and their use could be lost. However, for broad regional and national level priority setting, one has to go for widely known species with higher acceptance across communities excluding lesser-known species which are localized in their use. Moreover, frequently cited species also indicate public consciousness towards their remedial power, traditional use, and substantial economic support through cultivation and business (Karki & Williams 1999). Complementing this notion further, we have generated cumulative species distribution as well as thematic maps on grove prioritization and fidelity value distribution.

Results

Taxonomic spectrum of the medicinal plant resources

A total of 1247 medicinal species included under 711 genera and 152 families was documented in our analysis (Appendix 1). Among these, herbs were dominant plant form (35%), followed by trees (31%), shrubs (18%) and climbers (14%). A small fraction of invasive, exotic and lower group plant members has found their way to the list. The species pool was not evenly distributed among the families; out of the 152 plant families, 50% of the total species were from 15 families whereas 39 families possessed 75% of total species (Fig 1). Among 1247 species, 897 (71%) were solely recorded from any single biogeographic region while the rest were shared between at least two regions. The Himalayas held maximum number of unique species (64%) followed by the north-

eastern region (62%) and the Deccan peninsula (58%) (Fig 2). When contribution of various families to species pool was examined, Fabaceae had the highest share (10.5%) followed by Compositae, Lamiaceae, and Rubiaceae (4.3% each).

Diseases and remedial measures

We conducted the analysis in two phases, i.e., with the whole dataset and the data pertaining to fifty prioritized species. Analyses to determine fidelity value and use value were conducted for prioritized species only.

Disease category

We recorded eighteen (18) categories of ailments from the full dataset following the nomenclature of ICD10. However, seven categories were more prevalent than others for fifty prioritized species (60-100%). The seven dominant categories were diseases related to digestive system (17%), infections and parasitic attacks (17%), skin and sub-cutaneous tissues (15%) and others (Fig 3).

Species diversity in disease

Taking account of the whole species pool, more than hundred species were employed against each disease category. To the higher end of the spectra, infections and parasitic attacks were treated with the highest number of species (366), followed by general health purposes (358 species), external injury and attacks (324 species) and respiratory problem (240 species). However, in each disease category, species distribution was skewed towards only handful of families. In general, 50% of the total species were represented by 11% -17% of the total families. The family contribution rose up to 44% when 75% of the total species was considered (Appendix 2).

Useful plant parts

We recorded an employment of variety of plant parts treating different diseases. In the whole data set, leaves (94%) were the most frequently used across all forms of plants followed by stems (55%) and roots (53%). The same trend was observed for fifty prioritized species, where CPP value showed leaf as a dominant ingredient (CPP 0.47) followed by root (CPP 0.39) and stem (CPP 0.29) (Fig 4). Plant part use also tended to vary with habit type, trees exhibited maximum number of part usage (6 ± 1.41) in comparison to climbers (4 ± 1.4), herbs (4 ± 1.3), and shrubs (5 ± 1.06) (Fig 5) as observed in prioritized species.

Fidelity values (FL)

The index varied widely from 9% to 100% for the prioritized species. A total of fifteen species out of fifty demonstrated > 50% FL value against specific treatments (Table 2). For instance, *Gymnema sylvestre* had highest fidelity value (FL = 100) for treating diabetes irrespective of reporting area. Similar results were also obtained for Ocimum tenuifolium (FL = 91, cough and cold), Tridax procumbens (FL = 80, cut and wounds), and *Syzygium cumini* (FL= 78.5, diabetes). In contrast, few other popular remedies scored less e.g. *Cissus quadrangularis* (FL=53.3, bone fracture), *Mangifera indica* (FL=53.3, diarrhoea), *Achyranthes aspera* (FL=52.1, animal bite), etc.

Use value (UV)

The use value for the selected species ranged from 0.03 to 0.78 indicating their diversity of use and availability across the study area (Table 3). Geographic distribution of species was moderately correlated with use value, i.e., widely distributed species generally had higher use-value indicating diverse use across communities and cultures (Kendall's tau = 0.425, p-value = 0.00003). Maximum use value was reported from *Gloriosa superba* (0.78) with 51 different types of use covering all recorded disease categories, while minimum value was shown by *Gymnema sylvestre* (0.03) with specific uses only in diabetes and fracture.

Spatial distribution pattern

The 65 shortlisted studies recorded 840 sacred groves from eighteen states of India. However, they were heterogeneously distributed. Tamil Nadu, Uttarakhand, West Bengal, and Andhra Pradesh outnumbered others reporting an average of seven studies from each. Biogeographic zone-wise, the Deccan peninsular region is over-represented in our dataset since majority of the studies (43%) have been reported from this area. Considering enlisted groves, the number of studies do not exactly correspond to the grove numbers, as many surveyed multiple groves in a single study. Taking account of remedial measures, higher fidelity value (FL value) assigned to a species against specific diseases corresponded to their wider reporting area (Fig 6 a,b). We have also identified 12 groves or grove clusters as hotspots based on ≥ 50% availability of highly cited species (Fig 7). These hotspots with greater number of popular species are recommended as primary candidate for connecting grove system with local healthcare.

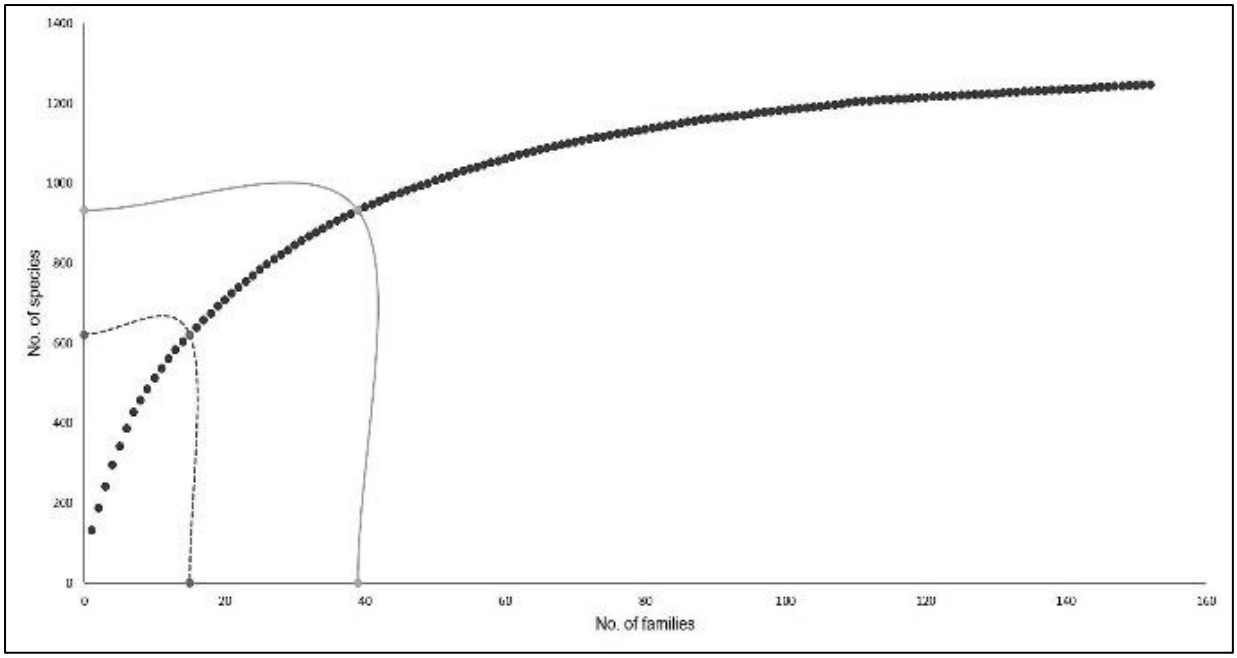


Figure 1. Cumulative graph of total species pool (1247 spp.) against 152 families. Dotted grey line represent 50% species cut-off, and continuous grey line represents 75% species cut-off.

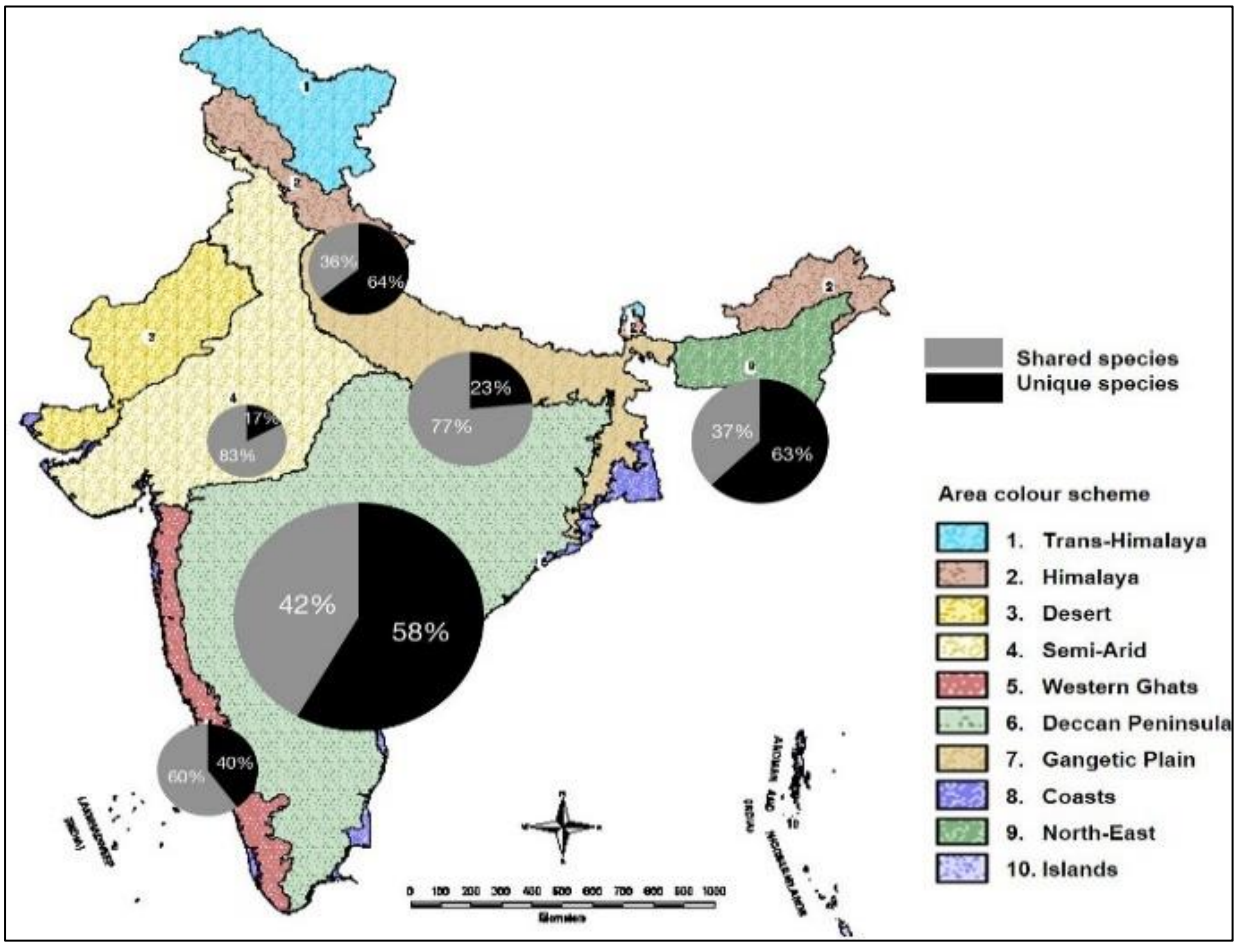


Figure. 2. Patterns of sacred grove species distribution in different biogeographic regions of India. Percentage of unique and shared species in different regions is presented in pie chart. (Map courtesy: Wildlife institute of India, 2000)

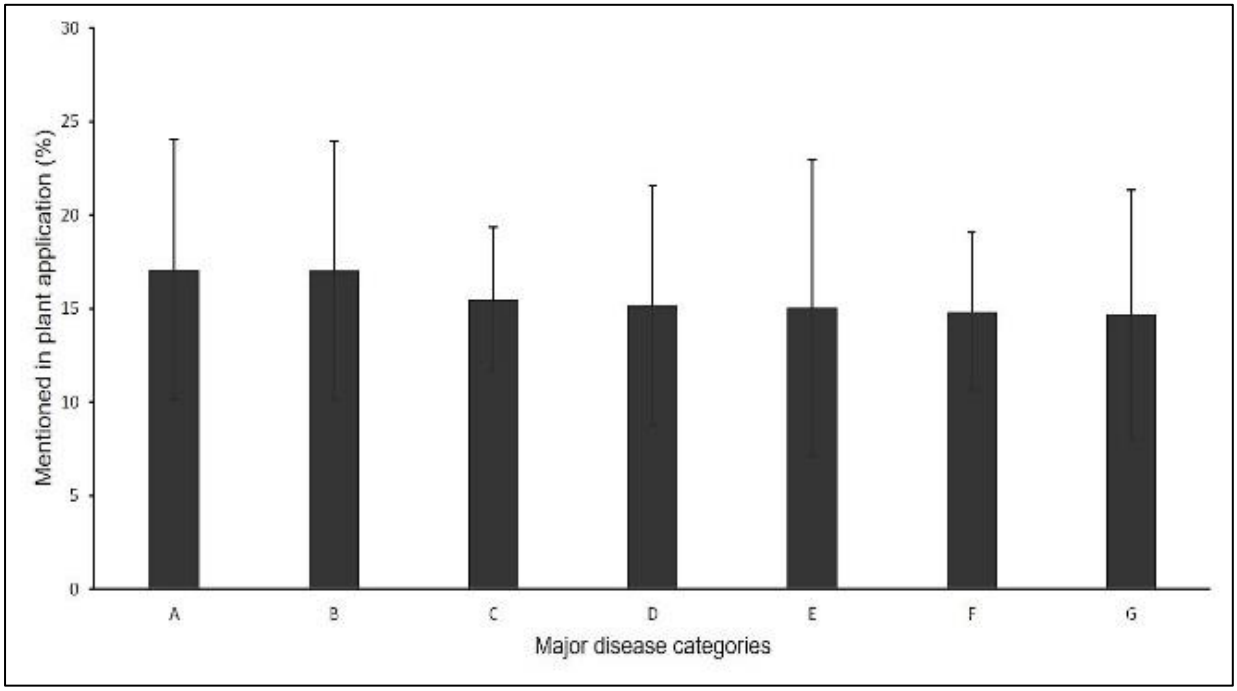


Figure 3. Prevalent disease categories from sacred grove based medicine practices. A = digestive system; B = infectious and parasitic diseases; C = skin and sub-cutaneous tissues; D = unspecified or general health problem; E = injury, poisoning and other external causes; F = respiratory system and G = genito-urinary system

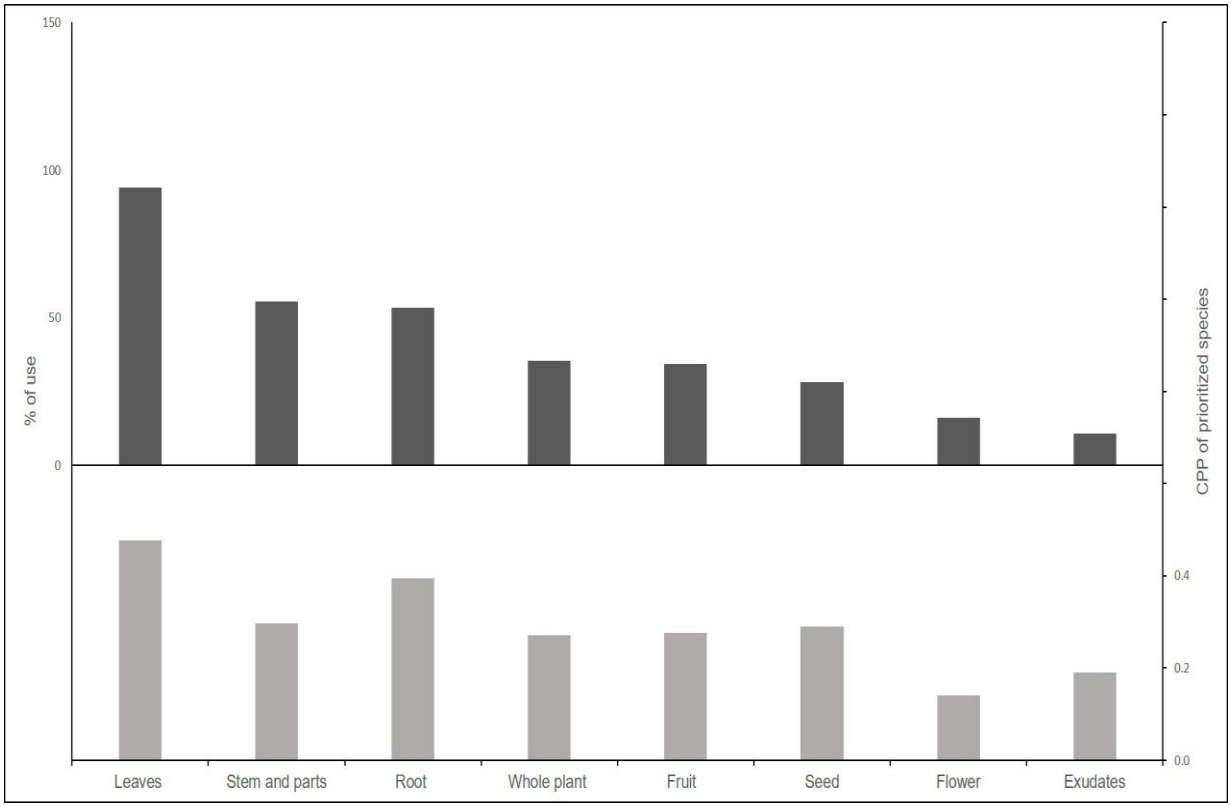


Fig 4. Preferred plant part use in medicine preparation. Upper panel shows findings from whole dataset (i.e. 1247 spp.) expressed in percentage (left axis); lower panel shows findings from fifty prioritised species expressed in CPP value (right axis).

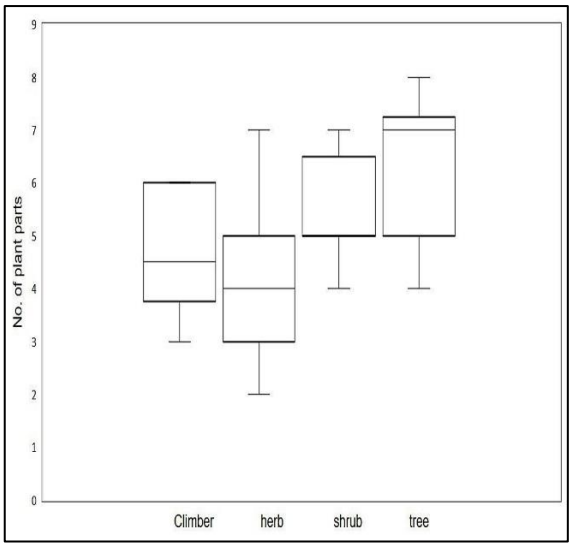


Figure 5. Pattern of plant part use for plant forms.

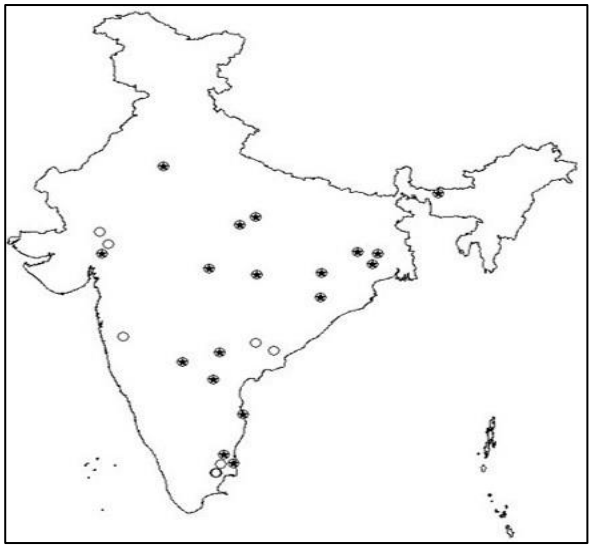
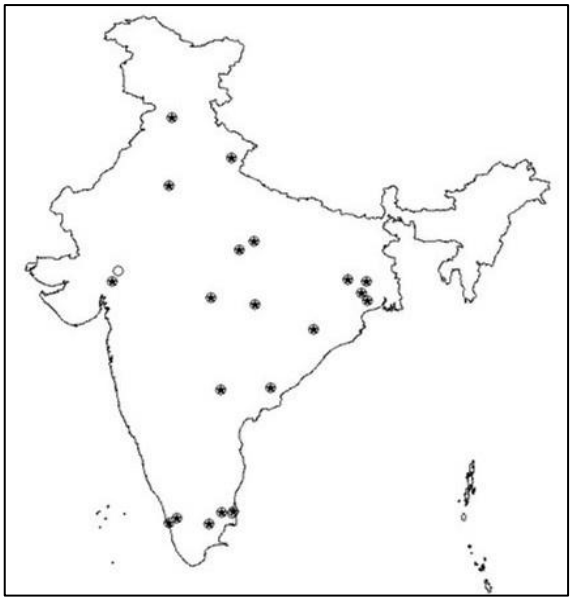


Figure 6b. Spatial Fidelity map for *Azadirachta indica*



Figures 6a & b. Spatial Fidelity map for selected species; 6a) *Ocimum tenuifolium* (FD = 91 for cough and cold) and 6b) *Azadirachta indica* (FD = 69 for skin disease). Dots indicate species geographic distribution (from consulted papers) and black dots indicate reporting of the specific use of the species against the disease for which the FL value was calculated.

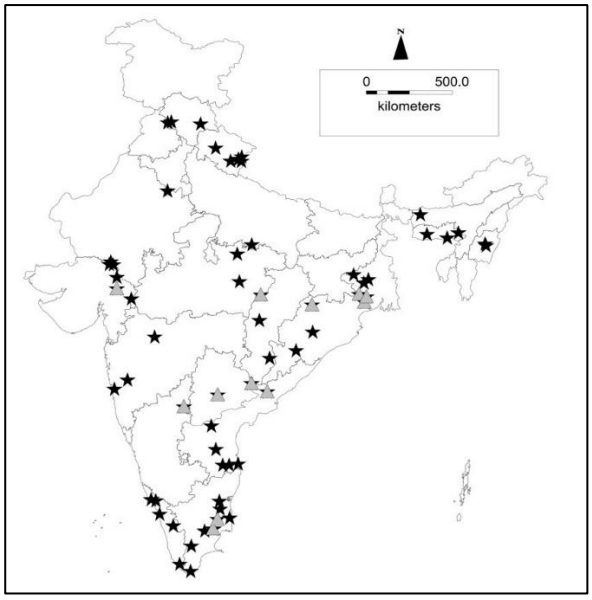


Figure 7. Distribution of studied grove / grove clusters across India. * = case studies and ▲= prioritised groves / grove clusters.

Table 2. Fidelity level of selected species against specific ailments (value > 50%)

Species	Ailments treated	Fidelity value (%)
Gymnema sylvestre	Diabetes	100
Ocimum tenuiflorum	Cough and cold	90.90909
Tridax procumbens	Cut and wound	80
Syzygium cumini	Diabetes	78.57143
Argemone mexicana	Skin disease	76.92308
Acalypha indica	Skin disease	75

Eclipta prostrata	Hair related problem	71.42857
Azadirachta indica	Skin disease	69.23077
Terminalia arjuna	Heart problems	69.23077
Boerhaavia diffusa	Liver problem	66.66667
Terminalia chebula	Digestive problem	63.63636
Aerva lanata	Kidney/Renal Stone	54.54545
Cissus quadrangularis	Bone fracture	53.33333
Mangifera indica	Diarrhoea	53.33333
Achyranthus aspera	Animal bite (scorpion, snake, dog)	52.17391

Table 3. Use value (UV) and Relative frequency of citation (RFC) for fifty prioritised species

Species	Use value	Relative frequency of citation
Abrus precatorius	0.47692	0.35385
Abutilon indicum	0.35385	0.2
Acalypha indica	0.33846	0.21538
Achyranthus aspera	0.43077	0.36923
Aegle marmelos	0.63077	0.46154
Aerva lanata	0.2	0.18462
Ageratum conyzoids	0.33846	0.21538
Alangium salviifolium	0.35385	0.24615
Albizia lebbeck	0.46154	0.18462
Andrographis paniculata	0.4	0.33846
Annona squamosa	0.35385	0.21538
Argimone mexicana	0.29231	0.21538
Asparagus racemosus	0.49231	0.29231
Azadirachta indica	0.67692	0.46154
Boerhaavia diffusa	0.43077	0.24615
Bombax ceiba	0.30769	0.2
Butea monosperma	0.55385	0.26154
Calotropis gigantea	0.43077	0.21538
Cassia fistula	0.41538	0.38462
Centella asiatica	0.46154	0.23077
Cheilocostus speciosus	0.23077	0.16923
Cissampelos pariera	0.23077	0.18462
Cissus quadrangularis	0.26154	0.23077
Curculigo orchioides	0.43077	0.26154
Cynodon dactylon	0.49231	0.36923
Datura metel	0.23077	0.18462
Eclipta prostata	0.24615	0.16923
Euphorbia hirta	0.30769	0.30769
Ficus benghalensis	0.61538	0.36923
Ficus religiosa	0.69231	0.33846
Gloriosa superba	0.78462	0.27692
Gymnema sylvestre	0.03077	0.23077

Hemidesmus indicus	0.49231	0.4
Holarrhena pubescens	0.24615	0.2
Ichnocarpus frutescens	0.2	0.2
Lantana camara	0.24615	0.2
Mangifera indica	0.27692	0.24615
Mimosa pudica	0.35385	0.21538
Ocimum tenuiflorum	0.61538	0.35385
Oxalis corniculata	0.33846	0.2
Phyllanthus emblica	0.24615	0.24615
Plumbago zeylanica	0.21538	0.2
Syzygium cumini	0.33846	0.24615
Tamarindus indica	0.41538	0.29231
Terminalia arjuna	0.44615	0.24615
Terminalia bellirica	0.38462	0.21538
Terminalia chebula	0.43077	0.18462
Tinospora sinensis	0.55385	0.33846
Tridax procumbens	0.30769	0.26154
Vitex negundo	0.44615	0.35385

Discussion

Taxonomic characteristics and assessment with other studies

A total of 1247 medicinal species from 152 families illustrated the reliance of local people on a rich source of medicinal flora from the sacred groves. The high species diversity perhaps ensured their availability and sustainable usage for health benefits. Apart from angiosperms, moderate representation of lower group of plants (e.g., pteridophytes, lichens) highlighted the existing traditional knowledge-base on curative potential (Nayaka *et al*. 2010, Shirsat 2008). Similarly, use of invasive and exotic species in ethnomedicine (e.g., *Lantana camara*, *Chromolena odorata*, *Sphagneticola* sp.) demonstrated human adaptive strategy to utilize alternate resources (Sandilyan & Klooster 2016), which implied the choice has been dynamic and contingent on local materials.

Considering ethnomedicinal plant resource, our study is fairly comparable with other findings, such as 8000 medicinal plants from 550 tribal communities revealed by All India Coordinated Research Project on Ethnobiology (AICRPE) (Pushpangadan *et al*. 2018); 782 species belonging to 132 families from the Eastern Ghats and the Deccan region (Karuppusamy & Pullaiah 2017), and 528 species of 112 families from the Indo-Gangetic plains (Chowdhury *et al*. 2017). Despite our study being restricted to sacred groves, availability of such a large number of species clearly underscores the potential of the system as a reservoir of useful medicinal plants.

In terms of family level contribution, Fabaceae, Compositae, Lamiaceae, Rubiaceae, and Malvaceae have occupied the dominant position which corroborated other regional assessments of ethnomedicinal plants, e.g., the Eastern Ghats and the Indo-Gangetic plains (Chowdhury *et al*. 2017, Karuppusamy & Pullaiah 2017). Pertinently, nearly same suite of families overwhelms the floral assemblage in overall angiosperm diversity in India (Arisdason & Lakshminarasimhan 2017). It might be an indirect support for ecological apparency hypothesis, where apparent or abundant floral assemblages supposed to have greater contribution in livelihood maintenance (Albuquerque *et al*. 2015). Taxonomic inclination of this assembled ethnomedicinal pharmacopeia towards certain families can be statistically tested with the complete family monographs, but their unavailability at country-level impaired such an analysis. In spite of this limitation, a comparative assessment with the other works has depicted fairly similar trend across the tropical and sub-tropical regions. A total of 11 frequently used families from our list was shared by overly-used categories in the South African ethno-medicinal study (Douwes *et al*. 2008). Amiguet *et al*. (2006) highlighted the similarity in tropical useful medicinal floras among Chiapaz, Ecuador, and Veracruz, three southern neo-tropical regions, where Rubiaceae and Compositae have higher use along with few other families. Likewise, Leonti *et al*. (2003)

have also reported the dominance of Fabaceae, Compositae, Euphorbiaceae, and Lamiaceae from Popoluca, Mexico.

Distribution of medicinal plants

The diversity of species was not homogeneous across administrative or biogeographic regions. The skewed distribution could be partly due to the access of the relevant studies from certain regions and lack of from the other. Although the biogeographic classification is very basic in contrast to the enormous local and regional variations, it provides a preliminary understanding on groves' association with certain ecosystems of India. In this regard, the Himalaya and the North-eastern regions demonstrated higher percentage of unique species (64% and 62%, respectively) owing to their distinct floral assemblage resulting from complex history (Mani 2012). On the other hand, higher percentage of unique species (58%) from the Deccan peninsula could be attributed to its geographical expanse and better documentation, since 28 of 65 (43%) studies are from this region. However, the assessment of uniqueness may have been overestimated due to the lack of sufficient data from the other regions. Alternatively, our grove-centric analyses may influence species comparison exercise as it selectively focused on grove flora ignoring the entire floral assemblage. Despite these limitations, these findings provided us with important clues related to floral availability, acceptance, and use pattern across cultures and communities. The aspect of shared species (i.e., remaining 29%), the species documented from two or more regions, deserves further research to gain an insight into the processes leading to their multiple use and applications over a broader area. They may provide an opportunity to understand the larger context of human-environment interaction and socio-cultural knowledge sharing and transmission among communities - the factors are important to uncover basic ethnomedicinal principles.

Rural healthcare system

Our interpretation unraveled a distinct pattern in prevalent disease categories, spectrum of plant use, and its country-level variation in acceptance. The major advantages were a steady supply of authentic resource and a vast body of socially accepted traditional medical knowledge.

Prevalent disease categories

Eighteen disease categories and their remedial floral package indicated heavy reliance on the existing system as well as exploitation of resource diversity to fulfill the need. However, not all the categories were equally common, e.g., diseases related to digestive system, bacterial and parasitic attacks, skin problems, and external injuries were more treated than the others; the observation reflected the general trend of disease prevalence throughout the tropics (Cunningham *et al*. 2012, Mitra & Mawson 2017). The causal factors could be multiple: malnutrition, ineffective food storage and family history; while, the agents inciting infections and skin problems are mostly external in nature (Negi & Singh 2018). These are closely related to the surrounding environment and the way people lead their daily chores. Majority of the diseases in our study were water- or animal-borne (e.g., cholera, diarrhoea, dysentery, malaria, scabies, rabies), and few were sexually transmitted (e.g., syphilis, gonorrhoea). Bacterial and parasitic agents were common in rural and forested landscapes, and their population shot up in specific seasons (e.g., rainy season). A general lack of awareness regarding their possible source and epidemiology was another reason of sickness (Anonymous 2017a). The other category, e.g., injuries and wounds could be caused by both biotic (e.g., snake, scorpion, insects, rodents and small mammals) and abiotic agents (accidental contacts). Summarizing, major diseases reported from the grove specific medicine system were related to low to moderately serious ailments associated with communities' life style choice and interaction with surroundings.

Diversity in plant use spectrum

It was found that nearly one-third of the total recorded plant species was in use to treat the dominant ailments. It was an indication that the treatment of a disease is not generally restricted to a few but employed a wide array of medicinal plants, an observation which also receives support from other studies (Jeeva *et al*. 2007, Sheikh *et al*. 2015). The finding of a number of species against a particular ailment also signified the flexibility, strong knowledge system, and rich resource base; it also insulated the loss of a species by replacement with other available and effective flora (Junior *et al*. 2015). On the other hand, employing a particular species against several diseases has been a common practice and the notion was supported by the fact that highly cited members demonstrated higher use values. The underlying reasons perhaps were easy availability, higher abundance, and cross-cultural knowledge base which allow experimentation against different ailments and facilitates cultural inclusion (Albuquerque *et al*. 2015, Leucena *et al*. 2012). However, species like *Gymnema sylvestre* and *Gloriosa superba* deviated from the predicted linear relation between citation index and use value. Both of them with moderate value of relative citation (0.23 and 0.27, respectively) have shown extreme opposite magnitude of use value. *G. sylvestre* scored the lowest with its major use in diabetes, irrespective

of its geographic and cultural presence. Its overly acceptance against diabetes could be an example of acquired knowledge through sharing of information or an independently perceived time-tested experience. Although the referred studies claimed to gather information from the local communities, the chances of information transfer from codified knowledge (i.e., Ayurvedic/Siddha/Unani) cannot be overruled (Biswas *et al*. 2017, Chandran 2016). On the other end of the spectrum, *G. superba* reportedly used in 51 ailments (highest among the priority species) portrayed its high acceptance among communities, but for its multipurpose use. The multifarious use of *G. superba* was in agreement with other studies where ethno-medicinal, pharmacological, and botanical aspects of the species have been discussed at length (Ashokkumar 2015, Padmapriya *et al*. 2015). Likewise, there were reviews on other plants, such as *Azadirachta indica*, *Syzygium cumini*, *Ocimum tenuifolium* (Ayyanar & Suresh-Babu 2012, Biswas *et al*. 2002, Gupta *et al*. 2002) indicating their wider acceptance but multi-community compilations, use-value determination, spatial patterns have rarely been described (but see Jain 2004, Srikanth *et al*. 2017).

Reliability in plant use

Evaluation of medicinal information from sacred groves revealed a considerable similarity in species and plant part use. Contrary to the popular use of the fidelity value index in one particular area, we have attempted to use the index to capture the acceptance level of a species throughout the country that may act as an indicator of its reliability. Inclusion of spatial dimension in reliability measure was an important addition to this study since it strengthened the widely held view on therapeutic potential of a plant. For instance, the common beliefs advocate the use of *Gymnema sylvestre* and *Syzygium cumini* in diabetes, *Ocimum tenuifolium* in cough and cold, which were quantitatively validated employing this index. The wider spatial distribution of the species with higher fidelity values also indicated broader cultural geographic acceptance than localized reliance. Jain (2004) earlier in his assessment of credibility of traditional medicinal knowledge performed a point-based credibility exercise to identify widely accepted plants against certain ailments. His findings demonstrated the cross-community applications of *G. sylvestre* and *S. cumini* in diabetes, *Boerhaavia diffusa* in liver problems which was in concord with our findings.

Among all, leaves appeared to be the most frequently used plant part. The underlying reason of such preference could be regular collections from herbs and trees where quantity and availability remained consistent throughout the year (Khan *et al*. 2014). Likewise, stem (or stem bark) and root were also regularly harvested probably due to the same reason. On the contrary, relatively lower use of reproductive parts (i.e., flower, fruits except seeds) may be explained by their seasonal availability, inconsistent quantity, and other uses in commercial, religious and cultural activities. Trees with highly differentiated morphology and longer life span allowed highest use of their parts than herbs and shrubs. Moreover, multiple other components (bark, secondary by-products, and aerial roots) were available from trees which collectively contributed to medicine preparation.

Implementation of grove tradition to rural healthcare system

The repertoire of medicinal flora conserved and managed in the sacred groves reinforced the fostering role of social institutions in biodiversity conservation and utilization (Colding & Folke 2001, Persha *et al*. 2011). From our analysis, we found that sacred groves allowed treatment of a wide variety of ailments with the available medicinal plants. It earned a strong support from isolated and marginalized people for whom accessibility and affordability to standard healthcare is a distant goal. To bridge the gap between healthcare services and marginalized and rural communities, the Government of India took initiatives at different levels which included plurality in medical practices (Katoch *et al*. 2017). The major aim to incorporate plurality was to make the healthcare sector more inclusive so that people may exercise different choices according to their socio-economic status, cultural inclination, and comfort level (Samal 2015). Similarly, plurality is also beneficial from the administrative and technical standpoint since it offers an option for healthcare services without heavy reliance on infrastructure and administrative intervention. For example, plurality in Indian context revolves around the inclusion of AYUSH (Ayurveda, Naturopathy, Yoga, Unani, Siddha, and Homoeopathy) codified systems in national health mission so that people get the benefit of age-old traditional medicine system with all divergent choices (Katoch *et al*. 2017, Samal 2015). The co-location of AYUSH facilities with Primary Health Centre (PHC), Community Health Centre (CHC), and District Hospital (DH) is the judicious implementation of this very idea (Priya & Sweta 2010). Medicinal plants are one of the integral component of the AYUSH system as the preparation mostly relies on resource availability, quality, and skilled handling. Pertinently, sacred groves in the villages could be an alternative resource for medicinal plants in the already established AYUSH program with an assurance for quality and availability. So, the need of the hour is the documentation of the medicinal plants and their

proper maintenance. Our study, in this line, revealed several important aspects of ethnomedicinal practices, e.g., multiple species use in particular ailments, spatial validity in disease treatment (spatial fidelity assessment), and multiple usages of certain species; these underscore the long term association of traditional healers with local flora and environment. This valuable experience pool can be utilized in for the improvement of the AYUSH program to render higher cultural acceptance (Dehury & Chatterjee 2016), since ethnomedicinal knowledge is informally accepted in medical research but lacks official recognition as a mode of treatment (Chandra & Patwardhan 2018).

Employing data-driven prioritization exercise, we have identified 12 groves or grove clusters with greater than 50% of widely used species; these can be taken as a model candidate for mending the local connection between primary healthcare and ethnomedicinal expertise. The grove flora could be useful for medicine preparation under proper management and skilled manpower, whereas the local healer can be consulted for treatment modality and socio-cultural link establishment with local community. Moreover, our analyses also demonstrated higher value in spatial fidelity of many frequently cited species (e.g. *Gymnema sylvestre*, *Syzygium cumini*, *Ocimum tenuiflorum*, *Eclipta prostrata*), i.e., their use against specific disease is well established across the country; it ensures long-term acceptance across wider cultural geographic regions which is advantageous for AYUSH program. Our prioritization exercise is an initial attempt to identify those spots where frequently used species with multi-community reliance are available in a cluster; we, therefore, intentionally kept aside the region-specific rare species which may have equal importance in medicine practice, for the sake of broad country-wide pattern. For instance, the Himalaya possesses a large number of valuable medicinal plants in the sacred groves but majority of them are locality specific (e.g., *Aconitum heterophyllum, Arnebia benthamii, Nardostachys grandiflora*, etc) thus exhibit low score as national candidates. However, this exercise can be region specific, improved, and extended further by adding other parameters, e.g., details of treatments, medicine preparation method, and community involvement, which can be further assimilated into health policies for successful implementation.

Conclusion

The study summarized an enormous diversity of folk medicinal flora conserved, managed, and utilized in sacred groves throughout the country. It further exhibited a heavy dependence of the users for a wide variety of ailments common in tropical and subtropical rural landscapes; not limited to a few set, a diverse suite of plants has been generally applied to curing of different ailments.

Armed with data-driven inference, our study has stressed on the notion that sacred grove could be a strong base for traditional medicinal knowledge which can be complemented in local healthcare program as a part of national health mission agenda. Sacred groves, being a social institution, have an enduring association with local communities which hints at their embeddedness that raises their credibility in healthcare and promotes their conservation at local scale. A resurgence of popularity and awareness on ethnomedicine would resurrect the conservation and healthcare nexus liaising among the sacred grove stakeholders, local medical practitioners, and administrative bodies. In many areas, the community-led framework has already been in place which requires to be strengthened through proper planning, policy, and execution.

Declarations

List of abbreviations:
ICD10 - 10th revision of the International Statistical Classification of Diseases and Related Health Problems
RFC - relative frequency of citation
UV - use value
CPP - consensus value for plant parts
FL - fidelity level
AICRPE - All India Coordinated Research Project on Ethnobiology
AYUSH - Ayurveda, Naturopathy, Yoga, Unani, Siddha, and Homoeopathy
PHC - Primary Health Centre
CHC - Community Health Centre
DH - District Hospital

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Appendix 1. Medicinal plants reported from the studied groves

Species	**Family**
Acanthus ilicifolius Lour.	Acanthaceae
Acanthus leucostachyus Wall. ex Nees	Acanthaceae
Andrographis paniculata (Burm.f.) Nees	Acanthaceae
Andrographis alata (Vahl) Nees	Acanthaceae
Andrographis echioides (L.) Nees	Acanthaceae
Asystasia chelonoides Nees	Acanthaceae
Avicennia officinalis L.	Acanthaceae
Barleria buxifolia L.	Acanthaceae
Barleria cristata L.	Acanthaceae
Barleria cuspidata F.Heyne ex Nees	Acanthaceae
Barleria lupulina Lindl.	Acanthaceae
Barleria prionitis L.	Acanthaceae
Blepharis maderaspatensis (L.) B.Heyne ex Roth	Acanthaceae
Crossandra infundibuliformis (L.) Nees	Acanthaceae
Dicliptera bupleuroides Nees	Acanthaceae
Dicliptera chinensis (L.) Juss.	Acanthaceae
Dicliptera paniculata (Forssk.) I.Darbysh.	Acanthaceae
Ecbolium ligustrinum (Vahl) Vollesen	Acanthaceae
Ecbolium viride (Forssk.) Alston	Acanthaceae
Elytraria acaulis (L.f.) Lindau	Acanthaceae
Eranthemum purpurascens Wight ex Nees	Acanthaceae
Eranthemum roseum (Vahl) R.Br.	Acanthaceae
Hemigraphis hirta (Vahl) T.Anderson	Acanthaceae
Hygrophila auriculata (Schumach.) Heine	Acanthaceae
Justicia adhatoda L.	Acanthaceae
Justicia betonica L.	Acanthaceae
Justicia gendarussa Burm.f.	Acanthaceae
Justicia glauca Rottler	Acanthaceae
Justicia japonica Thunb.	Acanthaceae
Lepidagathis cristata Willd.	Acanthaceae
Peristrophe bicalyculata (Retz.) Nees	Acanthaceae
Phlogacanthus thyrsiflorus Nees	Acanthaceae
Phlogacanthus thyrsiformis (Roxb. ex Hardw.) Mabb.	Acanthaceae
Ruellia prostrata Poir.	Acanthaceae
Rungia pectinata (L.) Nees	Acanthaceae
Strobilanthes ciliata Nees	Acanthaceae
Strobilanthes scaber T.Anderson	Acanthaceae
Thunbergia fragrans Roxb.	Acanthaceae
Thunbergia grandiflora (Roxb. ex Rottl.) Roxb.	Acanthaceae
Thunbergia laevis Nees	Acanthaceae
Hydnocarpus macrocarpa Warb.	Achariaceae
Hydnocarpus pentandrus (Buch.-Ham.) Oken	Achariaceae
Hydnocarpus wightianus Blume	Achariaceae
Acorus calamus L.	Acoraceae
Viburnum cotinifolium D. Don	Adoxaceae

Viburnum foetidum Wall.	Adoxaceae
Trianthema portulacastrum L.	Aizoaceae
Achyranthes aspera L.	Amaranthaceae
Aerva javanica (Burm.f.) Juss. ex Schult.	Amaranthaceae
Aerva lanata (L.) Juss.	Amaranthaceae
Allmania nodiflora (L.) R.Br. ex Wight	Amaranthaceae
Alternanthera brasiliana (L.) Kuntze	Amaranthaceae
Alternanthera pungens Kunth	Amaranthaceae
Alternanthera sessilis (L.) R.Br. ex DC.	Amaranthaceae
Amaranthus caudatus L.	Amaranthaceae
Amaranthus spinosus L.	Amaranthaceae
Amaranthus tricolor L.	Amaranthaceae
Amaranthus blitum L.	Amaranthaceae
Celosia argentea L.	Amaranthaceae
Chenopodium album L.	Amaranthaceae
Cyathula prostrata (L.) Blume	Amaranthaceae
Cyathula tomentosa (Roth) Moq.	Amaranthaceae
Dysphania ambrosioides (L.) Mosyakin & Clemants	Amaranthaceae
Gomphrena serrata L.	Amaranthaceae
Pupalia lappacea (L.) Juss.	Amaranthaceae
Allium cepa L.	Amaryllidaceae
Allium sativum L.	Amaryllidaceae
Crinum asiaticum L.	Amaryllidaceae

Anacardium occidentale L.	Anacardiaceae
Buchanania axillaris (Desr.) Ramamoorthy	Anacardiaceae
Buchanania cochinchinensis (Lour.) M.R.Almeida	Anacardiaceae
Holigarna arnottiana Hook.f.	Anacardiaceae
Holigarna caustica (Dennst.) Oken	Anacardiaceae
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae
Mangifera indica L.	Anacardiaceae
Rhus chinensis Mill.	Anacardiaceae
Rhus mysorensis G.Don	Anacardiaceae
Rhus parviflora Roxb.	Anacardiaceae
Rhus succedanea L.	Anacardiaceae
Semecarpus anacardium L.f.	Anacardiaceae
Spondias pinnata (L. f.) Kurz	Anacardiaceae
Ancistrocladus heyneanus Wall. ex J.Graham	Ancistrocladaceae
Annona reticulata L.	Annonaceae
Annona squamosa L.	Annonaceae
Artabotrys hexapetalus (L.f.) Bhandari	Annonaceae
Miliusa tomentosa (Roxb.) J.Sinclair	Annonaceae
Polyalthia longifolia (Sonn.) Thwaites	Annonaceae
Uvaria narum A.DC.	Annonaceae
Angelica glauca Edgew.	Apiaceae
Bunium persicum (Boiss.) B.Fedtsch.	Apiaceae
Centella asiatica (L.) Urb.	Apiaceae

Chaerophyllum reflexum Aitch.	Apiaceae
Ferula jaeskeana C.B.Clarke	Apiaceae
Heracleum lanatum Michx.	Apiaceae
Narthex asafoetida Falc. ex Lindl.	Apiaceae
Oenanthe javanica (Blume) DC.	Apiaceae
Peucedanum nagpurense Prain	Apiaceae
Pimpinella diversifolia DC.	Apiaceae
Allamanda cathartica L.	Apocynaceae
Alstonia scholaris (L.) R. Br.	Apocynaceae
Alstonia venenata R.Br.	Apocynaceae
Calotropis gigantea (L.) Dryand.	Apocynaceae
Calotropis procera (Aiton) Dryand.	Apocynaceae
Caralluma adscendens (Roxb.) R.Br.	Apocynaceae
Caralluma stalagmifera C.E.C.Fisch.	Apocynaceae
Carissa carandas L.	Apocynaceae
Carissa spinarum L.	Apocynaceae
Cascabela thevetia (L.) Lippold	Apocynaceae
Catharanthus pusillus (Murray) G.Don	Apocynaceae
Catharanthus roseus (L.) G.Don	Apocynaceae
Ceropegia attenuata Hook.	Apocynaceae
Ceropegia bulbosa Roxb.	Apocynaceae
Ceropegia candelabrum L.	Apocynaceae
Ceropegia vincifolia Hook.	Apocynaceae
Chonemorpha fragrans (Moon) Alston	Apocynaceae
Cryptolepis dubia (Burm.f.) M.R.Almeida	Apocynaceae
Cryptostegia grandiflora Roxb. ex R.Br.	Apocynaceae
Cynanchum viminale (L.) L.	Apocynaceae
Dregea volubilis (L.f.) Benth. ex Hook.f.	Apocynaceae
Gymnema decaisneanum Wight	Apocynaceae
Gymnema sylvestre (Retz.) R.Br. ex Sm.	Apocynaceae
Hemidesmus indicus (L.) R. Br. ex Schult.	Apocynaceae
Holarrhena pubescens Wall. ex G.Don	Apocynaceae
Hoya parviflora Wight	Apocynaceae
Ichnocarpus frutescens (L.) W.T.Aiton	Apocynaceae
Leptadenia reticulata (Retz.) Wight & Arn.	Apocynaceae
Nerium oleander L.	Apocynaceae
Pergularia daemia (Forssk.) Chiov.	Apocynaceae
Plumeria obtusa L.	Apocynaceae
Plumeria rubra L.	Apocynaceae
Rauvolfia serpentina (L.) Benth. ex Kurz	Apocynaceae
Rauvolfia tetraphylla L.	Apocynaceae
Sarcostemma acidum (Roxb.) Voigt	Apocynaceae
Secamone emetica (Retz.) R. Br. ex Schult.	Apocynaceae
Tabernaemontana alternifolia L.	Apocynaceae
Tabernaemontana divaricata (L.) R.Br. ex Roem. & Schult.	Apocynaceae
Telosma pallida (Roxb.) W. G. Craib	Apocynaceae
Thevetia neriifolia Juss. ex Steud.	Apocynaceae

Tylophora asthmatica (L. f.) Wight & Arn.	Apocynaceae
Tylophora indica (Burm. f.) Merr.	Apocynaceae
Tylophora rotundifolia Buch.-Ham. ex Wight	Apocynaceae
Vallaris solanacea (Roth) Kuntze	Apocynaceae
Wrightia tinctoria R.Br.	Apocynaceae
Ilex embelioides Hook.f.	Aquifoliaceae
lex khasiana Purkay.	Aquifoliaceae
Alocasia macrorrhizos (L.) G.Don	Araceae
Amorphophallus paeoniifolius (Dennst.) Nicolson	Araceae
Amorphophallus sylvaticus (Roxb.) Kunth	Araceae
Arisaema consanguineum Schott	Araceae
Arisaema jacquemontii Blume	Araceae
Arisaema tortuosum (Wall.) Schott	Araceae
Colocasia esculenta (L.) Schott	Araceae
Lasia spinosa (L.) Thwaites	Araceae
Pothos curtisii Hook.f.	Araceae
Pothos scandens L.	Araceae
Remusatia vivipara (Roxb.) Schott	Araceae
Rhaphidophora hookeri Schott	Araceae
Sauromatum venosum (Dryand. ex Aiton) Kunth	Araceae
Scindapsus officinalis (Roxb.) Schott	Araceae
Hedera nepalensis K.Koch	Araliaceae
Hydrocotyle javanica Thunb.	Araliaceae
Macropanax undulatus (Wall. ex G.Don) Seem.	Araliaceae
Schefflera hypoleuca (Kurz) Harms	Araliaceae
Trevesia palmata (Roxb. ex Lindl.) Vis.	Araliaceae
Areca catechu L.	Arecaceae
Borassus flabellifer L.	Arecaceae
Caryota urens L.	Arecaceae
Cocos nucifera L.	Arecaceae
Phoenix acaulis Roxb.	Arecaceae
Phoenix dactylifera L.	Arecaceae
Phoenix loureiroi Kunth	Arecaceae
Phoenix pusilla Gaertn.	Arecaceae
Phoenix sylvestris (L.) Roxb.	Arecaceae
Aristolochia bracteolata Lam.	Aristolochiaceae
Aristolochia indica L.	Aristolochiaceae
Aristolochia littoralis Parodi	Aristolochiaceae
Aristolochia saccata Wall.	Aristolochiaceae
Agave americana L.	Asparagaceae
Agave sisalana Perrine	Asparagaceae
Asparagus adscendens Roxb.	Asparagaceae
Asparagus filicinus Buch.-Ham. ex D.Don	Asparagaceae
Asparagus racemosus Willd.	Asparagaceae
Chlorophytum borivilianum Santapau & R.R.Fern.	Asparagaceae
Chlorophytum breviscapum Dalzell	Asparagaceae
Chlorophytum tuberosum (Roxb.) Baker	Asparagaceae

Drimia indica (Roxb.) Jessop	Asparagaceae
Furcraea foetida (L.) Haw.	Asparagaceae
Ledebouria revoluta (L.f.) Jessop	Asparagaceae
Muscari commutatum Guss.	Asparagaceae
Polygonatum cirrhifolium (Wall.) Royle	Asparagaceae
Polygonatum verticillatum (L.) All.	Asparagaceae
Sansevieria trifasciata Prain	Asparagaceae
Sansevieria roxburghiana Schult. & Schult.f.	Asparagaceae
Impatiens balsamina L.	Balsaminaceae
Impatiens racemosa DC.	Balsaminaceae
Basella alba L.	Basellaceae
Begonia palmata D.Don	Begoniaceae
Berberis aristata DC.	Berberidaceae
Berberis asiatica Roxb. ex DC.	Berberidaceae
Berberis chitria Buch.-Ham. ex Lindl.	Berberidaceae
Berberis jaeschkeana C.K.Schneid.	Berberidaceae
Berberis wallichiana DC.	Berberidaceae
Mahonia napaulensis DC.	Berberidaceae
Sinopodophyllum hexandrum (Royle) T.S.Ying	Berberidaceae
Dolichandrone falcata (Wall. ex DC.) Seem.	Bignoniaceae
Oroxylum indicum (L.) Kurz	Bignoniaceae
Spathodea campanulata P.Beauv.	Bignoniaceae
Stereospermum chelonoides (L.f.) DC.	Bignoniaceae
Tecoma stans (L.) Juss. ex Kunth	Bignoniaceae
Tecomella undulata (Sm.) Seem.	Bignoniaceae
Cochlospermum religiosum (L.) Alston	Bixaceae
Arnebia benthamii (Wall. ex G.Don)	Boraginaceae
Arnebia euchroma (Royle) I.M.Johnst.	Boraginaceae
Coldenia procumbens L.	Boraginaceae
Cordia dichotoma G.Forst.	Boraginaceae
Cordia fragrantissima Kurz	Boraginaceae
Cordia grandis Roxb.	Boraginaceae
Cordia macleodii Hook.f. & Thomson	Boraginaceae
Cordia monoica Roxb.	Boraginaceae
Cordia sinensis Lam.	Boraginaceae
Ehretia laevis Roxb.	Boraginaceae
Ehretia microphylla Lam.	Boraginaceae
Heliotropium bracteatum R.Br.	Boraginaceae
Heliotropium indicum L.	Boraginaceae
Tournefortia candollei C.B.Clarke	Boraginaceae
Tournefortia montana Lour.	Boraginaceae
Trichodesma indicum (L.) Lehm.	Boraginaceae
Brassica juncea (L.) Czern.	Brassicaceae
Cardamine hirsuta L.	Brassicaceae
Lepidium sativum L.	Brassicaceae
Boswellia serrata Roxb. ex Colebr.	Burseraceae
Canarium strictum Roxb.	Burseraceae
Commiphora caudata (Wight & Arn.) Engl.	Burseraceae

Sarcococca pruniformis Lindl.	Buxaceae
Cereus hexagonus (L.) Mill.	Cactaceae
Cereus pterogonus Lem.	Cactaceae
Opuntia stricta (Haw.) Haw.	Cactaceae
Mesua ferrea L.	Calophyllaceae
Cannabis sativa L.	Cannabaceae
Celtis australis L.	Cannabaceae
Celtis tetrandra Roxb.	Cannabaceae
Celtis timorensis Span.	Cannabaceae
Trema orientalis (L.) Blume	Cannabaceae
Canna indica L.	Cannaceae
Cadaba fruticosa (L.) Druce	Capparaceae
Capparis brevispina DC.	Capparaceae
Capparis decidua (Forssk.) Edgew.	Capparaceae
Capparis divaricata Lam.	Capparaceae
Capparis sepiaria L.	Capparaceae
Capparis spinosa L.	Capparaceae
Capparis trifoliata Roxb.	Capparaceae
Capparis zeylanica L.	Capparaceae
Crateva adansonii DC.	Capparaceae
Crateva nurvala Buch.-Ham.	Capparaceae
Crateva religiosa G.Forst.	Capparaceae
Lonicera japonica Thunb.	Caprifoliaceae
Valeriana jatamansi Jones	Caprifoliaceae

Carica papaya L.	Caricaceae
Drymaria cordata (L.) Willd. ex Schult.	Caryophyllaceae
Polycarpaea aurea Wight & Arn.	Caryophyllaceae
Polycarpaea corymbosa (L.) Lam.	Caryophyllaceae
Casuarina equisetifolia L.	Casuarinaceae
Cassine glauca (Rottb.) Kuntze	Celastraceae
Celastrus paniculatus Willd.	Celastraceae
Euonymus lawsonii C.B.Clarke ex Prain	Celastraceae
Gymnosporia emarginata (Willd.) Thwaites	Celastraceae
Gymnosporia heyneana (Roth) M.A.Lawson	Celastraceae
Gymnosporia montana (Roth) Benth.	Celastraceae
Gymnosporia senegalensis (Lam.) Loes.	Celastraceae
Reissantia indica (Willd.) N.Hallé	Celastraceae
Calophyllum inophyllum L.	Ciusiaceae
Cleome aspera J.Koenig ex DC.	Cleomaceae
Cleome gynandra L.	Cleomaceae
Cleome rutidosperma var. burmannii (Wight & Arn.) Siddiqui & S.N.Dixit	Cleomaceae
Cleome viscosa L.	Cleomaceae
Garcinia cowa Roxb. ex Choisy	Clusiaceae
Garcinia sopsopia (Buch.-Ham.) Mabb.	Clusiaceae
Garcinia spicata Hook.f.	Clusiaceae
Mammea suriga (Buch.-Ham. ex Roxb.) Kosterm.	Clusiaceae
Disporum calcaratum D.Don	Colchicaceae

Disporum cantoniense (Lour.) Merr.	Colchicaceae
Gloriosa superba L.	Colchicaceae
Anogeissus latifolia (Roxb. ex DC.) Wall. ex Guillem. & Perr.	Combretaceae
Combretum albidum G.Don	Combretaceae
Combretum album Pers.	Combretaceae
Combretum decandrum Jacq.	Combretaceae
Combretum indicum (L.) DeFilipps	Combretaceae
Combretum ovalifolium Roxb.	Combretaceae
Combretum pilosum Roxb. ex G.Don	Combretaceae
Getonia floribunda Roxb.	Combretaceae
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae
Terminalia catappa L.	Combretaceae
Terminalia chebula Retz.	Combretaceae
Terminalia citrina Roxb. ex Fleming	Combretaceae
Terminalia cuneata Roth	Combretaceae
Terminalia pallida Brandis	Combretaceae
Terminalia paniculata Roth	Combretaceae
Terminalia tomentosa Wight & Arn.	Combretaceae
Commelina benghalensis L.	Commelinaceae
Commelina clavata C.B.Clarke	Commelinaceae
Cyanotis axillaris (L.) D.Don ex Sweet	Commelinaceae
Cyanotis cristata (L.) D.Don	Commelinaceae
Murdannia pauciflora (G.Brückn.) G.Brückn.	Commelinaceae
Acanthospermum hispidum DC.	Compositae
Achillea millefolium L.	Compositae
Acmella calva (DC.) R.K.Jansen	Compositae
Acmella paniculata (Wall. ex DC.) R.K.Jansen	Compositae
Ageratina adenophora (Spreng.) R.M.King & H.Rob.	Compositae
Ageratum conyzoides (L.) L.	Compositae
Ainsliaea aptera DC.	Compositae
Ainsliaea latifolia (D.Don) Sch.Bip.	Compositae
Anaphalis contorta (D.Don) Hook.f.	Compositae
Artemisia dracunculus L.	Compositae
Artemisia maritima L.	Compositae
Artemisia nilagirica (C.B.Clarke) Pamp.	Compositae
Artemisia roxburghiana Wall. ex Besser	Compositae
Artemisia vulgaris L.	Compositae
Bidens biternata (Lour.) Merr. & Sherff	Compositae
Bidens pilosa L.	Compositae
Blainvillea acmella (L.) Philipson	Compositae
Blumea axillaris (Lam.) DC.	Compositae
Blumea hieracifolia Hayata	Compositae
Blumea lacera (Burm.f.) DC.	Compositae
Chromolaena odorata (L.) R.M.King & H.Rob.	Compositae
Cirsium verutum (D.Don) Spreng.	Compositae

Cirsium wallichii DC.	Compositae
Cotula anthemoides L.	Compositae
Cyanthillium albicans (DC.) H.Rob.	Compositae
Cyanthillium cinereum (L.) H.Rob.	Compositae
Dicoma tomentosa Cass.	Compositae
Echinops echinatus Roxb.	Compositae
Eclipta prostrata (L.) L.	Compositae
Elephantopus scaber L.	Compositae
Emilia sonchifolia (L.) DC. ex DC.	Compositae
Enydra fluctuans DC.	Compositae
Erigeron trilobus (Decne.) Boiss.	Compositae
Eupatorium cannabinum L.	Compositae
Galinsoga parviflora Cav.	Compositae
Grangea maderaspatana (L.) Poir.	Compositae
Gynura cusimbua (D.Don) S.Moore	Compositae
Gynura lycopersicifolia DC.	Compositae
Inula cuspidata (Wall. ex DC.) C.B.Clarke	Compositae
Jurinea dolomiaea Boiss.	Compositae
Lagascea mollis Cav.	Compositae
Launaea intybacea (Jacq.) Beauverd	Compositae
Mikania micrantha Kunth	Compositae
Parthenium hysterophorus L.	Compositae
Pentanema indicum (L.) Ling	Compositae
Saussurea costus (Falc.) Lipsch.	Compositae
Sonchus oleraceus (L.) L.	Compositae
Sphaeranthus indicus L.	Compositae
Sphagneticola calendulacea (L.) Pruski	Compositae
Spilanthes acmella (L.) L.	Compositae
Synedrella nodiflora (L.) Gaertn.	Compositae
Tagetes erecta L.	Compositae
Taraxacum campylodes G.E.Haglund	Compositae
Tridax procumbens (L.) L.	Compositae
Xanthium strumarium L.	Compositae
Connarus monocarpus L.	Connaraceae
Argyreia cuneata Ker Gawl.	Convolvulaceae
Argyreia kleiniana Raizada	Convolvulaceae
Argyreia nervosa (Burm. f.) Bojer	Convolvulaceae
Convolvulus arvensis L.	Convolvulaceae
Cuscuta hyalina Roth	Convolvulaceae
Cuscuta reflexa Roxb.	Convolvulaceae
Evolvulus alsinoides (L.) L.	Convolvulaceae
Evolvulus nummularius (L.) L.	Convolvulaceae
Ipomoea aquatica Forssk.	Convolvulaceae
Ipomoea cairica (L.) Sweet	Convolvulaceae
Ipomoea cheirophylla O'Donell	Convolvulaceae
Ipomoea hederifolia L.	Convolvulaceae
Ipomoea marginata (Desr.) Verdc.	Convolvulaceae
Ipomoea mauritiana Jacq.	Convolvulaceae

Ipomoea nil (L.) Roth	Convolvulaceae
Ipomoea obscura (L.) Ker Gawl.	Convolvulaceae
Ipomoea obtusata Griseb.	Convolvulaceae
Ipomoea pes-tigridis L.	Convolvulaceae
Ipomoea sumatrana (Miq.) Ooststr.	Convolvulaceae
Merremia emarginata (Burm. f.) Hallier f.	Convolvulaceae
Merremia tridentata (L.) Hallier f.	Convolvulaceae
Merremia vitifolia (Burm. f.) Hallier f.	Convolvulaceae
Operculina turpethum (L.) Silva Manso	Convolvulaceae
Rivea hypocrateriformis Choisy	Convolvulaceae
Coriaria nepalensis Wall.	Coriariaceae
Alangium salviifolium (L.f.) Wangerin	Cornaceae
Alangium chinense (Lour.) Harms	Cornaceae
Cornus capitata Wall.	Cornaceae
Cornus macrophylla Wall.	Cornaceae
Cornus oblonga Wall.	Cornaceae
Cheilocostus speciosus (J.Koenig)	Costaceae
Bryophyllum pinnatum (Lam.) Oken	Crassulaceae
Rhodiola heterodonta (Hook. f. & Thomson) Boriss.	Crassulaceae
Cayaponia laciniosa (L.) C.Jeffrey	Cucurbitaceae
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae
Coccinia grandis (L.) Voigt	Cucurbitaceae
Corallocarpus epigaeus (Rottler) Hook.f.	Cucurbitaceae
Cucumis melo L.	Cucurbitaceae
Cucumis sativus L.	Cucurbitaceae
Diplocyclos palmatus (L.) C.Jeffrey	Cucurbitaceae
Hodgsonia macrocarpa (Blume) Cogn.	Cucurbitaceae
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae
Luffa cylindrica (L.) M.Roem.	Cucurbitaceae
Momordica charantia L.	Cucurbitaceae
Momordica dioica Roxb. ex Willd.	Cucurbitaceae
Mukia maderaspatana (L.) M.Roem.	Cucurbitaceae
Solena amplexicaulis (Lam.) Gandhi	Cucurbitaceae
Trichosanthes cucumerina L.	Cucurbitaceae
Trichosanthes tricuspidata Lour.	Cucurbitaceae
Bulbostylis barbata (Rottb.) C.B.Clarke	Cyperaceae
Cyperus compressus L.	Cyperaceae
Cyperus difformis L.	Cyperaceae
Cyperus rotundus L.	Cyperaceae
Cyperus scariosus R.Br.	Cyperaceae
Fimbristylis aestivalis Vahl	Cyperaceae
Fimbristylis dichotoma (L.) Vahl	Cyperaceae
Hypolytrum nemorum (Vahl) Spreng.	Cyperaceae
Rhynchospora colorata (L.) H.Pfeiff.	Cyperaceae
Dillenia indica L.	Dilleniaceae
Dillenia pentagyna Roxb.	Dilleniaceae
Dioscorea alata L.	Dioscoreaceae

Dioscorea bulbifera L.	Dioscoreaceae
Dioscorea deltoidea Wall. ex Griseb.	Dioscoreaceae
Dioscorea hispida Dennst.	Dioscoreaceae
Dioscorea oppositiflora Griseb.	Dioscoreaceae
Dioscorea pentaphylla L.	Dioscoreaceae
Dioscorea pubera Blume	Dioscoreaceae
Dioscorea wallichii Hook.f.	Dioscoreaceae
Tacca leontopetaloides (L.) Kuntze	Dioscoreaceae
Hopea parviflora Bedd.	Dipterocarpaceae
Shorea robusta Gaertn.	Dipterocarpaceae
Shorea roxburghii G.Don	Dipterocarpaceae
Shorea tumbuggaia Roxb.	Dipterocarpaceae
Vateria indica L.	Dipterocarpaceae
Diospyros ebenum J.Koenig ex Retz.	Ebenaceae
Diospyros malabarica (Desr.) Kostel.	Ebenaceae
Diospyros melanoxylon Roxb.	Ebenaceae
Diospyros montana Roxb.	Ebenaceae
Diospyros pilosiuscula G.Don	Ebenaceae
Diospyros vera (Lour.) A.Chev.	Ebenaceae
Elaeagnus rhamnoides (L.) A.Nelson	Elaeagnaceae
Hippophae salicifolia D.Don	Elaeagnaceae
Elaeocarpus tuberculatus Roxb.	Elaeocarpaceae
Agapetes auriculata (Griff.) Benth. & Hook.f.	Ericaceae
Agapetes variegata (Roxb.) D.Don ex G.Don	Ericaceae
Gaultheria fragrantissima Wall.	Ericaceae
Lyonia ovalifolia (Wall.) Drude	Ericaceae
Rhododendron lepidotum Wall. ex G. Don	Ericaceae
Rhododendron anthopogon D. Don	Ericaceae
Rhododendron arboreum Sm.	Ericaceae
Rhododendron campanulatum D. Don	Ericaceae
Erythroxylum kunthianum Kurz	Erythroxylaceae
Erythroxylum monogynum Roxb.	Erythroxylaceae
Acalypha alnifolia Klein ex Willd.	Euphorbiaceae
Acalypha fruticosa Forssk.	Euphorbiaceae
Acalypha indica L.	Euphorbiaceae
Croton bonplandianus Baill.	Euphorbiaceae
Croton caudatus Geiseler	Euphorbiaceae
Euphorbia antiquorum L.	Euphorbiaceae
Euphorbia fusiformis Buch.-Ham. ex D.Don	Euphorbiaceae
Euphorbia hirta L.	Euphorbiaceae
Euphorbia indica Lam.	Euphorbiaceae
Euphorbia neriifolia L.	Euphorbiaceae
Euphorbia pilosa L.	Euphorbiaceae
Euphorbia tirucalli L.	Euphorbiaceae
Euphorbia tortilis Rottler ex Ainslie	Euphorbiaceae
Euphorbia trigona Mill.	Euphorbiaceae
Excoecaria agallocha L.	Euphorbiaceae
Givotia moluccana (L.) Sreem.	Euphorbiaceae

Hevea brasiliensis (Willd. ex A.Juss.)	Euphorbiaceae
Homonoia riparia Lour.	Euphorbiaceae
Jatropha curcas L.	Euphorbiaceae
Jatropha glandulifera Roxb.	Euphorbiaceae
Jatropha gossypiifolia L.	Euphorbiaceae
Macaranga peltata (Roxb.) Müll.Arg.	Euphorbiaceae
Mallotus philippensis (Lam.) Müll.Arg.	Euphorbiaceae
Mallotus repandus (Willd.) Müll.Arg.	Euphorbiaceae
Microstachys chamaelea (L.) Müll.Arg.	Euphorbiaceae
Ricinus communis L.	Euphorbiaceae
Tragia involucrata L.	Euphorbiaceae
Tragia plukenetii Radcl.-Sm.	Euphorbiaceae
Quercus oblongata D.Don	Fagaceae
Quercus semecarpifolia Sm.	Fagaceae
Quercus serrata Murray	Fagaceae
Canscora alata (Roth) Wall.	Gentianaceae
Canscora diffusa (Vahl) R.Br. ex Roem. & Schult.	Gentianaceae
Enicostema axillare (Poir. ex Lam.) A.Raynal	Gentianaceae
Gentiana kurroo Royle	Gentianaceae
Swertia angustifolia Buch.-Ham. ex D. Don	Gentianaceae
Swertia chirayita (Roxb.) Buch.-Ham. ex C.B.Clarke	Gentianaceae
Swertia cordata (Wall. ex G. Don) C.B. Clarke	Gentianaceae
Geranium mascatense Boiss.	Geraniaceae
Geranium wallichianum D.Don ex Sweet	Geraniaceae
Aeschynanthus superbus C.B.Clarke	Gesneriaceae
Aeschynomene aspera L.	Gesneriaceae
Corylopsis himalayana Griff.	Hamamelidaceae
Gyrocarpus americanus Jacq.	Hernandiaceae
Hypericum oblongifolium Choisy	Hypericaceae
Curculigo orchioides Gaertn.	Hypoxidaceae
Nothapodytes nimmoniana (J.Graham) Mabb.	Icacinaceae
Engelhardtia spicata Lechen ex Blume	Juglandaceae
Juglans regia L.	Juglandaceae
Ajuga integrifolia Buch.-Ham.	Lamiaceae
Anisochilus carnosus (L.f.) Wall.	Lamiaceae
Anisomeles indica (L.) Kuntze	Lamiaceae
Anisomeles malabarica (L.) R.Br. ex Sims	Lamiaceae
Basilicum polystachyon (L.) Moench	Lamiaceae
Callicarpa arborea Roxb.	Lamiaceae
Callicarpa macrophylla Vahl	Lamiaceae
Clerodendrum chinense (Osbeck) Mabb.	Lamiaceae
Clerodendrum cordatum D.Don	Lamiaceae
Clerodendrum infortunatum L.	Lamiaceae
Clerodendrum paniculatum L.	Lamiaceae
Clerodendrum phlomidis L.f.	Lamiaceae
Clerodendrum volubile P.Beauv.	Lamiaceae
Colebrookea oppositifolia Sm.	Lamiaceae

Gmelina arborea Roxb.	Lamiaceae
Gmelina asiatica L.	Lamiaceae
Hyptis suaveolens (L.) Poit.	Lamiaceae
Hyssopus officinalis L.	Lamiaceae
Lavandula bipinnata (Roth) Kuntze	Lamiaceae
Leonotis nepetifolia (L.) R.Br.	Lamiaceae
Leonurus sibiricus L.	Lamiaceae
Leucas aspera (Willd.) Link	Lamiaceae
Leucas biflora (Vahl) Sm.	Lamiaceae
Leucas cephalotes (Roth) Spreng.	Lamiaceae
Leucas lanata Benth.	Lamiaceae
Leucas zeylanica (L.) W.T.Aiton	Lamiaceae
Mentha arvensis L.	Lamiaceae
Ocimum americanum L.	Lamiaceae
Ocimum basilicum L.	Lamiaceae
Ocimum gratissimum L.	Lamiaceae
Ocimum tenuiflorum L.	Lamiaceae
Origanum vulgare L.	Lamiaceae
Orthosiphon thymiflorus (Roth) Sleesen	Lamiaceae
Pogostemon myosuroides (Roth) Kuntze	Lamiaceae
Pogostemon parviflorus Benth.	Lamiaceae
Pogostemon purpurascens Dalzell	Lamiaceae
Pogostemon quadrifolius (Benth.) F.Muell.	Lamiaceae
Premna mollissima Roth	Lamiaceae
Premna serratifolia L.	Lamiaceae
Premna tomentosa Willd.	Lamiaceae
Rotheca serrata (L.) Steane & Mabb.	Lamiaceae
Salvia nubicola Wall. ex Sweet	Lamiaceae
Scutellaria discolor Colebr.	Lamiaceae
Symphorema involucratum Roxb.	Lamiaceae
Symphorema polyandrum Wight	Lamiaceae
Tectona grandis L.f.	Lamiaceae
Thymus mongolicus (Ronniger) Ronniger	Lamiaceae
Thymus vulgaris L.	Lamiaceae
Vitex altissima L.f.	Lamiaceae
Vitex leucoxylon L.f.	Lamiaceae
Vitex negundo L.	Lamiaceae
Vitex parviflora A.Juss.	Lamiaceae
Vitex trifolia L.	Lamiaceae
Volkameria inermis L.	Lamiaceae
Actinodaphne madraspatana Bedd. ex Hook.f.	Lauraceae
Alseodaphne semecarpifolia Nees	Lauraceae
Cassytha filiformis L.	Lauraceae
Cinnamomum curvifolium (Lam.) Nees	Lauraceae
Cinnamomum glanduliferum (Wall.) Meisn.	Lauraceae
Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm.	Lauraceae
Cinnamomum verum J.Presl	Lauraceae

Cryptocarya amygdalina Nees	Lauraceae
Lindera latifolia Hook. f.	Lauraceae
Lindera pulcherrima (Nees) Hook. f.	Lauraceae
Litsea cubeba (Lour.) Pers.	Lauraceae
Litsea glutinosa (Lour.) C.B.Rob.	Lauraceae
Litsea monopetala (Roxb.) Pers.	Lauraceae
Litsea salicifolia (J. Roxb. ex Nees) Hook. f.	Lauraceae
Machilus duthiei King	Lauraceae
Machilus gamblei King ex Hook. f.	Lauraceae
Persea gamblei (King ex Hook. f.) Kosterm.	Lauraceae
Phoebe attenuata (Nees) Nees	Lauraceae
Barringtonia acutangula (L.) Gaertn.	Lecythidaceae
Careya arborea Roxb.	Lecythidaceae
Careya herbacea Roxb.	Lecythidaceae
Couroupita guianensis Aubl.	Lecythidaceae
Abrus precatorius L.	Leguminosae
Abrus pulchellus Thwaites	Leguminosae
Acacia caesia (L.) Willd.	Leguminosae
Acacia catechu (L.f.) Willd.	Leguminosae
Acacia chundra (Rottler) Willd.	Leguminosae
Acacia farnesiana (L.) Willd.	Leguminosae
Acacia ferruginea DC.	Leguminosae
Acacia intsia (L.) Willd.	Leguminosae
Acacia leucophloea (Roxb.) Willd.	Leguminosae

Acacia nilotica (L.) Delile	Leguminosae
Acacia polyacantha Willd.	Leguminosae
Acacia sinuata (Lour.) Merr.	Leguminosae
Acacia torta (Roxb.) Craib	Leguminosae
Adenanthera pavonina L.	Leguminosae
Albizia amara (Roxb.) B.Boivin	Leguminosae
Albizia chinensis (Osbeck) Merr.	Leguminosae
Albizia lebbeck (L.) Benth.	Leguminosae
Albizia odoratissima (L.f.) Benth.	Leguminosae
Albizia procera (Roxb.) Benth.	Leguminosae
Alysicarpus monilifer (L.) DC.	Leguminosae
Astragalus rhizanthus Benth.	Leguminosae
Bauhinia acuminata L.	Leguminosae
Bauhinia malabarica Roxb.	Leguminosae
Bauhinia purpurea L.	Leguminosae
Bauhinia racemosa Lam.	Leguminosae
Bauhinia vahlii Wight & Arn.	Leguminosae
Bauhinia variegata L.	Leguminosae
Butea monosperma (Lam.) Taub.	Leguminosae
Butea superba Roxb.	Leguminosae
Caesalpinia bonduc (L.) Roxb.	Leguminosae
Caesalpinia crista L.	Leguminosae
Caesalpinia decapetala (Roth) Alston	Leguminosae
Caesalpinia globulorum Bakh.f. & P.Royen	Leguminosae

Caesalpinia pulcherrima (L.) Sw.	Leguminosae
Cajanus cajan (L.) Millsp.	Leguminosae
Cajanus crassus (King) Maesen	Leguminosae
Cajanus scarabaeoides (L.) Thouars	Leguminosae
Cassia bakeriana Craib	Leguminosae
Cassia fistula L.	Leguminosae
Senna montana (Roth) V.Singh	Leguminosae
Centrosema coriaceum Benth.	Leguminosae
Chamaecrista absus (L.) H.S.Irwin & Barneby	Leguminosae
Chamaecrista mimosoides (L.) Greene	Leguminosae
Clitoria ternatea L.	Leguminosae
Codariocalyx motorius (Houtt.) H.Ohashi	Leguminosae
Crotalaria albida Roth	Leguminosae
Crotalaria pallida Aiton	Leguminosae
Crotalaria prostrata Willd.	Leguminosae
Crotalaria ramosissima Roxb.	Leguminosae
Crotalaria retusa L.	Leguminosae
Crotalaria spectabilis Roth	Leguminosae
Crotalaria verrucosa L.	Leguminosae
Cullen corylifolium (L.) Medik.	Leguminosae
Dalbergia candenatensis (Dennst.) Prain	Leguminosae
Dalbergia lanceolaria L.f.	Leguminosae
Dalbergia lanceolaria subsp. paniculata (Roxb.) Thoth	Leguminosae
Dalbergia latifolia Roxb.	Leguminosae
Dalbergia sissoo DC.	Leguminosae
Delonix elata (L.) Gamble	Leguminosae
Delonix regia (Hook.) Raf.	Leguminosae
Derris scandens (Roxb.) Benth.	Leguminosae
Desmodium elegans DC.	Leguminosae
Desmodium gangeticum (L.) DC.	Leguminosae
Desmodium heterocarpon (L.) DC.	Leguminosae
Desmodium oojeinense (Roxb.) H.Ohashi	Leguminosae
Desmodium scorpiurus (Sw.) Desv.	Leguminosae
Desmodium triflorum (L.) DC.	Leguminosae
Dichrostachys cinerea (L.) Wight & Arn.	Leguminosae
Entada gigas (L.) Fawc. & Rendle	Leguminosae
Entada phaseoloides (L.) Merr.	Leguminosae
Entada rheedii Spreng.	Leguminosae
Eriosema himalaicum H.Ohashi	Leguminosae
Erythrina stricta Roxb.	Leguminosae
Erythrina suberosa Roxb.	Leguminosae
Erythrina variegata L.	Leguminosae
Flemingia macrophylla (Willd.) Merr.	Leguminosae
Flemingia semialata Roxb.	Leguminosae
Flemingia strobilifera (L.) W.T.Aiton	Leguminosae
Gliricidia sepium (Jacq.) Walp.	Leguminosae
Indigofera aspalathoides DC.	Leguminosae

Indigofera endecaphylla Jacq. ex Poir.	Leguminosae
Indigofera hirsuta L.	Leguminosae
Indigofera linnaei Ali	Leguminosae
Indigofera mysorensis DC.	Leguminosae
Indigofera oblongifolia Forssk.	Leguminosae
Indigofera tinctoria L.	Leguminosae
Indigofera trita L.f.	Leguminosae
Kingiodendron pinnatum (DC.) Harms	Leguminosae
Leucaena leucocephala (Lam.) de Wit	Leguminosae
Mimosa hamata Willd.	Leguminosae
Mimosa pudica L.	Leguminosae
Mimosa rubicaulis Lam.	Leguminosae
Mucuna gigantea (Willd.) DC.	Leguminosae
Mucuna pruriens (L.) DC.	Leguminosae
Parkia timoriana (DC.) Merr.	Leguminosae
Peltophorum pterocarpum (DC.) K.Heyne	Leguminosae
Pithecellobium dulce (Roxb.) Benth.	Leguminosae
Pongamia pinnata (L.) Pierre	Leguminosae
Prosopis chilensis (Molina) Stuntz	Leguminosae
Prosopis cineraria (L.) Druce	Leguminosae
Pseudarthria viscida (L.) Wight & Arn.	Leguminosae
Pterocarpus marsupium Roxb.	Leguminosae
Pterolobium hexapetalum (Roth) Santapau & Wagh	Leguminosae
Pueraria phaseoloides (Roxb.) Benth.	Leguminosae
Pueraria tuberosa (Willd.) DC.	Leguminosae
Rhynchosia beddomei Baker	Leguminosae
Rhynchosia cana (Willd.) DC.	Leguminosae
Rhynchosia minima (L.) DC.	Leguminosae
Saraca asoca (Roxb.) Willd.	Leguminosae
Saraca indica L.	Leguminosae
Senna alata (L.) Roxb.	Leguminosae
Senna alexandrina Mill.	Leguminosae
Senna auriculata (L.) Roxb.	Leguminosae
Senna occidentalis (L.) Link	Leguminosae
Senna siamea (Lam.) H.S.Irwin & Barneby	Leguminosae
Senna sophera (L.) Roxb.	Leguminosae
Senna tora (L.) Roxb.	Leguminosae
Sesbania grandiflora (L.) Pers.	Leguminosae
Sesbania sesban (L.) Merr.	Leguminosae
Tadehagi triquetrum (L.) H.Ohashi	Leguminosae
Tamarindus indica L.	Leguminosae
Tephrosia purpurea (L.) Pers.	Leguminosae
Tephrosia tinctoria Pers.	Leguminosae
Tephrosia villosa (L.) Pers.	Leguminosae
Teramnus labialis (L.f.) Spreng.	Leguminosae
Trigonella foenum-graecum L.	Leguminosae
Uraria lagopodoides (L.) DC.	Leguminosae

Uraria picta (Jacq.) DC.	Leguminosae
Vigna aconitifolia (Jacq.) Marechal	Leguminosae
Vigna radiata (L.) R.Wilczek	Leguminosae
Zornia diphylla (L.) Pers.	Leguminosae
Zornia gibbosa Span.	Leguminosae
Fritillaria cirrhosa D.Don	Liliaceae
Hugonia serrata Lam.	Linaceae
Reinwardtia indica Dumort.	Linaceae
Lindernia ciliata (Colsm.) Pennell	Linderniaceae
Lindernia crustacea (L.) F.Muell.	Linderniaceae
Mitreola petiolata (J.F.Gmel.) Torr. & A.Gray	Loganiaceae
Spigelia anthelmia L.	Loganiaceae
Strychnos colubrina L.	Loganiaceae
Strychnos dalzellii C.B.Clarke	Loganiaceae
Strychnos nux-vomica L.	Loganiaceae
Strychnos potatorum L.f.	Loganiaceae
Dendrophthoe falcata (L.f.) Ettingsh.	Loranthaceae
Helixanthera ligustrina (Wall.) Danser	Loranthaceae
Loranthus longiflorus Desr.	Loranthaceae
Taxillus tomentosus Tiegh.	Loranthaceae
Ammannia baccifera L.	Lythraceae
Lagerstroemia parviflora Roxb.	Lythraceae
Lagerstroemia speciosa (L.) Pers.	Lythraceae
Lawsonia inermis L.	Lythraceae
Punica granatum L.	Lythraceae
Woodfordia fruticosa (L.) Kurz	Lythraceae
Magnolia champaca (L.) Baill. ex Pierre	Magnoliaceae
Hiptage benghalensis (L.) Kurz	Malpighiaceae
Abelmoschus manihot (L.) Medik.	Malvaceae
Abroma augusta (L.) L.f.	Malvaceae
Abutilon indicum (L.) Sweet	Malvaceae
Abutilon pannosum (G.Forst.) Schltdl.	Malvaceae
Bombax ceiba L.	Malvaceae
Byttneria herbacea Roxb.	Malvaceae
Ceiba pentandra (L.) Gaertn.	Malvaceae
Corchorus aestuans L.	Malvaceae
Corchorus capsularis L.	Malvaceae
Corchorus trilocularis L.	Malvaceae
Firmiana simplex (L.) W.Wight	Malvaceae
Grewia carpinifolia Juss.	Malvaceae
Grewia flavescens Juss.	Malvaceae
Grewia hirsuta Vahl	Malvaceae
Grewia multiflora Juss.	Malvaceae
Grewia nervosa (Lour.) Panigrahi	Malvaceae
Grewia optiva J.R.Drumm. ex Burret	Malvaceae
Grewia tiliifolia Vahl	Malvaceae
Guazuma ulmifolia Lam.	Malvaceae
Helicteres isora L.	Malvaceae

Herissantia crispa (L.) Brizicky	Malvaceae
Hibiscus hispidissimus Griff.	Malvaceae
Hibiscus mutabilis L.	Malvaceae
Hibiscus rosa-sinensis L.	Malvaceae
Hibiscus sabdariffa L.	Malvaceae
Hibiscus vitifolius L.	Malvaceae
Kleinhovia hospita L.	Malvaceae
Kydia calycina Roxb.	Malvaceae
Melochia corchorifolia L.	Malvaceae
Pavonia zeylanica (L.) Cav.	Malvaceae
Pterospermum acerifolium (L.) Willd.	Malvaceae
Pterospermum canescens Roxb.	Malvaceae
Pterospermum xylocarpum (Gaertn.) Santapau & Wagh	Malvaceae
Sida acuta Burm.f.	Malvaceae
Sida cordata (Burm.f.) Borss.Waalk.	Malvaceae
Sida cordifolia L.	Malvaceae
Sida rhombifolia L.	Malvaceae
Sterculia coccinea Roxb.	Malvaceae
Sterculia guttata Roxb. ex G.Don	Malvaceae
Sterculia villosa Roxb.	Malvaceae
Thespesia lampas (Cav.) Dalzell	Malvaceae
Thespesia populnea (L.) Sol. ex Corrêa	Malvaceae
Triumfetta pilosa Roth	Malvaceae
Triumfetta rhomboidea Jacq.	Malvaceae
Triumfetta rotundifolia Lam.	Malvaceae
Urena lobata L.	Malvaceae
Waltheria indica L.	Malvaceae
Manilkara hexandra (Roxb.) Dubard	Martyniaceae
Martynia annua L.	Martyniaceae
Paris polyphylla Sm.	Melanthiaceae
Melastoma malabathricum L.	Melastomataceae
Memecylon edule Roxb.	Melastomataceae
Memecylon randerianum S.M.Almeida & M.R.Almeida	Melastomataceae
Memecylon umbellatum Burm. f.	Melastomataceae
Osbeckia capitata Benth. ex Naudin	Melastomataceae
Osbeckia chinensis L.	Melastomataceae
Osbeckia muralis Naudin	Melastomataceae
Osbeckia stellata Buch.-Ham. ex Ker Gawl.	Melastomataceae
Aglaia elaeagnoidea (A.Juss.) Benth.	Meliaceae
Aphanamixis polystachya (Wall.) R.Parker	Meliaceae
Azadirachta indica A.Juss.	Meliaceae
Chukrasia tabularis A.Juss.	Meliaceae
Cipadessa baccifera (Roth) Miq.	Meliaceae
Dysoxylum excelsum Blume	Meliaceae
Dysoxylum gotadhora (Buch.-Ham.) Mabb.	Meliaceae
Dysoxylum mollissimum Blume	Meliaceae

Melia azedarach L.	Meliaceae
Naregamia alata Wight & Arn.	Meliaceae
Soymida febrifuga (Roxb.) A. Juss.	Meliaceae
Toona ciliata M.Roem.	Meliaceae
Cissampelos pareira L.	Menispermaceae
Cocculus hirsutus (L.) W.Theob	Menispermaceae
Cyclea peltata (Lam.) Hook.f. & Thomson	Menispermaceae
Pachygone ovata (Poir.) Diels	Menispermaceae
Pericampylus glaucus (Lam.) Merr.	Menispermaceae
Stephania hernandiifolia (Willd.) Walp.	Menispermaceae
Stephania japonica (Thunb.) Miers	Menispermaceae
Stephania glabra (Roxb.) Miers	Menispermaceae
Tiliacora racemosa Colebr.	Menispermaceae
Tinospora sinensis (Lour.) Merr.	Menispermaceae
Glinus oppositifolius (L.) Aug.DC.	Molluginaceae
Mollugo pentaphylla L.	Molluginaceae
Antiaris toxicaria Lesch.	Moraceae
Artocarpus heterophyllus Lam.	Moraceae
Artocarpus hirsutus Lam.	Moraceae
Artocarpus rigidus Blume	Moraceae
Artocarpus lacucha Buch.-Ham.	Moraceae
Ficus amplissima Sm.	Moraceae
Ficus arnottiana (Miq.) Miq.	Moraceae
Ficus auriculata Lour.	Moraceae
Ficus benghalensis L.	Moraceae
Ficus benjamina L.	Moraceae
Ficus hispida L.f.	Moraceae
Ficus microcarpa L.f.	Moraceae
Ficus mollis Vahl	Moraceae
Ficus nervosa B.Heyne ex Roth	Moraceae
Ficus palmata Forssk.	Moraceae
Ficus racemosa L.	Moraceae
Ficus religiosa L.	Moraceae
Ficus semicordata Buch.-Ham. ex Sm.	Moraceae
Ficus virens Aiton	Moraceae
Morus alba L.	Moraceae
Plecospermum spinosum Trécul	Moraceae
Streblus asper Lour.	Moraceae
Moringa concanensis Nimmo	Moringaceae
Moringa oleifera Lam.	Moringaceae
Ensete superbum (Roxb.) Cheesman	Musaceae
Musa acuminata Colla	Musaceae
Musa balbisiana Colla	Musaceae
Musa × *paradisiaca* L.	Musaceae
Myrcia bracteata (Rich.) DC.	Myricaceae
Myrica esculenta Buch.-Ham. ex D. Don	Myricaceae
Knema attenuata Warb.	Myristicaceae
Knema latifolia Warb.	Myristicaceae

Myristica beddomei King	Myristicaceae
Myristica fragrans Houtt.	Myristicaceae
Myristica malabarica Lam.	Myristicaceae
Corymbia citriodora (Hook.) K.D.Hill & L.A.S.Johnson	Myrtaceae
Corymbia maculata (Hook.) K.D.Hill & L.A.S.Johnson	Myrtaceae
Eucalyptus globulus Labill.	Myrtaceae
Eucalyptus tereticornis Sm.	Myrtaceae
Psidium guajava L.	Myrtaceae
Syzygium alternifolium (Wight) Walp.	Myrtaceae
Syzygium caryophyllatum (L.) Alston	Myrtaceae
Syzygium cumini (L.) Skeels	Myrtaceae
Syzygium formosum (Wall.) Masam.	Myrtaceae
Syzygium jambos (L.) Alston	Myrtaceae
Syzygium salicifolium (Wight) J.Graham	Myrtaceae
Nelumbo nucifera Gaertn.	Nelumbonaceae
Boerhavia diffusa L.	Nyctaginaceae
Mirabilis jalapa L.	Nyctaginaceae
Pisonia aculeata L.	Nyctaginaceae
Gomphia serrata (Gaertn.) Kanis	Ochnaceae
Ochna obtusata DC.	Ochnaceae
Anacolosa crassipes (Kurz) Kurz	Olacaceae
Olax acuminata Wall. ex Benth.	Olacaceae
Olax scandens Roxb.	Olacaceae
Ximenia americana L.	Olacaceae
Chionanthus zeylanicus L.	Oleaceae
Fraxinus micrantha Lingelsh.	Oleaceae
Jasminum angustifolium (L.) Willd.	Oleaceae
Jasminum arborescens Roxb.	Oleaceae
Jasminum auriculatum Vahl	Oleaceae
Jasminum grandiflorum L.	Oleaceae
Jasminum humile L.	Oleaceae
Jasminum lanceolarium Roxb.	Oleaceae
Jasminum multiflorum (Burm.f.) Andrews	Oleaceae
Myxopyrum smilacifolium (Wall.) Blume	Oleaceae
Nyctanthes arbor-tristis L.	Oleaceae
Olea dioica Roxb.	Oleaceae
Schrebera swietenioides Roxb.	Oleaceae
Ludwigia adscendens (L.) H.Hara	Onagraceae
Ludwigia hyssopifolia (G.Don) Exell	Onagraceae
Cansjera rheedei J.F.Gmel.	Opiliaceae
Crepidium acuminatum (D.Don) Szlach.	Orchidaceae
Habenaria digitata Lindl.	Orchidaceae
Habenaria furcifera Lindl.	Orchidaceae
Habenaria marginata Colebr.	Orchidaceae
Habenaria grandifloriformis Blatt. & McCann	Orchidaceae
Vanda tessellata (Roxb.) Hook. ex G.Don	Orchidaceae
Vanda testacea (Lindl.) Rchb.f.	Orchidaceae

Striga angustifolia (D. Don) C.J. Saldanha	Orobanchaceae
Striga asiatica (L.) Kuntze	Orobanchaceae
Biophytum reinwardtii (Zucc.) Klotzsch	Oxalidaceae
Biophytum sensitivum (L.) DC.	Oxalidaceae
Oxalis corniculata L.	Oxalidaceae
Oxalis latifolia Kunth	Oxalidaceae
Pandanus odorifer (Forssk.) Kuntze	Pandanaceae
Argemone mexicana L.	Papaveraceae
Meconopsis aculeata Royle	Papaveraceae
Passiflora foetida L.	Passifloraceae
Pedalium murex L.	Pedaliaceae
Eurya acuminata DC.	Pentaphylacaceae
Eurya japonica Thunb.	Pentaphylacaceae
Antidesma acidum Retz.	Phyllanthaceae
Aporosa octandra (Buch.-Ham. ex D.Don) Vickery	Phyllanthaceae
Bischofia javanica Blume	Phyllanthaceae
Breynia retusa (Dennst.) Alston	Phyllanthaceae
Breynia vitis-idaea (Burm.f.) C.E.C.Fisch.	Phyllanthaceae
Bridelia retusa (L.) A.Juss.	Phyllanthaceae
Bridelia stipularis (L.) Blume	Phyllanthaceae
Bridelia tomentosa Blume	Phyllanthaceae
Cleistanthus collinus (Roxb.) Benth. ex Hook.f.	Phyllanthaceae
Embelia ribes Burm.f.	Phyllanthaceae
Embelia tsjeriam-cottam (Roem. & Schult.) A.DC.	Phyllanthaceae
Flueggea leucopyrus Willd.	Phyllanthaceae
Flueggea virosa (Roxb. ex Willd.) Royle	Phyllanthaceae
Glochidion ellipticum Wight	Phyllanthaceae
Glochidion heyneanum (Wight & Arn.) Wight	Phyllanthaceae
Glochidion lanceolarium (Roxb.) Voigt	Phyllanthaceae
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae
Phyllanthus debilis Klein ex Willd.	Phyllanthaceae
Phyllanthus emblica L.	Phyllanthaceae
Phyllanthus fraternus G.L.Webster	Phyllanthaceae
Phyllanthus maderaspatensis L.	Phyllanthaceae
Phyllanthus niruri L.	Phyllanthaceae
Phyllanthus parvifolius Buch.-Ham. ex D.Don	Phyllanthaceae
Phyllanthus polyphyllus Willd.	Phyllanthaceae
Phyllanthus reticulatus Poir.	Phyllanthaceae
Phyllanthus urinaria L.	Phyllanthaceae
Phyllanthus virgatus G.Forst.	Phyllanthaceae
Peperomia tetraphylla (G.Forst.) Hook. & Arn.	Piperaceae
Piper attenuatum Buch.-Ham. ex Miq.	Piperaceae
Piper betle L.	Piperaceae
Piper griffithii C.DC.	Piperaceae
Piper longum L.	Piperaceae
Piper nigrum L.	Piperaceae

Pittosporum wightii A.K.Mukh.	Pittosporaceae
Bacopa monnieri (L.) Wettst.	Plantaginaceae
Limnophila indica (L.) Druce	Plantaginaceae
Lindenbergia grandiflora (Buch.-Ham. ex D. Don) Benth.	Plantaginaceae
Picrorhiza kurrooa Royle	Plantaginaceae
Plantago asiatica subsp. erosa (Wall.) Z.Yu Li	Plantaginaceae
Scoparia dulcis L.	Plantaginaceae
Plumbago zeylanica L.	Plumbaginaceae
Apluda mutica L.	Poaceae
Aristida adscensionis L.	Poaceae
Bambusa bambos (L.) Voss	Poaceae
Chloris barbata Sw.	Poaceae
Chrysopogon aciculatus (Retz.) Trin.	Poaceae
Chrysopogon zizanioides (L.) Roberty	Poaceae
Coix lacryma-jobi L.	Poaceae
Cymbopogon citratus (DC.) Stapf	Poaceae
Cymbopogon flexuosus (Nees ex Steud.) W.Watson	Poaceae
Cynodon dactylon (L.) Pers.	Poaceae
Dactyloctenium aegyptium (L.) Willd.	Poaceae
Dendrocalamus strictus (Roxb.) Nees	Poaceae
Desmostachya bipinnata (L.) Stapf	Poaceae
Echinochloa crus-galli (L.) P.Beauv.	Poaceae
Eleusine indica (L.) Gaertn.	Poaceae
Eragrostis nigra Nees ex Steud.	Poaceae
Eulaliopsis binata (Retz.) C.E.Hubb.	Poaceae
Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult.	Poaceae
Imperata cylindrica (L.) Raeusch.	Poaceae
Oryza sativa L.	Poaceae
Saccharum bengalense Retz.	Poaceae
Saccharum officinarum L.	Poaceae
Setaria macrostachya Kunth	Poaceae
Sporobolus diandrus (Retz.) P.Beauv.	Poaceae
Themeda quadrivalvis (L.) Kuntze	Poaceae
Polygala arvensis Willd.	Polygalaceae
Polygala chinensis L.	Polygalaceae
Polygala elongata Klein ex Willd.	Polygalaceae
Fagopyrum acutatum (Lehm.) Mansf. ex K.Hammer	Polygonaceae
Fagopyrum esculentum Moench	Polygonaceae
Persicaria amplexicaulis (D.Don) Ronse Decr.	Polygonaceae
Persicaria capitata (Buch.-Ham. ex D.Don) H.Gross	Polygonaceae
Persicaria chinensis (L.) H. Gross	Polygonaceae
Persicaria glabra (Willd.) M.Gómez	Polygonaceae
Persicaria hydropiper (L.) Delarbre	Polygonaceae
Persicaria orientalis (L.) Spach	Polygonaceae
Rheum webbianum Royle	Polygonaceae

Rumex hastatus D. Don	Polygonaceae
Rumex nepalensis Spreng.	Polygonaceae
Rumex vesicarius L.	Polygonaceae
Anagallis arvensis L.	Primulaceae
Ardisia paniculata Roxb.	Primulaceae
Maesa indica (Roxb.) A. DC.	Primulaceae
Myrsine africana L.	Primulaceae
Myrsine semiserrata Wall.	Primulaceae
Helicia excelsa (Roxb.) Blume	Proteaceae
Drypetes sepiaria (Wight & Arn.) Pax & K.Hoffm.	Putranjivaceae
Putranjiva roxburghii Wall.	Putranjivaceae
Aconitum heterophylloides (Brühl) Stapf	Ranunculaceae
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae
Aconitum villosum Rchb.	Ranunculaceae
Anemone obtusiloba D.Don	Ranunculaceae
Aquilegia fragrans Benth.	Ranunculaceae
Clematis buchananiana DC.	Ranunculaceae
Clematis gouriana Roxb. ex DC.	Ranunculaceae
Clematis heynei M.A.Rau & al.	Ranunculaceae
Nigella sativa L.	Ranunculaceae
Ranunculus arvensis L.	Ranunculaceae
Ranunculus sceleratus L.	Ranunculaceae
Thalictrum foliolosum DC.	Ranunculaceae
Gouania tiliifolia Lam.	Rhamnaceae
Scutia myrtina (Burm.f.) Kurz	Rhamnaceae
Ventilago denticulata Willd.	Rhamnaceae
Ventilago maderaspatana Gaertn.	Rhamnaceae
Ziziphus glabrata B.Heyne ex Roth	Rhamnaceae
Ziziphus jujuba Mill.	Rhamnaceae
Ziziphus nummularia (Burm.f.) Wight & Arn.	Rhamnaceae
Ziziphus oenopolia (L.) Mill.	Rhamnaceae
Ziziphus rugosa Lam.	Rhamnaceae
Ziziphus xylopyrus (Retz.) Willd.	Rhamnaceae
Carallia brachiata (Lour.) Merr.	Rhizophoraceae
Agrimonia pilosa Ledeb.	Rosaceae
Cotoneaster affinis Lindl.	Rosaceae
Cotoneaster microphyllus Wall. ex Lindl.	Rosaceae
Docynia indica (Wall.) Decne.	Rosaceae
Duchesnea indica (Jacks.) Focke	Rosaceae
Geum elatum Wall. ex Hook.f.	Rosaceae
Malus domestica Borkh.	Rosaceae
Potentilla indica (Jacks.) Th.Wolf	Rosaceae
Prinsepia utilis Royle	Rosaceae
Prunus campanulata Maxim.	Rosaceae
Prunus nepalensis Ser.	Rosaceae
Pyracantha crenulata (Roxb. ex D.Don) M.Roem.	Rosaceae
Pyrus pashia Buch.-Ham. ex D.Don	Rosaceae
Rubus foliosus Weihe	Rosaceae

Rubus × *nobilis* hort. angl. ex Regel	Rosaceae
Rubus biflorus Buch.-Ham. ex Sm.	Rosaceae
Rubus buergeri Miq.	Rosaceae
Rubus ellipticus Sm.	Rosaceae
Rubus khasianus Cardot	Rosaceae
Rubus niveus Thunb.	Rosaceae
Benkara malabarica (Lam.) Tirveng.	Rubiaceae
Canthium coromandelicum (Burm.f.) Alston	Rubiaceae
Catunaregam spinosa (Thunb.) Tirveng.	Rubiaceae
Catunaregam spinosa (Thunb.) Tirveng.	Rubiaceae
Ceriscoides campanulata (Roxb.) Tirveng.	Rubiaceae
Chassalia curviflora (Wall.) Thwaites	Rubiaceae
Coffea benghalensis B.Heyne ex Schult.	Rubiaceae
Galium asperifolium Wall.	Rubiaceae
Galium elegans Wall. ex Roxb.	Rubiaceae
Galium rotundifolium L.	Rubiaceae
Gardenia gummifera L.f.	Rubiaceae
Gardenia latifolia Aiton	Rubiaceae
Gardenia resinifera Roth	Rubiaceae
Geophila repens (L.) I.M.Johnst.	Rubiaceae
Haldina cordifolia (Roxb.) Ridsdale	Rubiaceae
Hedyotis scandens Roxb.	Rubiaceae
Himalrandia tetrasperma (Wall. ex Roxb.) T.Yamaz.	Rubiaceae
Houstonia purpurea L.	Rubiaceae
Ixora coccinea L.	Rubiaceae
Ixora elongata B.Heyne ex G.Don	Rubiaceae
Ixora malabarica (Dennst.) Mabb.	Rubiaceae
Ixora parviflora Lam.	Rubiaceae
Ixora pavetta Andr.	Rubiaceae
Ixora thwaitesii Hook.f.	Rubiaceae
Meyna laxiflora Robyns	Rubiaceae
Meyna spinosa Roxb. ex Link	Rubiaceae
Mitragyna parvifolia var. microphylla (Kurz) Ridsdale	Rubiaceae
Morinda citrifolia L.	Rubiaceae
Morinda coreia Buch.-Ham.	Rubiaceae
Morinda umbellata L.	Rubiaceae
Mussaenda frondosa L.	Rubiaceae
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae
Neonauclea purpurea (Roxb.) Merr.	Rubiaceae
Oldenlandia corymbosa L.	Rubiaceae
Oldenlandia diffusa (Willd.) Roxb.	Rubiaceae
Oldenlandia umbellata L.	Rubiaceae
Ophiorrhiza mungos L.	Rubiaceae
Oxyceros longiflorus (Lam.) T.Yamaz.	Rubiaceae
Paederia foetida L.	Rubiaceae
Pavetta indica L.	Rubiaceae

Pavetta tomentosa Roxb. ex Sm.	Rubiaceae
Psydrax dicoccos Gaertn.	Rubiaceae
Richardia scabra L.	Rubiaceae
Rubia cordifolia L.	Rubiaceae
Rubia manjith Roxb. ex Fleming	Rubiaceae
Saprosma ternatum (Wall.) Hook.f.	Rubiaceae
Spermacoce alata Aubl.	Rubiaceae
Spermacoce articularis L.f.	Rubiaceae
Spermacoce hispida L.	Rubiaceae
Spermadictyon suaveolens Roxb.	Rubiaceae
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre	Rubiaceae
Tarenna asiatica (L.) Kuntze ex K.Schum.	Rubiaceae
Wendlandia heynei (Schult.) Santapau & Merchant	Rubiaceae
Wendlandia tinctoria (Roxb.) DC.	Rubiaceae
Acronychia pedunculata (L.) Miq.	Rutaceae
Aegle marmelos (L.) Corrêa	Rutaceae
Atalantia monophylla DC.	Rutaceae
Atalantia racemosa Wight ex Hook.	Rutaceae
Boenninghausenia albiflora (Hook.) Rchb. ex Meisn.	Rutaceae
Chloroxylon swietenia DC.	Rutaceae
Citrus aurantiifolia (Christm.) Swingle	Rutaceae
Citrus latipes (Swingle) Yu.Tanaka	Rutaceae
Citrus limon (L.) Osbeck	Rutaceae
Citrus medica L.	Rutaceae
Clausena dentata (Willd.) Roem.	Rutaceae
Clausena excavata Burm.f.	Rutaceae
Glycosmis mauritiana (Lam.) Tanaka	Rutaceae
Glycosmis pentaphylla (Retz.) DC.	Rutaceae
Hesperethusa crenulata (Roxb.) M. Roem.	Rutaceae
Limonia acidissima Groff	Rutaceae
Micromelum pubescens Blume	Rutaceae
Murraya koenigii (L.) Spreng.	Rutaceae
Murraya paniculata (L.) Jack	Rutaceae
Naringi alata (Wall. ex Wight & Arn.) J.L.Ellis	Rutaceae
Pamburus missionis (Wight) Swingle	Rutaceae
Pleiospermium alatum (Wight & Arn.) Swingle	Rutaceae
Ruta graveolens L.	Rutaceae
Skimmia laureola Franch.	Rutaceae
Toddalia asiatica (L.) Lam.	Rutaceae
Zanthoxylum armatum DC.	Rutaceae
Zanthoxylum khasianum Hook. f.	Rutaceae
Zanthoxylum limonella (Dennst.) Alston	Rutaceae
Zanthoxylum oxyphyllum Edgew.	Rutaceae
Zanthoxylum rhetsa DC.	Rutaceae
Casearia vareca Roxb.	Salicaceae
Flacourtia indica (Burm.f.) Merr.	Salicaceae
Flacourtia jangomas (Lour.) Raeusch.	Salicaceae

Flacourtia montana J.Graham	Salicaceae
Populus ciliata Wall. ex Royle	Salicaceae
Salix tetrasperma Roxb.	Salicaceae
Xylosma longifolia Clos	Salicaceae
Azima tetracantha Lam.	Salvadoraceae
Salvadora oleoides Decne.	Salvadoraceae
Salvadora persica L.	Salvadoraceae
Santalum album L.	Santalaceae
Viscum angulatum B.Heyne ex DC.	Santalaceae
Acer oblongum Wall. ex DC.	Sapindaceae
Aesculus assamica Griff.	Sapindaceae
Aesculus indica (Wall. ex Cambess.) Hook.	Sapindaceae
Allophylus cobbe (L.) Raeusch.	Sapindaceae
Allophylus serratus (Hiern) Kurz	Sapindaceae
Cardiospermum corindum L.	Sapindaceae
Cardiospermum halicacabum L.	Sapindaceae
Dodonaea viscosa (L.) Jacq.	Sapindaceae
Lepisanthes tetraphylla Radlk.	Sapindaceae
Sapindus attenuatus Wall.	Sapindaceae
Sapindus emarginatus Vahl	Sapindaceae
Sapindus laurifolius Vahl	Sapindaceae
Sapindus mukorossi Gaertn.	Sapindaceae
Schleichera oleosa (Lour.) Merr.	Sapindaceae
Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.	Sapotaceae
Madhuca neriifolia (Moon) H.J.Lam	Sapotaceae
Mimusops elengi L.	Sapotaceae
Houttuynia cordata Thunb.	Saururaceae
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae
Verbascum thapsus L.	Scrophulariaceae
Ailanthus excelsa Roxb.	Simaroubaceae
Brucea javanica (L.) Merr.	Simaroubaceae
Picrasma javanica Blume	Simaroubaceae
Smilax aspera L.	Smilacaceae
Smilax ovalifolia Roxb. ex D.Don	Smilacaceae
Smilax perfoliata Lour.	Smilacaceae
Smilax zeylanica L.	Smilacaceae
Brugmansia suaveolens (Willd.) Sweet	Solanaceae
Capsicum annuum L.	Solanaceae
Datura inoxia Mill.	Solanaceae
Datura metel L.	Solanaceae
Datura stramonium L.	Solanaceae
Hyoscyamus niger L.	Solanaceae
Nicotiana tabacum L.	Solanaceae
Physalis minima L.	Solanaceae
Physochlaina praealta (Decne.) Miers	Solanaceae
Solanum aculeatissimum Jacq.	Solanaceae
Solanum americanum Mill.	Solanaceae
Solanum melongena L.	Solanaceae

Solanum surattense Burm.f.	Solanaceae
Solanum torvum Sw.	Solanaceae
Solanum trilobatum L.	Solanaceae
Solanum violaceum Ortega	Solanaceae
Solanum virginianum L.	Solanaceae
Withania somnifera (L.) Dunal	Solanaceae
Gomphandra coriacea Wight	Stemonuraceae
Symplocos lucida (Thunb.) Siebold & Zucc.	Symplocaceae
Symplocos racemosa Roxb.	Symplocaceae
Symplocos ramosissima Wall. ex G. Don	Symplocaceae
Camellia kissii Wall.	Theaceae
Schima khasiana Dyer	Theaceae
Schima wallichii Choisy	Theaceae
Aquilaria agallocha Roxb.	Thymelaeaceae
Daphne mucronata Royle	Thymelaeaceae
Daphne papyracea Wall. ex G. Don	Thymelaeaceae
Typha domingensis Pers.	Typhaceae
Holoptelea integrifolia Planch.	Ulmaceae
Boehmeria macrophylla Hornem.	Urticaceae
Boehmeria rugulosa Wedd.	Urticaceae
Girardinia diversifolia (Link) Friis	Urticaceae
Pouzolzia hirta Blume ex Hassk.	Urticaceae
Pouzolzia pentandra var. wightii (Benn. & Br.) Friis & Wilmot-Dear	Urticaceae
Pouzolzia zeylanica (L.) Benn.	Urticaceae
Urtica dioica L.	Urticaceae
Duranta erecta L.	Verbenaceae
Lantana camara L.	Verbenaceae
Lantana indica Roxb.	Verbenaceae
Lippia javanica (Burm.f.) Spreng.	Verbenaceae
Phyla nodiflora (L.) Greene	Verbenaceae
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae
Hybanthus enneaspermus (L.) F.Muell.	Violaceae
Hybanthus linearifolius (Vahl) Urb.	Violaceae
Viola canescens Wall.	Violaceae
Viola diffusa Ging.	Violaceae
Viola pilosa Blume	Violaceae
Ampelocissus indica (L.) Planch.	Vitaceae
Ampelocissus latifolia (Roxb.) Planch.	Vitaceae
Ampelocissus tomentosa (B.Heyne & Roth) Planch.	Vitaceae
Cayratia pedata (Lam.) Gagnep.	Vitaceae
Cayratia trifolia (L.) Domin	Vitaceae
Cissus adnata Roxb.	Vitaceae
Cissus javana DC.	Vitaceae
Cissus quadrangularis L.	Vitaceae
Cissus verticillata (L.) Nicolson & C.E.Jarvis	Vitaceae
Cissus vitiginea L.	Vitaceae

Cissus woodrowii (Stapf ex Cooke) Santapau	Vitaceae
Leea asiatica (L.) Ridsdale	Vitaceae
Leea indica (Burm. f.) Merr.	Vitaceae
Leea macrophylla Roxb. ex Hornem.	Vitaceae
Tetrastigma leucostaphylum (Dennst.) Alston	Vitaceae
Aloe vera (L.) Burm.f.	Xanthorrhoeaceae
Alpinia galanga (L.) Willd.	Zingiberaceae
Curcuma amada Roxb.	Zingiberaceae
Curcuma angustifolia Roxb.	Zingiberaceae
Curcuma aromatica Salisb.	Zingiberaceae
Curcuma caesia Roxb.	Zingiberaceae
Curcuma caulina J.Graham	Zingiberaceae
Curcuma longa L.	Zingiberaceae
Kaempferia galanga L.	Zingiberaceae
Curcuma pseudomontana J.Graham	Zingiberaceae
Elettaria cardamomum (L.) Maton	Zingiberaceae
Globba marantina L.	Zingiberaceae
Hedychium spicatum Sm.	Zingiberaceae
Zingiber capitatum Roxb.	Zingiberaceae
Zingiber montanum (J.Koenig) Link ex A.Dietr.	Zingiberaceae
Zingiber neesanum (J.Graham)	Zingiberaceae
Zingiber nimmonii (J.Graham) Dalzell	Zingiberaceae
Zingiber officinale Roscoe	Zingiberaceae
Zingiber roseum (Roxb.) Roscoe	Zingiberaceae

Balanites aegyptiaca (L.) Delile	Zygophyllaceae
Tribulus pentandrus Forssk.	Zygophyllaceae
Tribulus terrestris L.	Zygophyllaceae

Appendix 2. Representation of plant families against seven prevalent disease categories as recorded from sacred grove studies

Disease Category	Families recorded	Species recorded	50% of total species (no. of families)	75% of total species (no. of families)	Top three families
Diseases related to the digestive system	64	170	85 (11)	127 (26)	Leguminosae, Apocynaceae, Compositae
Diseases related to the infections and parasitic attacks	96	366	183 (11)	274 (31)	Leguminosae, Malvaceae, Compositae
Diseases related to the skin and sub-cutaneous tissues	68	153	76 (12)	114 (29)	Leguminosae, Compositae, Lamiaceae
General health problem	100	358	179 (13)	268 (35)	Leguminosae, Compositae, Apocynaceae
Diseases related to the external causes	105	324	162 (12)	243 (38)	Leguminosae, Malvaceae, Lamiaceae
Diseases related to the respiratory system	80	240	120 (11)	180 (29)	Leguminosae, Lamiaceae, Compositae
Diseases related to the genito-urinary system	45	100	50 (9)	75 (20)	Leguminosae, Malvaceae, Compositae