Title: Analysis of in-situ biodiversity conservation and ecosystem management in Twenty-three selected Sacred Groves of Manipur within Indo-Burma Biodiversity Hotspot: Bio-legal aspects

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Abstract

In Manipur, Sacred Groves (SGs), known as “Umang Lai," which literally means ‘forest deities’, are worshipped in forest or thick vegetation areas. A total of 365 SGs have been officially reported in Manipur, a biodiversity hotspot of India. The concept of SG is founded on the traditional religious belief systems which aid in the sustainable and restrictive utilization of resources within it. Proper documentation of SGs of North-East India and limited study on them have propelled this study. A total of 23 SGs were selected to understand their role in in-situ biodiversity conservation, ecosystem management and relevant legal frameworks. These SGs were chosen from 5 districts of Manipur viz., Bishnupur, Imphal East, Imphal West, Kakching and Thoubal. Documentation of the selected sites, related cultural and social aspects and random inventorization of native plants growing in those selective sites were conducted. The study revealed that SGs are sites of rich biodiversity conservation, effective carbon sequestration and provide supportive ecosystem services to the human settlement around. Considering the ecological uniqueness and biological diversity, it is concluded that a holistic conservation strategy of SGs, particularly focused on traditional, scientific, and cultural methods is imperative. These groves can be viewed as micro-scale climate change mitigation models which may be replicated for wider impact. Further, in view of the SGs present and futuristic role, enactment of a specific law and active involvement of the community for the protection and management of SGs is the need of the hour.

Keywords Biodiversity hotspot. Indigenous community. North-East India. Traditional knowledge. Conservation policies.

Extended author information available on the last page of the article

Introduction

Sacred groves (SGs) are patches of vegetation or forest that are dedicated to deities or ancestral spirits by various communities all over the world. The idea of SGs originates from local communities dedicating pristine forest ancestral spirits or deities that have safeguarded untouched forests in their pristine state by consecrating them (Emmanuel and Sharon 2019). They embody an age-old tradition of preserving natural spaces associated with cultural and/or religious significance. Numerous scholars have characterized SGs in various ways, but one clear fact remains: wherever sacred groves existed, they were upheld by Indigenous traditional societies with deep spiritual connections to their surrounding physical environment Khumbongmayum et al. (2005).

The SGs act as natural repositories of biodiversity, conserved in a sustainable manner by local inhabitants through taboos and belief systems that are as old as the origin of the sacredness of these spaces. SG is often closely knitted with its folklore, legends, and associated myths. Removal of even a small branch or stone from the SG is a taboo as the deity that resides in that SG is believed to provide protection to them Vartak and Gadgil (1973). Sacred grove also represents a continuum of biodiversity and religio-cultural elements of a community from the past to the present see, Ahmed et al. (2023). Locally known as 'Umang Lai' in Manipur, SGs can be viewed as pristine forest patches forming part of the forest area, located on the outskirts of local habitats and devoted to ancestral spirits and local folk deities Devi (2000). Engagement and contribution of the communities in the conservation of SGs and their management hinges upon the long-standing socio-cultural practices and belief systems that are attached to the SGs (Gadgil and Vartak 1975 and 1976; Boojh and Ramakrishnan 1983; Khiewtam and Ramakrishnan 1989; Rodgers 1994; King et al. 1997; Sinha and Maikhuri 1998; Tiwari et al. 1998; Sunitha and Rao 1999; Basu 2000; Kushalapa et al. 2001; Yoseph Maru et al. 2023;). They also serve as repositories of traditional knowledge, folklore, and rituals unique to indigenous communities, ensuring the preservation and transmission of this heritage across generations.

Sacred forests have been documented across all the continents except Antarctica (Khumbongmayum et al. 2005a). The north-eastern states of India house numerous SGs, some of which are reported (Tripathi 2001). In terms of the number of SGs in the country, Manipur stands 8th among all the Indian States and 1st among the North Eastern States (Milaap 2017) with a total of 365 SGs as reported by Devi (2000).

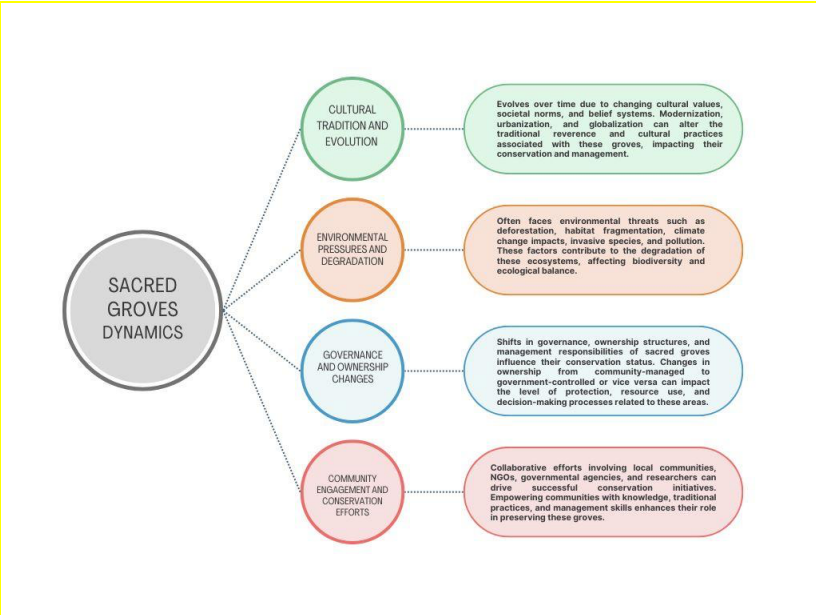


Fig. 1 Infographic showing Dynamics of Sacred Groves

Different ethnic groups of Manipur have SGs associated with their belief systems. However, maximum SGs belong to the Meitei who form the dominant community and are administered by them. The Meiteis of Manipur deeply revere nature and ancestral spirits, intertwining their daily lives with spiritual practices that maintain harmony between the human and divine realms. SGs or “Umang Lai" in Manipur are associated with deities that are believed to govern the landscapes, hills, rivers, lakes, great ancestors, legendary forefathers of particular families and clans who possess superhuman qualities and powers. All Umang Lais deities are believed to have their sacred abode which generally consists of large plots of land area available on the outskirts of the village or inside the village.

Karthong Lamlen, one of the ancient manuscripts of Manipur, mentions on many accounts about SGs. About 163 local deities in their stature and presence are worshiped in these sacred groves of Manipur. The local deity Koubru is worshipped maximum in 29 different sacred groves which are generally big in size with high plant diversity. The other major local deities are Pakhangba which is worshiped in 16 different sacred groves, other deities include Lairemma, Loyalakpa and Panthoibi represented each by 15 sacred groves can also be considered as highly worshipped by the local peoples.

It is stated that characterization of the traditional societies depended mostly on understanding their close interconnection with nature and its resources (Daye & Healey 2015). Beyond their ecological value, sacred groves often function as vital centers for rituals, ceremonies, and traditional practices which is strongly evident in the SGs of Manipur.

Central to Meitei’s religious tradition is the ritual of “Lai Haraoba” (the pleasing of God), a vibrant festival that embodies their cultural ethos and spiritual aspirations (Milaap 2017) and celebrated to propitiate the deity. Such rituals associated with the SGs or Umang Lais are called Umang Lai Haraoba. Through elaborate ceremonies, dances, and offerings, the Meiteis seek blessings for fertility, prosperity, and happiness while warding off misfortunes and unforeseen calamities. These rituals not only serve as acts of devotion but also strengthen the collective identity and cultural heritage of the community.

The rituals and ceremonies of Lai-Haraoba encapsulate the culture of the Meitei community in terms of their beliefs, superstitions, nature-space-spirit continuum, celebration of life among others. It reveals people at their deepest and most profound essence (Singh 1961). The celebration starts at the onset of the rainy season i.e. April

- May and may continue through June. The duration of each celebration varies from several days or even weeks. Offerings to the deity during worship are peculiar to each grove.

The SGs in Manipur are distributed over all types of landscapes, wherein many rare and endemic species of flora and fauna of the state are conserved in some of these groves (Singh 2001). Traditional sacred groves situated in densely populated areas are generally smaller in size than those found in forests generally free from disturbance owing to the expansion of human settlements. Among 166 sacred groves reported from four valley areas of Manipur, about 58% were under partly threatened, 31% were under threatened and the remaining 11% were under well protected and preserved category (Khumbongmayum 2004).

Among the 365 sacred groves recorded in Manipur, groves in hills or forest margin are well maintained, others in the community areas are threatened and groves in the urban area are in unrevivable condition such as the sacred grove of *Lai Ishing Chaibi* at Imphal West district. Many SGs are facing huge threats from anthropogenic pressures, urbanization, development activities and deforestation (Khumbongmayum 2004). The construction of big community hall at the Umang Lai complex in the open grounds, plantation of ornamental plants, and intrusion by invasive and alien species have also threatened the diversity of plants in the groves. Plant diversity and their protection is found more in sacred groves where traditional ritual practices are followed, especially in Meitei scheduled caste [as defined in Article 366(24) of the Constitution of India] inhabited areas.

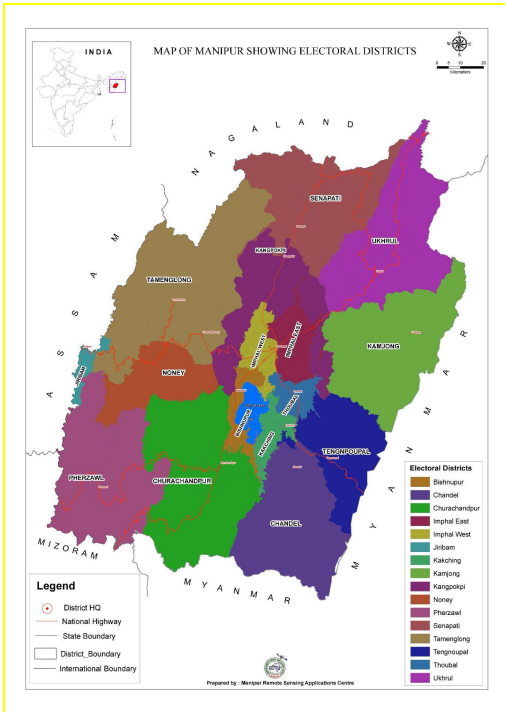
SGs' contribution in the conservation of biodiversity, increase in forest biomass and carbon storage has been long recognized (Kosambi 1962; Maru et al. 2023; Gadgil and Vartak 1976; Haridasan and Rao 1985; Khan et al. 1997). Fig. 1 highlights the dynamics of Sacred Groves defining broadly the functioning of SGs. They stand as living examples of how traditional beliefs and practices can coexist with modern conservation efforts. It has been found that research on medicinal and aromatic plants of several SGs in different parts of India have been carried out (Hajra 1975; Balasubramanyan and Induchoodan 1996; Khan et al. 1997; Boraiah et al. 2003; Kumar and Swamy 2003) but not on the 23 selected SGs of Manipur. Inventorisation of biodiversity related activities have been carried out in many SGs, and flora and fauna identified are available worldwide, but thorough studies of biodiversity and functional ecology with aim to focus on conservation is minimal (Ray et al. 2014). Similar situation also exists in Manipur in the context of the SGs located therein. Comprehensive study highlighting the current legal and policy frameworks relevant to the protection of SGs is scarce. Therefore, there was a felt need for conducting a study to fill the underlying gaps for the purpose of promoting and conserving the SGs in general and Manipur, in particular.

Material and methods

The present study used mixed research methods involving doctrinal as well as empirical research. The doctrinal study was done to understand the existing knowledge related to SGs and the legal framework that promote or conserve the SGs. The primary sources of the doctrinal study include the Constitution of India, relevant legislations, International Conventions, Reports and judgments of the Supreme Court of India; while the secondary sources are research articles and books related to the study. The empirical study conducted is exploratory in nature and was aimed at understanding the characteristics of the 23 selected SGs out of the 365 SGs in Manipur, random inventorisation of the native plants found there, their ethnomedicinal significance, conservation status, cultural importance and community participation. The exploratory research of the SGs was done by using field observation method to inventorise the native plants found in those SGs, the presence of invasive species and the extent of concretization or infrastructural development (if any). The cultural significance of the SGs and the ethnomedicinal importance of the native plants were studied through interaction with various stakeholders of the community using appropriate data collection tools.

Study Area

The study area is Manipur [latitude 23°50' N to 25°42' N and longitude 92°58' E to 94°45' E], a state located in the North-Eastern part of India. The state enjoys subtropical climate, with temperature ranging from 4° C to 31° C. Rainfall varies from 1000 mm to 3500 mm with average rainfall of 2000 mm. Twenty-three SGs [area, longitudes and latitudes of the selected SGs are shown in Table no (1)] situated in five different districts of Manipur, namely Bishnupur, Imphal East, Imphal West, Thoubal and Kakching, were selected and carefully thought out survey was carried out. The districts can be seen in Fig. 2.



Source: Manipur Remote Sensing Applications Centre

Fig. 2 Physical map of Manipur indicating the Districts


(a) Kongbu Maru, Imphal East


(b) Ibudhou Thonang Panganba, Lai Manou Mayamba, Kha Potsangbam, Imphal East

Fig. 3 Photos of few Sacred Groves Sites of Manipur

Fig. 4 Word Cloud of medicinal and aromatic plants (in their local names) found in the study area

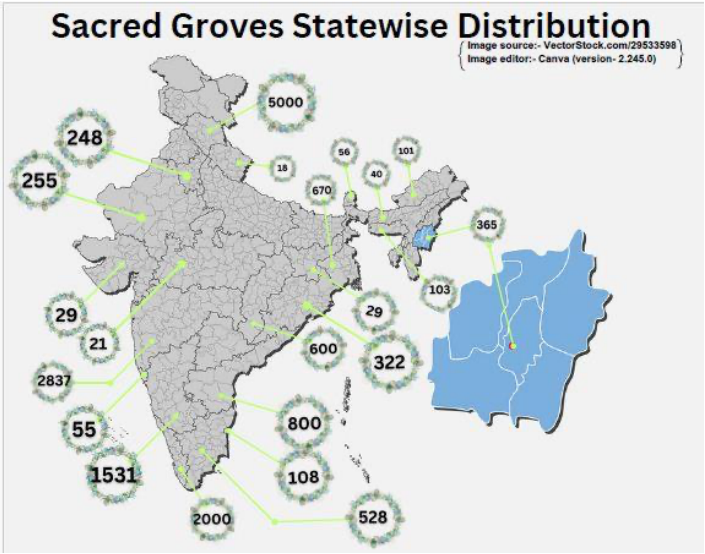


Fig. 5 State wise distribution of sacred groves in India

Sources - Parmar and Patel (2010); Rao and Sunitha (2011); Basha et al. (2012); CPREEC ENVIS (2020)

Ecological profile

The study area is located in the region of confluence of the Burmese and Indian tectonic plates and is part of the Indo-Burma biodiversity hotspot. The region has been the Vavilovian centre of origin of a variety of angiospermic plants. Ashalata (2005) expressed her opinion about the abundant flora and fauna and its physical characteristics, found in forests ranging from tropical to the sub-alpine. The soil belongs to two major types, residual and transported, which cover the hill areas and the central valley, respectively (Vedaja 1998). The climatic condition is monsoon with warm moist summers and dry winters. Mean annual rainfall is 1400 mm, most of which is received during May to September. The climatic conditions make it extremely viable for many plants to grow abundantly.

Selected Sacred Groves

Twenty-three sacred groves were selected from Bishnupur, Imphal East, Imphal West, Thoubal and Kakching districts based on the inventory and preliminary survey. Selection of the 23 SGs was based on size, vegetation and location. The selected SGs are: Chaning Larembi, Phoijing; Ibudhou Thonang Panganba, Lai Manou, Mayamba, Kha Potsangbam; Ebudhou Marjing, Heinang; Ibudhou Panam Ningthou, Andro; Ibudhou Loiyalakpa, Khaidem; Ibudhou Koubru, Awang Sekmai; Malem Ema Nungthong, Shidabi, Serou; Ebudhou Ekhan Chaoba , Wangbrel, Sugnu; Kaina Poirou Khongjem Kana, Yairipok and Ibudhou Hokha Sorarel (Table 1). These SGs have sub-tropical forests as its dominant vegetation. The general characteristics of the twenty-three selected SGs are described in Table 1.

Extensive survey cum collection were carried out during March 2022- April 2023 to document the floristic composition in the SGs of Manipur. Random sampling method was used to conduct this research. The study is designed with documenting a checklist of native and invasive plants found in the groves as one of the objectives. The plants were identified by following works of Kanjilal et al. (1934-1940); Deb (1961 a, b); Singh, 2004; Singh et al. 2002; Sinha 1996). The plant's names were updated using the World Flora Online website. Detailed studies indicating the ethnobotanical importance as well as analysis of these 23 SGs have been covered in this study. Further, the present status, threats and revival measures were analyzed.

Data Collection

Extensive field survey of the 23 SGs was conducted between March 2022- April 2023. The reigning deity, diversity of plants, socio-cultural plants, and characteristics of these SGs were studied using observational study. Photos of four SGs of Manipur randomly selected can be seen in Fig. 3. In these photos, the sacred place of deity which is inside the respective SGs is noticeable. The data on ethno-medicinal plants and cultural importance in these SGs were collected using different data collection tools. For collecting data related to the cultural significance of the SGs from the community, semi-structured interview schedule was used and administered to the members of the committee or members of the particular family managing the SG or prominent members of the community (where there is no specific committee or family managing the SG) including elders who play a role in the affairs of the respective SGs. For collecting data related to the uses of the native plants in the SGs for ethno-medicinal purposes, Focus Group Discussion (FGD) method was used where the participants were traditional healers and *maibas* & *maibis* (Meitei priest and priestess respectively who perform rituals and rites in the sacred groves). The FGD tool was used because the collective traditional knowledge is not universal and most of this knowledge is passed on through oral tradition The participants of the FGDs were selected using purposive sampling method, where age and experience of the respondents selected from the corresponding SGs were given primacy. The legal aspects of the study have been conducted using doctrinal method (as described earlier). The coordinates of the 23 selected SGs were ascertained using Global Positioning System (GPS). The International Union for Conservation of Nature (IUCN) Red List of Ecosystems which measures the relative risks of ecosystem collapse for terrestrial, freshwater and marine ecosystems at subnational, national, regional and global scales has been used as a point of reference for categorizing the conservation status of the selected SGs.

Data Analysis

Ethno-medicinal data collected through semi-structured interviews and FGDs were analyzed using content analysis method to understand and identify various types of plant about their medicinal values. The data related to the frequency and diversity status of the plants in these SGs were collated and organized using MS Excel spreadsheet and thereafter analyzed. Based on the data collected through observational study of the SGs and their respective ecosystems, the degree of conservation have been classified using the IUCN Red List of Ecosystems as 'Endangered', 'Near Threatened' and 'Least Concern'.

Results

Ethnomedicinal Knowledge and SGs ecosystem services

In this study an inventory of 23 sacred groves were conducted. Within the scope of the study, general characteristics of the location were noted and related area distribution are highlighted in Table 1. It was found that out of the 23 SGs under study, 9 (39.1%) were Least Concern, 9 (39.1%) were Near Threatened and 5 (21.1%) were Endangered. More than 50 plants (with high medicinal values) with local names have been identified from the selected SGs. The diversity of indigenous ethnomedicinal, socio-cultural and Rare, Endangered and threatened plant (RET) species are still intact in some of the groves. Table (2) shows native plants found in various SGs of Manipur with their local names. Study area listed in the paper are habited by various indigenous medicinal and aromatics plants and the ethno-medicinal knowledge of these plants has enormous prospects for bio-prospecting and natural resources. The plant families of the reported 50 medicinal plants and the dominant family can be referred to from the word cloud in Fig. 4. In these SGs, dominant family is Leguminosae, and the dominant plants is herbs, maximum plant parts having ethno-medicinal value are leaves while other parts of some plants have high utility values. Indigenous plants particularly with many benefits need more attention in terms of its restoration and

conservation strategies. Phyto-chemical and pharmacological studies need to be conducted to validate the medicinal properties and to protect all the recorded ethnomedicinal plants.

Further, it has been observed that SGs provide enormous ecosystem services including biodiversity conservation; conservation related to various aspects like air, water etc. Tree cover helps in decomposition of litter and regulates temperature. Other aspects like seed dispersion, pollination, carbon sink and last but not the least as food and corridor for animals/ home for thousands of birds, reptiles and insects.

It helps in maintaining the ecological balance by the continued conservation of coexisting indigenous plants and animals. Owing to the presence of water bodies within or near to the SGs, it plays a key role in keeping up the hydrological balance (Parthasarathy et al. 2015). In Rajasthan, water bodies associated with sacred groves (*Orans)* meet the needs of livestock and local communities (Ray et al. 2014). Similar use of the water bodies is also visible in SGs of Manipur. Table 1 highlights the different aspects of Sacred Groves.

Sl. No.	Sacred Grove	District	Longitude	Ownership	Degree of disturbance	Conservation status
1.	Thanga Chingningthou Thanga	Bishnupur	93^0 49/ 52.13// E	Community land	Medium	Endangered
2.	Wangoo Tampha Lairembi	Bishnupur	93^0 50/ 51.30// E	Community land	High	Near threatened
3.	Chaning Larembi, Phoijing	Bishnupur	93^0 50/ 27.94// E	Community land	Low	Least concern
4.	Yangol Ningthou Ayangleima, Toubul	Bishnupur	93^0 47/ 37.63// E	Community land	High	Endangered
5.	Ibudhou Thonang Panganba, Lai Manou, Mayamba, Kha Potsangbam	Bishnupur	93^0 46/ 22.45// E	Community land	High	Near threatened
6.	Ibudhou Loiyalakpa, Terakhongshanbi	Bishnupur	93^0 44/ 55.08// E	Community land	Medium	Near threatened
7.	Ebudhou Marjing, Heinang	Imphal East	93^0 56/ 58.18// E	Reserve forest	High	Least concern
8.	Kongbu Maru	Imphal East	93^0 58/ 42.96// E	Reserve forest	Medium	Near threatened
9.	Ibudhou Awang Koubru, Kha Potsangbam	Imphal East	93^0 54/ 2.18// E	Community land	Medium	Least concern
10.	Ibudhou Panam Ningthou, Andro	Imphal East	94^0 00/ 44.39// E	Community land	Low	Least concern
11.	Hiyangthang Lairembi, Hiyangthang	Imphal East	93^0 54/ 36.74// E	Reserve forest	High	Near threatened
12.	Ema Nungthel Leima, Top Siphai	Imphal West	93^0 53/ 52.13// E	Community land	Medium	Endangered

13.	Ibudhou Loiyalakpa, Khaidem	Imphal West	93^0 49/ 59.71// E	Community land	High	Near threatened
14.	Ibudhou Korouhanba, Moidangpok	Imphal West	93^0 49/ 09.14// E	Community land	Medium	Least concern
15.	Konthoujam Lairembi, Konthoujam	Imphal West	93^0 51/ 09.77// E	Community land	Low	Least concern
16.	Ibudhou Koubru, Awang Sekmai	Imphal West	93^0 52/ 44.63// E	Community land	Medium	Near threatened
17.	Nongpok Ningthou Erum Ningthou, Langmeidong, Laimanai	Kakching	93^0 56/ 24.50// E	Community land	Medium	Least concern
18.	Mondum Mahadev, Mondum	Kakching	93^0 53/ 21.03// E	Reserve forest	Medium	Near threatened
19.	Malem Ema Nungthong, Shidabi, Serou	Kakching	93^0 54/ 40.89// E	Community land	High	Endangered
20.	Ebudhou Ekhan Chaoba, Wangbrel, Sungu	Kakching	93^0 52/ 28.49// E	Community land	High	Near threatened
21.	Kaina Poirou Khongjem Kana, Yairipok	Thoubal	94^0 00/ 54.39// E	Reserve land	High	Least concern
22.	Ibudhou Hokha Sorarel	Thoubal	93^0 58/ 57.35// E	Community land	High	Endangered
23.	Ibudhou Koubru, Kounu, Loyarakpa nungthel Leima, Phayeng	Imphal west	93^0 48/ 36.26// E	Reserve forest		Least concern

Table 1 Important highlights about some significant sacred groves of Manipur

Sl No.	**Botanical names of wild edible plants**	**Local name**
1.	*Aegle marmelos* (L.) Correa	Hei-khagok
2.	*Alangium chinense* (Lour.) Harms	Kokan
3.	*Albizia myriophylla* Benth.	Yangli
4.	*Albizia procera* (Roxb.) Benth.	Khok
5.	*Alnus nepalensis* D. Don	Pareng
6.	*Alocasia macrorrhizos* (L.) G. Don	Honghoo
7.	*Alpinia nigra* (Gaertn.) Burtt	Pullei
8.	*Antidesma bunius* (L.) Spreng.	Heiyen
9.	*Aphanamixis polystachya* (Wall.) R.Parker	Hei-rangoi
10.	*Ardisia sanguinolenta* Blume	U-thum
11.	*Artemisia nilagirica* (C.B.Clarke) Pamp.	Laibakngou
12.	*Artocarpus lacucha* Roxb. ex Buch.-Ham.	Heiri kokthong
13.	*Bauhinia variegata* L.	Chingtharao
14.	*Bischofia javanica* Blume	Uthum naroubi
15.	*Bombax ceiba* L.	Tera
16.	*Bombax insigne* Wall.	Khuman tera
17.	*Brasiiopsis bodinieri* (H. Leveille) J. Wen & Lowry	Chom
18.	*Butea monosperma* (Lam.) Kuntze	Pangong
19.	*Celtis timorensis* Span.	Heikreng
20.	*Centella asiatica* (L.) Urb.	Peeruck
21.	*Clerodendrum indicum* (L.) Kuntze	Charoi utong
22.	*Curcuma amada* Roxb.	Yai heinouman
23.	*Curcuma caesia* Roxb	Yaimu
24.	*Cynodon dactylon* (L.) Pers.	Tingthou
25.	*Dendrobium aphyllum* (Roxb.) C.E.C.Fisch.	Iyonglei
26.	*Dendrobium nobile* Lindl.	Yerumlei

27.	*Derris taiwaniana* (Hayata) Z.Q.Song	Gnamu yai
28.	*Dillenia indica* L.	Heigree
29.	*Engelhardia spicata* Lechen ex Blume	Linphop
30.	*Entada gigas* (L.) Fawc. & Rendle	Kang-khil
31.	*Equisetum ramosissimum*.subsp. debile (Roxb ex Vaucher) Hauke	Laiutong achouba
32.	*Erythrina variegata* L.	Kurao angouba
33.	*Eupatorium cannabinum* L.	Langthrei
34.	*Ficus hispida* L.f.	Ashi Heibong
35.	*Ficus racemosa* L.	Heibong
36.	*Garcinia pedunculata* Roxb. ex Buch.-Ham.	Heibung
37.	*Garcinia xanthochymus* Hook.f. ex T. Anderson	Heirangoi
38.	*Glochidion coccineum* (Banks) Mull.Arg.	Ningthourembi
39.	*Hedychium coronarium* J. Koenig	Takhelei angouba
40.	*Hedychium flavum* Roxb.	Takhelei
41.	*Hellenia speciosa* (J.Koenig) S.R.Dutta	Okchak khombi
42.	*Holigarna caustica* (Dennst.) Oken	Kherai
43.	*Holmskioldia sanguinea* Retz.	Kharom leishok
44.	*Justicia gendarussa* Burm.f.	Nongpok langthrei
45.	*Kaempferia galanga* L.	Yai thamnamanbi
46.	*Litsea glutinosa* (Lour.) C.B.Rob.	Thang-hidak
47.	*Litsea monopetala* (Roxb.) Pers.	Tutmila
48.	*Macaranga denticulata* Müll. Arg.	Lakoi
49.	*Mallotus philippensis* (Lam.) Mull.Arg	Ureirom-laba
50.	*Melastoma malabathricum* L.	Nura khudol lei
51.	*Melia azedarach* L.	Seizrak
52.	*Meyna spinosa* Roxb. ex Link	Heibi
53.	*Mucuna pruriens* (L.) DC.	Samu hawai

54.	*Nanorrhinum ramosissimum* (Wall.) Betsche.	Nungai peruk
55.	*Oroxylum indicum* (L.) Kurz	Shamba
56.	*Paederia foetida* L.	Uri oinum
57.	*Paris polyphylla* Sm.	Singpan
58.	*Pavetta indica* L.	Nongmangkha asinba
59.	*Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb.	Nongmangkha
60.	*Phyllanthus emblica* L.	Heikru
61.	*Phyllanthus urinaria* L.	Chakpa Heikru
62.	*Piper griffithii* C, DC.	Uchithi
63.	*Premna mucronata* Roxb.	Upongtha
64.	*Rhus chinensis* Mill.	Heimang
65.	*Rotheca serrata* (L.) Steane & Mabb.	Moirang khanum
66.	*Rubia cordifolia* L.	Moyum
67.	*Sapindus marginatus* Willd.	Kekru
68.	*Schima wallichii* Choisy	Ushoi
69.	*Scoparia dulcis* L.	Sabal yangli
70.	*Scutellaria discolor* Wall. ex Benth	Yenkhut
71.	*Senna timoriensis* (DC.) H.S.Irwin & Barneby.	Laiki
72.	*Sisyrinchium palmifolium* L.	Hoojam
73.	*Smilax lanceifolia* Roxb.	Kwamanbi
74.	*Solanum lasiocarpum* Dunal	Morokmaan
75.	*Stephania japonica* (Thunb.) Miers	Thang uri angouba
76.	*Stereospermum chelonoides* (L.f.) DC.	Meesi
77.	*Strobilanthes cusia* Nees	Kum
78.	*Syzygium nervosum* A.Cunn. ex DC.	Tom heinou
79.	*Syzygium praecox* (Roxb.) Rathakr. & N.C.Nair	Nongnangkori
80.	*Termialia arjuna* (Roxb.) Wight & Arn.	Mayokpha

81.	*Terminalia chebula* Retz.	Manahei
82.	*Terminalia myriocarpa* Van Heurck & Müll. Arg	Tolhao
83.	*Tinospora cordifolia* (Willd.) Miers	Ningthoukhongli
84.	*Toona ciliata* M. Roem.	Tairen
85.	*Trema orientalis* (L.) Blume	Lok-uri
86.	*Xylosma longifolia* Clos	Nongleishung
87.	*Zanthoxylum rhetsa* (Roxb.) DC.	Gnang
88.	*Zehneria scabra* Sond.	Lam thabi
89.	*Zingiber zerumbet* (L.) Roscoe ex Sm.	Tekhao yaikhu

Table 2 List of native plants found in various Sacred Groves of Manipur with their local names

Legal and Policies related to SGs

Conservation efforts duly complemented by law and policy frameworks play a crucial role in bringing effective outcomes (Cooney 2004). Often regulations which are protective as well as conservation based, safeguard habitats of endangered species, curb detrimental actions, and promote sustainable utilization of resources (Berrens 2001). India has shown concern towards conservation of natural sites by being party to international conventions and legislating national laws. Mention may be made of the International Labour Organization (ILO) Convention on Indigenous and Tribal Populations Convention, 1957 (No.107), Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change, UNESCO- World Heritage Convention) 1972, Forest (Conservation) Act, 1980, National Forest Policy 1988, Panchayats (Extension of the Scheduled Areas) Act, 1996, The Scheduled Tribe and other Traditional Forest Dwellers (Recognition of Forest Right) Act, 2006 etc. which have a bearing on the conservation and protection of forest, some of which house SGs.

India has ratified the Convention on Biological Diversity (CBD). The CBD has relevance with the protection of sacred sites (Chandrashekara & Sankar 1998). Article 8(j) of the Convention urges Parties to respect traditional knowledge and indigenous practices for the conservation of biodiversity (https://www.cbd.int/traditional/default.shtml). Subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.

India has enacted the Biological Diversity Act, 2002 (BDA) and the Biological Diversity Rules, 2004 (BDR) in furtherance of its obligations under the CBD. Biodiversity Management Committee (BMC) is envisaged to be constituted by every local body as per Section 41(1) of the BDA. BMC is obligated to maintain and validate Peoples' Biodiversity Registers (PBRs) under Rule 22(6) of the BDR. PBR contains comprehensive information found locally related to Bio-resources including landscape and demography of a particular area or village. In this

context, Bio-resources mean plants, animals and microorganisms or parts thereof, their genetic material and by-products (excluding value added products) with actual or potential use or value but do not include human genetic material. So far, 268031 PBRs have been documented in India (last updated on 23rd January 2024), out of which, only 199 have been indicated to be in the State of Manipur, which implies that PBR of the majority of the 365 SGs officially documented is still pending.

As per the International Union for Conservation of Nature (IUCN), thousands of sacred natural sites (SNS) are in jeopardy around the world despite the fact that many lie within formal Protected Areas (Press release dated 07 Oct, 2008 of IUCN-UNESCO). The position of SGs in India is no different. Research from India shows that SGs are significantly being reduced in size due to changes in culture, high pressure on land and the indiscriminate use of the natural resources that these groves contain (Malhotra, Kailash C. et al). Modernization, mechanization and globalization in the recent past has transformed and weakened both cultural and biological integrity (Kandari et al 2014). Most SGs are degraded due to shifts in belief systems, changing attitudes of people towards biodiversity conservation, the eroding of traditional values, the introduction of alien species, and development projects (Poreku 2014).

It may be noted that India ratified the Convention concerning the Protection of the World Cultural and Natural Heritage, 1972 (in short, World Heritage Convention) on November 14, 1977. It has succeeded in getting 43 sites listed in the World Cultural Heritage list till date. Out of these 43 sites, eight are basically natural sites. India has been submitting more sites for inclusion in the World Heritage list from time to time, one of which is Keibul Lamjao Conservation Area of Manipur - comprising of Loktak Lake, Pumlen Pat and Keibul Lamjao National Park, the associated Umang-lai or SGs. The basis for inclusion of Keibul Lamjao Conservation Area in the list, as provided by India, is founded on the claims of fulfilment of Criteria (v) (vii) (ix) and (x) of the World Heritage Convention (https://whc.unesco.org/en/tentativelists/6086/). As many SGs form part of natural sites in India, they may be potential "Cultural and Natural Heritage" sites. Detailed research of these SGs will be required to validate their inclusion in the list.

In view of the cultural, biological and ecological significance of SGs, it is important to regulate human conduct for their protection and conservation through laws and regulations. In the national context, the Indian Forest Act, 1927 was the first legislation enacted by the British colonial government and was meant to protect its interest in the forest thus disregarding the traditional rights of the communities to access the SGs in the forest. This injustice has been aimed to be undone to a great extent by the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

It is significant to note that the Forest (Conservation) Amendment Act, 2023 has inserted a Preamble that captures the importance of forests and emphasises upon achieving national targets and economic, social and environmental benefits, which indeed is a shift from the approach of the old Forest (Conservation) Act, 1980 i.e. restriction on the de-reservation of forests or use of forest land for non-forest purpose.

The management of forests are backed by many laws which are prohibitory and preventive in nature and have legal sanctions attached to them. For instance, The Manipur Forest Rules, 2021 which was passed by the Manipur Government in extension of its delegated powers under The Indian Forest Act, 1927. The Rules provide for provisions related to protection of reserved and protected forests from fire, hunting of certain animals etc. But whether these rules are applicable to SGs is uncertain as the rules nowhere mentions the word 'sacred groves' or describes such protected or reserved areas which may be inferred as SGs. The Indian Forest Act, 1927 also mentions Village forests that may be assigned to village communities for its management and for cattle trespassing. However, it is again open to interpretation whether these areas will cover SGs or not.

The analysis of present legal provisions in India as well as in the State of Manipur show that there are no specific laws that govern the management and protection of sacred groves per se. Many SGs are situated in forest; and

forest is an item in the Concurrent List of the Seventh Schedule of the Constitution of India. Therefore, both Parliament and the State Legislatures may make laws for the protection, conservation and management of forest. Parliament may make a broad law for exclusive protection and management of sacred groves and the State Legislature may enact State specific law on SGs, as the nature of SGs may be different from one State to another. Using the power to promulgate delegated legislation, the State Government may promulgate rules with further details for effective protection, conservation and management of the SGs. The aim behind framing such legislations should be to protect the biodiversity, ecological balance and sustainability to contribute towards mitigating climate change.

Although legal frameworks have demonstrated effectiveness to a certain level, tackling emerging environmental concerns and integrating scientific discoveries and community rights into conservation activities must undergo continuous evolution (Techera 2013b). The evolving jurisprudence of community rights in India with respect to such spaces is worth mentioning. The Supreme Court of India in *Orissa Mining Corporation Ltd vs Ministry of Environment & Forest & Ors*. (W.P.C. No. 180 of 2011) had examined the ecological and cultural impact of mining in Niyamgiri Hill, a sacred hill of Dhongria Kondh tribes of Odisha, India and recognised the cultural rights associated with it. *In Re: T.N. Godavarman Thirumulpad vs Union of India* [IA NO(S). 41723 of 2022 of W.P.C. No. 202 of 1995, decided on 18.12.2024], the Supreme Court recently held the *Orans*, the Sacred Groves of Rajasthan, as deemed 'forest' and legal protections applicable to forest shall be extended to them.

Discussion

Sacred Groves management

This study also reveals that SGs contribute significantly to the overall ecosystem health of Manipur. They regulate local hydrological cycles by protecting watersheds and facilitating groundwater recharge. The dense vegetation prevents soil erosion, stabilizes land, and maintains nutrient cycling. SGs also act as microclimatic stabilizers, moderating temperature and humidity levels in their surroundings. Importantly, the community-driven management practices associated with SGs often align with sustainable resource use and traditional ecological knowledge, promoting a harmonious relationship between humans and nature. The mature trees within these groves store significant amounts of carbon in their biomass, while the undisturbed soil beneath acts as a long-term carbon sink. SGs are thus vital in sequestering carbon and mitigating climate change.

The SGs of Manipur harbour diverse flora and fauna, many of which are endemic or rare. These SGs act as biodiversity hotspots, providing a refuge for species that might otherwise be threatened by habitat destruction. The traditional prohibitions against logging, hunting, and land conversion within these groves ensure minimal human disturbance, allowing ecosystems to thrive naturally. Studies of the selected SGs reveal the presence of medicinal plants, rare orchids, and endangered species, underlining their ecological importance. Furthermore, these SGs serve as genetic reservoirs, supporting ecological balance and resilience in the region.

In the context of North-East India, where deforestation and land-use change contribute to carbon emissions, SGs provide a critical counterbalance. Additionally, the SGs' role in preserving native vegetation aids in maintaining regional climate stability and resilience against climate-induced stresses. Currently, there is no universal approach to SGs management globally due to the significant variation in land rights systems. In India, for instance, forest ownership differs across and within states, such as Kerala. SGs are managed by various groups, including families, local communities, temple trusts, tribes, or the government. In 1905, the SGs of Kodagu, Karnataka, were transferred from the Forest Department to the Revenue Department, leading to a substantial decrease in area, from 15,506 hectares to 5,947 hectares (a 62% reduction) by 1985 (Kalam 1996). This decline occurred after the government took over management, displacing the local community, which no longer played a role in conservation efforts. Similarly, in Ratnagiri, Maharashtra, the Revenue Department assumed control over SGs, and during this

period, locals harvested trees to build temples (Burman 1995). The erosion of traditional beliefs, social changes, and inconsistent management further contributed to the degradation of many SGs. Once taboos are broken, people begin to degrade these areas.

Regarding the revival of SGs in Manipur, there are several opportunities, as it has community attachment and involvement from people of all ages. Every SG has a community or a community-based committee who manages and organizes rituals and other traditional practices. For instance, *Phoijing Awang Chaning Lairembi* Association is a community-based organization which manages *Changing Lairembi* [Fig. 3(c)] SG. These groves exemplify a harmonious bond between humans and nature, acting as biodiversity hotspots and sanctuaries for rare plant and animal species. They play a pivotal role in safeguarding the region's flora and fauna while serving as natural reservoirs that help to maintain ecological balance.

The socio-cultural bonding of the younger generation with the SGs is gradually declining. Raising awareness amongst the youths about the importance of these SGs, upkeep of the indigenous plants, restoration of culturally associated native plants, and eliciting their support in the restoration of the degraded SGs will ensure their sustenance in future. To effectively conserve and protect the rich biodiversity of SGs, active participation from local communities, NGOs, and Umang Lai committees is essential.

It may be noted that there are several SGs that are impossible to restore, most of which are in the urban areas. Specific plants which are highly associated with the rituals or deity were found in several groves. Special plantation drive of ethnobotanical important plants during the Lai Haraoba for restoration of vegetation should be made mandatory. Last but not the least, to undertake an in-depth study to analyze the potential SGs in building a sustainable future and policy for conservation.

Additionally, it is crucial to designate SGs as special protected areas due to their deep association with myths, legends, and cultural heritage. Any activity that affects the SG's pristine state, such as clearing of the vegetation in the grove should be banned.

SGs offer compelling evidence of successful biodiversity conservation when ownership is shared by the entire community. This model involves various stakeholders, including government and non-governmental organizations, temple committees, and local leaders, all collaborating for sustainable livelihood development. For example, in the Tafi Atome Monkey Sanctuary in Ghana, the community partnered with an NGO to promote ecotourism, supporting the conservation of their SG traditions (Ormsby and Edelman 2010). Similarly, the Applied Environmental Research Foundation (AERF) has worked for over 15 years SGs conservation in the North Western Ghats.(Godbole et al. 2010).

Sacred Natural Sites (SNS) and its conservation strategies

Sacred Natural sites (including SGs) are gradually gaining attention of and collaborations (Alison Ornsby, 2011) among the international bodies such as IUCN and UNESCO thus leading to the formulation of guidelines for their management (Wild & McLeod 2008), constitution of a Specialist Group on Cultural and Spiritual Values of Protected Areas (CSVPA) of IUCN to illicit input on policies and figures in the World Heritage growing concern of biodiversity loss is three-pronged: firstly, high density of flora and fauna vis-à-vis the area (Bhagwat and Rutte 2006) [findings of Kulkarni et al (2018) that SGs situated in a distance of 2.5 km exhibited 70% difference of species]; secondly, the only culturally and religiously protected natural space; thirdly, loss of biodiversity from the SNS/SGs has far reaching impact on the social, cultural, economic as well as ecological balance. In today's context sophisticated modern technologies can be used to include spatial data, GIS etc. to understand tree cover loss, forest cover loss etc. The need to preserve SGs as it is, without adverse anthropogenic intervention, has been advocated (Ray et al 2014).

Many UNESCO World Heritage Sites contain sacred forests, mountains, and springs (Robson & Berkes 2010; Schaaf & Rossler 2010). There has been growing collaboration and intersection between international bodies such as the IUCN, UNESCO, and the Convention on Biological Diversity with regard to sacred sites (Alison Ornsby 2011)

In the present study, we have focused merely on the collection of different medicinal and aromatic plants found in the selected SGs and have analyzed the geographical distribution which is within the scope of this study. A lot can be done in terms of further research clearly focusing on different aspects like molecular studies, anthropological aspects, ecological aspects, legal aspects just to name a few. The distribution in Fig. 5 indicates that it can be one of the most practical microclimatic regions mitigating climate change tremendously. It is high time to have thorough research based studies which should be beyond studying only the physiological and geographical aspects of these natural ecosystems.

Unfortunately, North-East India even though it is known for its rich natural biodiversity till today remains an underrepresented region in terms of research based documentation. This present review can be the stepping stone to pursue detailed studies of SGs in future.

Respecting, acknowledging, and learning from cultural traditions can greatly enhance the conservation of nature and biodiversity, offering a more sustainable approach than relying solely on laws or government regulations (Shengji 2010).

Although SGs are often small in size, they are home to rich biodiversity and hold significant cultural and ethnobotanical value (Negi et al. 2018; Onyekwelu and Olusola 2014; Parthasarathy and Naveen Babu 2019). Given their importance for conservation, it has been proposed that SGs be integrated into existing protected area networks to further enhance their role in preserving biodiversity (Bhagwat and Rutte 2006; Avtzis et al. 2018). Close to 70% of existing data comparing biodiversity in SGs to a nearby forest originated from India (Sullivan et al. 2023).

The experiences and best practices in the conservation of SGs in different states of our country may be utilized in Manipur to formulate holistic ways that could seep into the community gradually. A non-religious incentive approach is needed, one that includes the government and other stakeholders, focusing on teaching the ecological importance and benefits of preserving these SGs in their pristine state. Such efforts could inspire the local community to protect the remaining natural areas and restore the degraded portion, to the extent possible.

It is noticed that PBRs have played an instrumental role in conserving biodiversity of habitats of small to large communities. Likewise, it is urged that ‘Sacred Groves Register’ may be specifically created through enactment of a law considering the immense importance of SGs.

Way forward

Despite their ecological and cultural significance, sacred groves in Manipur are under threat from urbanization, agricultural expansion, and shifting socio-cultural values. Encroachments and reduced adherence to traditional conservation norms weaken their protective status. To address these challenges, there is a need for a multi-pronged approach that include:

- **Strengthening Community Engagement**: Revitalizing cultural and religious connections to sacred groves through awareness programs and participatory management initiatives.

- **Policy Support**: Integrating sacred grove conservation into broader biodiversity and climate policies at state and national levels.
- **Sacred Groves Register (SGR):** Creating a register only for Sacred Groves to have a dedicated database of everything related to SGs of our country.

- **Scientific Research**: Conducting systematic studies on the ecological functions of sacred groves to support evidence-based conservation strategies.

- **Sustainable Livelihoods**: Encouraging ecotourism and sustainable livelihoods that align with the preservation of sacred groves.

Conclusion

This study has brought to the fore not only the cultural and spiritual importance of SGs but also their role in maintaining biodiversity, increasing carbon sink and ecological balance in the context of today's world. Breaking cultural taboos or losing faith in belief systems often leads to degradation of these natural ecosystems. Therefore, alongside legal protections, there's a need to emphasize the cultural significance of these groves to encourage local communities to safeguard them. The SGs of Manipur exemplify a unique blend of cultural heritage and ecological stewardship. By conserving biodiversity, supporting ecosystem functions, and contributing to climate mitigation, they offer a sustainable model for integrating traditional knowledge with modern conservation efforts. Preserving these groves is not only crucial for the environmental health of the region but also for sustaining the cultural identity and ecological wisdom of its communities.

To preserve the functional values of these groves, effective conservation and management practices are urgently needed. These groves hold significant research potential for in situ conservation of rare, endangered, and threatened plant species. It is crucial to raise public awareness about the importance of these SGs, prohibit developmental activities, and implement a complete ban on tree felling or the removal of any vegetation from these sacred areas except the invasive species and replacing them with native species. This conservation effort may be enhanced by way of enacting a special law for the protection and management of SGs and its effective implementation. The introduction of the protected area category community reserves under the Wildlife (Protection) Amendment Act, 2002 has introduced legislation for providing government protection to community held lands, which could include SGs. However, a unique or specific policy safeguarding SGs solely is the need of the hour. Additionally, raising awareness about the value of SGs in the current context, along with the potential for their sustainable use and direct benefits, can significantly enhance community participation. Since management practices and rituals differ across states, the government of Manipur could introduce an act tailored to the state's specific needs. The primary goal should be to protect rare, endangered, and threatened plant species in the face of global warming and climate change.

As Manipur falls under Indo-Burma biodiversity hotspots, the rich biodiversity would be degraded if there is lack of strategic conservation policies and efforts. Despite their small sizes, SGs harbour diverse habitats and serve as repositories for plant and animal diversity, including medicinal plants and endemic species. Effective conservation involves multiple stakeholders — government bodies, NGOs, Umang Lai committees (or similar organizations) or community leaders (as the case may be) — working together with local communities. Local people especially the youth should be involved and trained in conservation practices. Efforts to conserve SGs require a holistic approach that acknowledges their cultural significance, involves local communities, integrates traditional knowledge with modern conservation practices, and collaborates with various stakeholders, locally, nationally and internationally, for effective and sustainable biodiversity conservation. Collaborative efforts show positive outcomes in biodiversity inventories, co-management strategies, restoration initiatives, and improved statuses of SGs. Raising

awareness, engaging in participatory management planning, fostering local understanding, and conducting comprehensive evaluations of plant resources are crucial for the long-term preservation of these groves.

Author Contributions

B.D. prepared the main manuscript. K.R. co-wrote and revised the manuscript. Fieldwork was conducted under the guidance of D.S.N. & B.S.C., and N.I.S. assisted in the field survey work. All authors reviewed the manuscript and gave final approval for publication.

Data availability

No datasets were generated or analyzed during the current study.

Declarations

Conflict of Interest The authors declare no conflict of interest

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