Biodiversity and Conservation **14:** 1541–1582, 2005.
DOI 10.1007/s10531-004-0530-5

Sacred groves of Manipur, northeast India: biodiversity value, status and strategies for their conservation

ASHALATA DEVI KHUMBONGMAYUM[1], M.L. KHAN[1,*] and R.S. TRIPATHI[2]

*[1]Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791-109 (Itanagar), Arunachal Pradesh, India; [2]Department of Botany, North-Eastern Hill University, Shillong 793-022, Meghalaya, India; *Author for correspondence (e-mail: khanml@yahoo.com; fax: +91-360-2257872/2244307)*

Received 20 August 2003; accepted in revised form 26 January 2004

Key words: Biodiversity value, Conservation status, Manipur, Sacred grove, Socio-cultural aspects, Tree diversity

Abstract. The people of Manipur, a state in northeast India, follow ancestral worship and animism in the form of deity worship, with the central focus on worship in forest patches. The beliefs and taboos associated with the Sylvan deities (*Umanglais*) in the forest patches are restricted to any sort of disturbance of flora and fauna. These social boundaries help to conserve the entire organism as a whole, which stand the concept of sacred groves. The pleasing of deities is performed every year by the *Meiteis*, a dominant community of Manipur, in honour of the deities and to gain their favour. Indigenous cultural and rituals practices of the local people in sacred groves serve as a tool for conserving biodiversity. Sacred groves are distributed over a wide ecosystem and help in conservation of rare and endemic species. Well-preserved sacred groves are store houses of valuable medicinal and other plants having high economic value, and serve as a refuge to threatened species. One hundred and sixty-six sacred groves were inventoried in Manipur valley that comprises Imphal east, Imphal west, Thoubal and Bishnupur districts of the state. Detailed studies were carried out in four selected sacred groves, to know the importance of biodiversity status and vegetation characteristics. A total of 173 plant species representing 145 genera under 70 families were recorded through baseline floristic survey. The species diversity indices were compared among the four studied groves. The vegetation composition and community characteristics were recorded. Ethnobotanical uses of species were examined, which reveal that 96% of the species were used as medicine for the treatment of various ailments. Utilization of herbal medicine by the *Meiteis* is closely related to the cultural and ritual practices. A few of the medicinal plants which have disappeared from the locality are now confined only to the groves. Socio-cultural aspects were investigated taking into account the attitudes of local people, which indicate social beliefs and taboo are eroding, simultaneously degrading the degree of protection of sacred groves. Therefore, conservation measures of sacred groves need to be formulated considering the factor of degradation and the basic necessities of the local people. Until and unless a viable option is provided to the local people (especially those who habitat nearby the adjoining areas) for sustaining their economic condition, no step for conservation of biodiversity will be successful.

Introduction

The phenomenon of beliefs in sacred groves is ancient. The tract of virgin forest harbouring rich biodiversity, protected by the local people based on the

ground of indigenous cultural and religious beliefs, and taboos is called sacred grove. They are the repositories of rare and endemic species and can be regarded as the remnant of the primary forest left untouched by the local inhabitants and protected by them due to the belief that the deities reside in these forests. Many scholars have described sacred groves in different ways; however, one fact is evident that wherever sacred groves existed, indigenous traditional societies having spiritual relationships with the existing physical environment sustained them. The role of sacred groves in the conservation of biodiversity has long been recognized (Kosambi 1962; Gadgil and Vartak 1976; Haridasan and Rao 1985; Khan et al. 1997). All forms of vegetation in the sacred groves are supposed to be under the protection of the reigning deity of that grove, and the removal of even a small twig is taboo (Vartak and Gadgil 1973).

It is believed that sacred virgin forests date back to several thousands of years when human society was in the primitive state. Gadgil and Vartak (1975) have traced the historical link of the sacred groves to the pre-agricultural, hunting and gathering stage of societies. Hughes and Chandran (1997) have presented an overview on the distribution of sacred groves around the earth – in Africa, Asia, Europe, Australia and America. A document of MAB (1995) has described sacred groves in Ghana, Senegal, and Sumatra. In India the earliest documented work on sacred groves is that of the first Inspector General of Forests, D. Brandis (1897). Seventy-five years later, in 1973, Professor Madhav Gadgil and Dr. V.D. Vartak conducted floristic and ethnobotanical studies on the sacred groves of Maharashtra. The existence of sacred groves all along the Himalayas from the northwest to northeast, west Himalayas of Kumaon and Garhwal, Darjeeling and Meghalaya has been reported by Burman (1992). Further, Ramakrishnan (1996) also reported sacred groves from different parts of India, known by the different names given to them in ethnic terms. A large number of sacred groves were reported from the north-eastern states of India viz., Meghalaya, Manipur and Karbi Anglong area of Assam (Tripathi 2001). Many scholars have been working on conservation of sacred groves through socio-cultural practices in different parts of India (Gadgil and Vartak 1975 and 1976; Boojh and Ramakrishnan 1983; Khiewtam and Ramakrishnan 1989; Rodgers 1994; King et al. 1997; Tiwari et al. 1998; Sinha and Maikhuri 1998; Sunitha and Rao 1999; Basu 2000; Kushalapa et al. 2001). Studies on the floristic composition of the sacred groves, occurring in different parts of India, have been conducted (Hajra 1975; Balasubramanyan and Induchoodan 1996; Khan et al. 1997; Boraiah et al. 2003; Kumar and Swamy 2003).

However, little information is available on sacred groves and conservation of the biodiversity in Manipur, a state in northeast India (Devi 2000; Singh 2001). People of Manipur follow ancestral worship and animism in the form of deity worship, with the central focus of worship on forest patches which signify sacred groves. The area of sacred groves range from a few square meters to several hectares situated in different altitudinal gradients and

natural ecosystems which help in conservation of biodiversity. But unfortunately, due to population explosion, various anthropogenic pressures and developmental activities, sacred groves have also become the victim of encroachment and exploitation, though the extent of degradation in the sacred groves is less when compared with the other forests. Degradation of groves not only signifies loss of rich and relict vegetation but also the loss of rich cultural diversity. Therefore, it has become an urgent need to make an extensive inventory of the groves, their biodiversity and ethnobotanical importance, and analyse the role of associated cultural and religious beliefs, and taboos in their conservation.

In the present study, an attempt has been made to document and analyse the vegetation composition and ethnobotanical uses of plant species in sacred groves of Manipur. People's attitudes towards the sacred groves were investigated to find out the causes of degradation and to develop strategies for their conservation.

Materials and methods

Descriptive features of Manipur

Geographical profile

Manipur is situated in the extreme north-eastern corner of India and lies between 23°80′N and 25°68′N latitudes and 93°03′E and 94°78′E longitudes. The state is bounded on the east by the Somra tract and the upper Chindwin areas of Myanmar, on the west by the Cachar hills of Assam, on the north by the Naga Hills of Nagaland, and on the south by the Chin hills of Myanmar. The total geographical area of the state is 22,327 km^2. It is predominantly a mountainous state with a central bowl-shaped valley formed by the deposits of alluvial soil. The state can be divided into two major regions namely the central valley with an area of 2230 km^2 (10.02%), at the elevation of 750–900 and the surrounding mountain covering an area of 20,089 km^2. The Imphal basin covers an area of 1813 km^2.

Socio-economic and cultural aspects

As per the population enumeration of the census of India 2001, the population of Manipur stood at 2,388,634 persons (representing 0.23% of the total population of India), which shows that the population density per square kilometer increased from 82 in 1991 to 107 in 2001. The state has 29 scheduled tribes, 7 scheduled castes, *Meitei pangals* (Manipuri Muslims) and *Meitei* community. As per the 1991 Census of Manipur, the population of the plain/valley accounts for 66.6%, while 33.4% population remains in the vast hills of the state. *Meitei* or Manipuri (non-tribal) community dominates the

plain/valley areas, accounting for about 52% of the population and maintains most of the sacred groves of Manipur. A small population of *Meitei Pangals* or Muslims (non-tribal) contribute to 12% of the plain habitants. The literacy rate is 68.97%. Linguistically, the people of Manipur are polyglot. The majority of Meiteis are Hindu by faith. However, a large chunk of the Meiteis follows their synthesized form (pre-Hindu and Hindu) of religion whereas a good section of them practices their pre-Hindu religion. Most of the tribal people of Manipur who inhabit the hilly districts follow Christianity.

Ecological profile

Manipur, by virtue of its physical characters, is graced with rich floral and faunal resources. There are different types of forests ranging from the tropical to the subalpine. Since Manipur belongs to the region which is located at the confluence of two tectonic plates (the Burmese and Indian), the region has been the Vavilovian centre of origin of a variety of angiospermic plants and is a component of the trans-Himalayan Geological formation from the Tethys sea in the Archaean period (about one billion years ago). The soils of the state belong to two major types, residual and transported, which cover the hill areas and the central valley, respectively (Vedaja 1998). The climate of the area is monsoonic with warm moist summers and cool dry winters. Mean annual rainfall is ca. 1400 mm, most of which is received during May to September. Except in winter, when the temperature occasionally drops to 0 °C, the climate is conducive to the luxuriant growth of plants.

Inventory of sacred groves

An extensive field survey was undertaken to inventorise the sacred groves of Manipur during 2000–2002. Records of the local government and literature were consulted to locate the groves and to ascertain their historical background. Traditional institutes such as village headmen, *Maiba* and *Maibi* (priests and priestesses or the local medicine men and women, respectively), and local people, educated persons, caretakers of the sacred groves etc. were contacted for identifying sacred groves in the territories under their control or in their knowledge. Data on sacred groves were collected from them through informal and formal interviews and by observing the groves.

The identified groves were listed accordingly. Most of the sacred groves were open and did not have well-demarcated boundaries, and therefore, the area measured for a given grove was mainly based on the information collected from the concerned village headman or caretaker of the grove and through measurement based on an imaginary line or boundary (using the knowledge of the caretaker or village headman or some authentic person) around the grove.

Table 1. Distribution of sacred groves in different locations.

Location	Total number of sacred groves	Total area (ca. ha)
Valley	145	40.99
Near catchment area /river banks	4	5.75
Hillocks	7	69.53
Hills	4	57.13
Foothills	6	2.22
Total	166	175.62

We inventoried 166 sacred groves from the Imphal East, Imphal West, Bishnupur and Thoubal districts of Manipur. Location, area, altitude etc. of each sacred grove were recorded. The area of the individual sacred groves varied from 11.14 m^2 (0.001ha) to 40 ha within the elevation of 691–860 m. A total of 145 groves were inventoried in the valley, six in the foothills, seven in the hillocks and four each near catchment area or river banks and hills (Table 1). Their distribution in varied locations/ecosystem not only helps in the conservation of a variety of valuable medicinal plants but also fostered rare and endemic plant and animal species. Besides, the sacred groves provide a number of ecosystem services such as reduction in erosive force of water, control of mass movement from upper reaches, availability of water of desired quality and natural dispersal of seeds of useful species.

Based on the inventory and preliminary survey, four sacred groves were selected from Imphal East and Imphal West districts for the purpose of detailed studies on floristic composition and ethnobotanical importance. Their selection was done taking into consideration their size, vegetation and location. The selected sacred groves are: Konthoujam Lairembi, Mahabali (Mongba Hanba), Langol Thongak Lairembi and Heingang Marjing. All these have sub-tropical forests as their dominant vegetation. The location of selected four sacred groves is shown on the map of Manipur (Figure 1). The general and physico-chemical characteristics of the four selected sacred groves are described in Tables 2 and 3.

Table 2. General characteristics of the selected sacred groves.

Sacred grove	Locality	Area (ca. ha)	Altitude (m)	Aspect and position	Deity resides
Konthoujam Lairembi (I)	Konthoujam	1.41	711	West–Valley	Tampha Lairembi
Mahabali (II)	Imphal	5.05	710	Central Valley	Mongba Hanba
Langol Thongak Lairembi (III)	Langol	5.05	800	North-West Hill base	Langol Ashithel Ema Thongak Lairembi
Heingang Marjing (IV)	Heingang	7.08	834	North-Hill base	Ebudhou Marjing

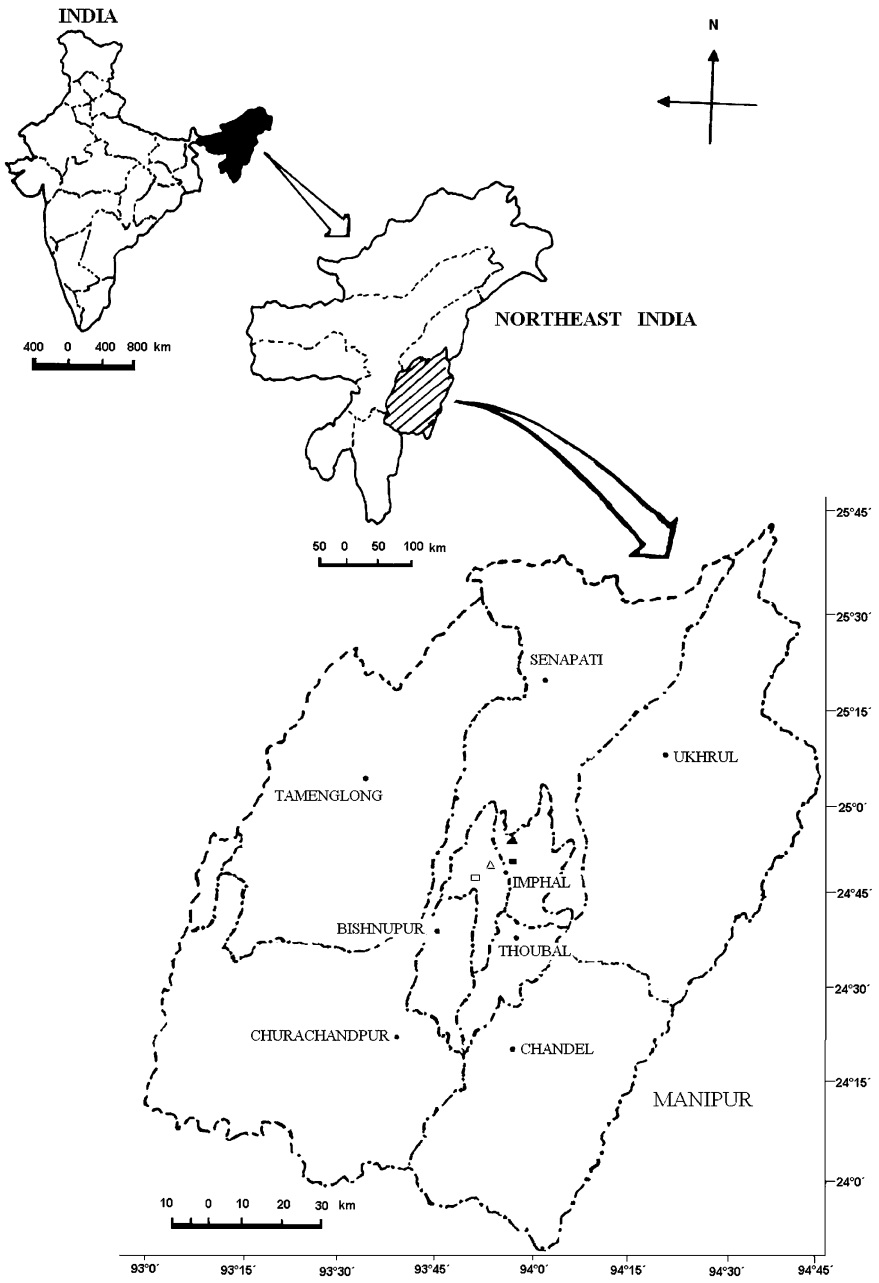

Figure 1. Map of Manipur showing the location of selected groves for the study. □ – Konthoujam Lairembi, ■ – Mahabali (Sacred groves located in plain), and △ - Langol Thongak Lairembi, ▲ – Heingang Marjing (Sacred groves located in hill).

Table 3. Physico-chemical characteristics of soils of the selected sacred groves.

Parameters	Sacred grove			
	Konthoujam Laairembi (I)	Mahabali (II)	Langol Thongak Lairembi (III)	Heingang Marjing (IV)
pH	5.68	6.59	5.4	5.88
Water holding capacity (%)	44.67	40.32	42.1	38.84
Soil moisture (%)	39.45	39.18	38.4	32.96
Soil texture				
Clay (%)	2.00	3.00	10.00	5.50
Silt (%)	20.00	18.00	21.50	17.25
Sand (%)	78.00	79.00	68.50	77.25
Organic carbon (%)	5.37	5.23	4.85	4.88
Total Kjeldahl Nitrogen (%)	0.04	0.04	0.02	0.01

Methodology

Phytosociological studies were carried out during 2001–2002 by quadrat method. Forty quadrats of 10 m × 10 m were laid randomly in each grove for trees (≥ 30 cm gbh). Twenty quadrats of 5 m × 5 m for shrubs and 20 quadrats of 1 m × 1 m size for herbs were laid within the same 10 m × 10 m quadrats that were laid for the study of trees. Density (trees ha^{-1}) and basal area values were calculated for each tree species. Importance Value Index (IVI) of each species was calculated as per Misra (1968). The similarity index (Sorensen 1948), species diversity index (Shannon and Weiner 1963), concentration of dominance of the community (Simpson 1949), species richness index (Menhinick 1964) and evenness index (Pielou 1969) were calculated using the formula as given in the references cited above.

Similarity index (Sorensen 1948)

$$\text{Similarity index} = \frac{2C}{A+B} \times 100$$

where C is the number of species common to two releves, A is the total number of species in releve A and B is the total number of species in releve B.

Shannon–Weiner diversity index (Shannon and Weiner 1963)

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

where, H' is the Shannon–Weiner diversity index, p_i is the proportion of individuals in the ith species i.e. (ni/N).

Table 4. Floristic composition of four sacred groves of Manipur.

Family	Genera	Species
Acanthaceae	3	3
Adiantaceae	1	3
Amaranthaceae	2	2
Anacardiaceae	5	7
Apiaceae	2	2
Araceae	2	2
Araliaceae	2	2
Asclepidiaceae	1	1
Asteraceae	11	11
Basellaceae	1	1
Betulaceae	1	1
Bignoniaceae	1	1
Bombacaceae	1	1
Boraginaceae	2	2
Brassicaceae	1	1
Caesalpiniaceae	2	3
Caprifoliaceae	1	1
Caryophyllaceae	1	1
Combretaceae	1	1
Commelinaceae	1	1
Convolvulaceae	1	1
Cornaceae	1	1
Cucurbitaceae	1	1
Cyperaceae	1	1
Dioscoreaceae	1	2
Elaeocarpaceae	1	1
Euphorbiaceae	5	6
Fagaceae	3	3
Flacourtiaceae	2	2
Iridaceae	1	1
Juglandaceae	1	1
Lamiaceae	1	1
Lauraceae	3	6
Liliaceae	2	2
Malvaceae	2	2
Melastomaceae	1	1
Meliaceae	3	3
Menispermaceae	1	1
Mimosaceae	5	8
Moraceae	2	7
Myrsinaceae	2	2
Myrtaceae	4	5
Oleaceae	2	2
Orchidaceae	2	3
Oxalidaceae	1	1
Palmae	1	1
Papilionaceae	2	2
Pinaceae	1	1
Piperaceae	1	1

Table 4. Continued.

Family	Genera	Species
Plantaginaceae	1	1
Poaceae	7	7
Polygonaceae	2	2
Pteridiaceae	1	1
Ranunculaceae	1	1
Rhamnaceae	1	1
Rosaceae	3	3
Rubiaceae	8	11
Rutaceae	2	2
Santalaceae	1	1
Saurauiaceae	1	1
Schizaeaceae	1	2
Scrophulariaceae	1	1
Solanaceae	3	3
Theaceae	1	1
Tiliaceae	1	1
Ulmaceae	2	2
Verbenaceae	7	8
Violaceae	1	1
Vitaceae	2	2
Zingiberaceae	2	2

Simpson's index (Simpson 1949)

$$\mathrm{Cd} = \sum_{i=1}^{s} (p_i)^2$$

where p_i is the same for the Shannon–Weiner diversity index (Shannon and Weiner 1963).

Species richness index (Menhinick 1964)

$$\text{Species richness index} = S/\sqrt{N}$$

where S is the total number of species and N the number of individuals.

Evenness index E (Pielou 1969)

$$E = H'/\ln S$$

where H' is the Shannon–Weiner diversity index and S the total number of species.

An ethnobotanical survey was carried out to collect information on the uses of plants in medicinal and other purposes by local people who reside near the sacred groves. Detailed information on medicinal plants was gathered from the medicine-men known as '*Maibas*' to whom the knowledge was passed on from their ancestors. Other ethnobotanical data were prepared, including the collection of information through folk, oral tradition, etc. and voucher specimens were made as per Jain and Rao (1977).

Results and discussion

Vegetation of four selected sacred groves

Diverse habitats harbour a variety of plant species and they are used by humans in many ways. The floristic composition varied across the four sacred groves (Table 4). This may be due to the variation in edaphic factors, microclimate and biotic interferences among the groves. Though there is no sharp boundary, vegetation of the groves is restricted to the grove alone and has not expanded to the adjoining areas. It may be due to the poor natural regeneration in the peripheral area (Khiewtam 1986) or lack of appropriate conditions for the species to establish themselves. A total of 173 species representing 145 genera under 70 families with two unidentified species were recorded. Of these, 81 species were trees representing 59 genera under 33 families. One species was a liana of Mimosaceae from grove I. Twenty-four species were shrubs belonging to 14 families and 23 genera. Sixty-two species were herbs representing 34 families and 58 genera. Six species were pteridophytes representing three genera under three families. Out of the total vascular plants, angiosperms contributed the highest (95.9%), followed by pteridophytes (3.5%) and gymnosperms (0.58%). Among the angiosperms, dicotyledons were the dominant component (92.5%) in the four groves. The percentage composition of angiosperms is close to the 94% of angiosperms recorded in the sacred groves of Meghalaya, northeast India (Jamir and Pandey 2002).

The maximum number of species was found in the family Asteraceae and Rubiaceae (11 each) followed by Mimosaceae and Verbenaceae having eight species each. Among the tree species, Rubiaceae was the dominant family with eight species in the four sacred groves. Co-dominant family was Mimosaceae with eight species followed by Anacardiaceae and Moraceae with seven species each. The family Verbenaceae with seven shrub species was the dominant family among shrubs. Asteraceae having nine herbaceous species was the dominant family for herbs followed by Poaceae which had seven species belonging to seven genera. Species richness of the two groves in the hills was less in comparison with the two groves in the plains. The vegetation of the four groves can be classified into four vertical strata: canopy, sub canopy, shrub and

Table 5. Species similarity (based on Sorensen similarity index (%)) among the selected sacred groves.

Sacred grove	Mahabali (II)	Langol Thongak Lairembi (III)	Heingang Marjing (IV)
Konthoujam Lairembi (I)	28.57	26.87	24.82
Mahabali (II)	100	16.51	14.29
Langol Thongak Lairembi (III)		100	44.04

Table 6. Similarity (based on Sorensen similarity index (%)) among the tree, shrub and herb species occurring in the selected sacred groves (T – trees, S – shrubs, H – herbs).

Sacred grove	Mahabali (II)			Langol Thongak Lairembi (III)			Heingang Marjing (IV)		
	T	S	H	T	S	H	T	S	H
Konthoujam Lairembi (I)									
T	36.92	–	–	23.19	–	–	24	–	–
S	–	30	–	–	42.11	–	–	23.53	–
H	–	–	19.23	–	–	26.09	–	–	22.22
Mahabali (II)									
T				8.16	–	–	12	–	–
S		–		–	31.58	–	–	23.53	–
H				–	–	17.39	–	–	13.33
Langol Thongak Lairembi (III)									
T					–		51.85	–	–
S		–			–		–	50	–
H							–	–	30.77

herb layer. *Ficus benjamina*, *Ficus benghalensis* etc. formed the canopy layer. *Quercus serrata*, *Schima wallichii*, *Machilus* sp. etc. occupied the sub canopy layer. The third layer is constituted of shrubs and saplings of trees. Grasses, herbs, creepers, ferns, and seedlings of trees occupied the ground vegetation. *Pinus kesiya* dominated the two groves in the hills. *Saprosma* sp. and *Machilus* sp. dominated groves I and II, respectively.

The present study shows less diversity of species in comparison to the sacred groves of Meghalaya (Tiwari et al. 1998). It may be due to the difference in altitude and climatic conditions. The variation in the altitude largely affects the floristic composition, at the same time bioclimatic and edaphic factors also influence vegetation types. It may also be mentioned here that the sacred groves occurring in Meghalaya are larger in size compared to groves in Manipur (Tiwari et al. 1999).

Vegetation analysis of individual sacred groves

Konthoujam Lairembi sacred grove

In the Konthoujam sacred grove, 44 woody species belonging to 36 genera under 22 families F (IValong with one unidentified species were recorded. Based on the contributed IVI values of species (in parenthesis), dominant species were assigned. Among tree species, *Ficus benjamina* was dominant (59.33) followed by *Saprosma* sp . (29.74), *Mangifera indica* (17.75) and *Ligustrum robustum* (15.38). *Ficus benjamina* with the density of 13 individuals

(ha^{-1}) scored the highest basal area (21.2 m^2 ha^{-1}) than the *Saprosma* sp. (1.16 m^2 ha^{-1}) having 54 individuals (ha^{-1}). This may be due to the fact that the individuals of *Ficus benjamina* are mature and have a larger girth. The emergent *Ficus benghalensis* and *F. benjamina* occupy the canopy layer. One liana, *Entada scandens* was recorded in this grove. Ten species of shrubs belonging to 10 genera under 7 families were recorded in this grove. *Jasminum pubescens* (IVI: 51.38) and *Lantana camara* (IVI: 42.86) were the dominant shrubs. Shrubs having medicinal values found in this grove include *Clerodendrum viscosum*, *Lantana camara*, *Mussaenda glabra* etc. The grove is rich in ground vegetation having 26 species of herbs representing 24 genera belonging to 20 families. The herbs were dominated by *Panicum patens* (IVI: 27.22), *Eclipta prostrata*(IVI: 22.37), *Muscari commutalum* (IVI: 20.46) and *Adiantum* sp. (IVI: 20.01). *Curcuma* sp., *Paederia foetida* and many other useful medicinal herbs are confined to this grove. Various fungi were found growingon the litter and decaying woods of the forest floor . The red fungi are found abundantly in this grove during summer.

Mahabali sacred grove

Twenty woody species of 17 genera in 11 families were recorded in the Mahabali sacred grove. Based on the contributed IVI values *Machilus* sp. (52.37) was dominant species and *Vanguirea spinosa* (43.29), *Ficus hispida* (44.12), *Ficus glomerata* (43.4) were co-dominant. Among these *Ficus glomerata* contributed highest basal cover 9.61 m^2 ha^{-1} with 37.5 stems ha^{-1}, followed by *Machilus* sp. (7.59 m^2 ha^{-1}) with 85 stems ha^{-1}. Ten species of shrubs belonging to six families were found in the grove. *Datura suaveolens* and *Vitex trifolia* are important medicinal shrubs. The dominant shrubs include *Glycosmis arborea* (IVI: 75.99) followed by *Lantana camara* (IVI: 46.58) and *Jasminum* sp. (IVI: 36.64). Monkeys are fond of the fruits of *Glycosmis arborea*. The ground vegetation was represented by 26 species of herbs of 25 genera belonging to 23 families. *Dactyloctenium aegyptium* was the dominant shrub (IVI: 32.55), followed by *Mikania micrantha* (IVI: 24.58) and *Ranunculus scleratus* (IVI: 24.43) and *Habenaria* sp. (IVI: 23.91). Important medicinal herbs found in this grove are *Melothria maderaspatana*, *Houttuynia cordata*, *Gynura cusimbua*, *Dioscorea bulbifera* etc. The Mahabali grove is not only rich in flora but is also the home of arboreal mammals like monkeys, flying fox, birds etc.

Langol Thongak Lairembi sacred grove

Twenty-four woody species belonging to 21 genera under 16 families were recorded in this grove. *Pinus kesiya* (IVI: 176.27) is the dominant tree species, followed by *Schima wallichii* (IVI: 25.57) and *Pasania polystachya* (IVI: 16.80).

The young leaves of *Schima wallichii* and inflorescences of *Wendlandia tinctoria* are used as vegetables. Shrubs were represented by nine species of nine genera in seven families. *Melastoma malabathricum* (IVI: 47.12), *Lantana camara* (IVI: 44.05) and *Callicarpa macrophylla* (IVI: 37.20) were the dominant shrubs. *Artemisia nilagirica*, *Eupatorium odoratum* etc. are used as medicine. Herbs were represented by 20 species in 19 genera and 12 families. Based on IVI values, *Eupatorium cannabinum* (53.12), *Lygodium microphyllum* (35.55), *Ageratum conyzoides* (25.39), *Adiantum* sp. (22.7) and *Imperata cylindrica* (21.09) were the dominant herbs. *Sauromatum guttalum*, *Phyllanthus fraternus* etc. are the important medicinal herbs.

Heingang sacred grove

Thirty woody species (1 unidentified) in 22 genera and 17 families were recorded in this grove. *Pinus kesiya* (IVI: 153.73), *Quercus serrata* (IVI: 26.73), *Schima wallichii* (IVI: 18.74) and *Engelhardtia colebrookiana* (IVI: 11.28) are the dominant tree species. Only seven species of shrubs are found in this grove belonging to seven genera in five families. *Triumfetta cana* (IVI: 75.01), *Tournefortia candallii* (IVI: 46.28) and *Maesa indica* (IVI: 42.43) were dominant shrubs. *Clerodendrum serratum*, *Artemisia nilagirica* etc. found in this grove are shrubs with medicinal value. Nineteen species of herbs represented ground vegetation and belonged to 17 genera and 13 families. Dominant herb species were *Imperata cylindrica* (IVI: 32.48), *Adiantum* sp. (IVI: 30.09), *Blumea hieracifolia* (IVI: 25.38) and *Pteris ensiformis* (IVI: 24.53). *Scutellaria discolor*, *Viola pilosa* etc. are the important medicinal herbs.

Comparison of diversity of the four sacred groves

The similarity index among the four sacred groves varied greatly (Table 5). The highest similarity index value was between groves III and IV exhibiting 44.04% and lowest between groves II and IV (14.29%). While considering the similarity index value among the tree, shrub and herb species separately, the maximum similarity value (%) was exhibited between groves III and IV contributing 51.85% for tree, 50% for shrub and 30.77% for herb species (Table 6). Groves II and III are the most dissimilar in terms of tree species having 8.16% similarity index, while groves II and IV showed least similarity (13.33%) for herb species. The minimum similarity index value for shrubs was exhibited between groves I and IV and groves II and IV recording 23.53%. Only four species were common to the four groves, and these were *Gomphrena decumbens* (a herb), *Lantana camara* (a shrub) and two trees species namely, *Litsea polyantha* and *Mallotus philippensis*. The density and IVI values of each species are given in Table 7. Least common species among the four groves may be due to diverse natural ecosystems, altitudinal variations, edaphic, physiographic and micro-

Table 7. Density (plants ha^{-1}) and Importance Value Indices (IVI) of different plant species occurring in the selected sacred groves of Manipur.

Scientific name	Habit	Konthoujam Lairembi (I)		Mahabali (II)		Langol Thongak Lairembi (III)		Heingang Marjing (IV)	
		Density/ha	IVI	Density/ha	IVI	Density/ha	IVI	Density/ha	IVI
Adenanthera pavonia Linn.	T	1	0.63	–	–	–	–	–	–
Albizia lebbeck Benth.	T	–	–	3	2.6	–	–	–	–
Albizia lucida Benth.	T	–	–	–	–	17.5	5.75	5	1.86
Albizia odoratissima (Linn.f.) Benth.	T	6	3.86	–	–	5	2.46	15	6.01
Albizia procera Benth.	T	–	–	–	–	–	–	5	2.09
Albizia stipulata (Roxb.) Boivin	T	–	–	–	–	2.5	1.21	17.5	5.95
Alnus nepalensis D.Don	T	–	–	–	–	–	–	2.5	1.15
Anthocephalus chinensis Walp.	T	–	–	3	2.2	–	–	–	–
Aphanamixis polystachya (Wall.) Parker	T	1	0.75	–	–	–	–	–	–
Aralia sp.	T	–	–	–	–	10	3.24	–	–
Ardisia sp.	T	–	–	–	–	–	–	5	2.01
Artocarpus lakoocha Roxb.	T	13	10.94	8	4.85	–	–	–	–
Bauhinia purpurea Linn.	T	–	–	–	–	2.5	1.4	–	–
Bauhinia variegata Linn.	T	5	2.92	–	–	–	–	–	–
Bischofia javanica Blume	T	–	–	10	5.01	–	–	–	–
Bombax ceiba Linn.	T	–	–	–	–	5	2.36	–	–
Caryota urens Linn.	T	2	1.32	25	10.18	–	–	–	–
Castanopsis hystrix A. DC.	T	1	0.93	–	–	–	–	–	–
Celtis timorensis Linn.	T	3	2	3	3.42	–	–	–	–
Chukrasia tabularis Andr. Juss.	T	3	1.61	–	–	–	–	–	–
Cordia grandis Roxb.	T	2	1.79	–	–	–	–	–	–
Delonix regia (Boj.) Raf.	T	2	1.28	–	–	–	–	–	–
Elaeocarpus sp.	T	–	–	–	–	–	–	2.5	0.91
Engelhardtia colebrookiana Lindl.	T	–	–	–	–	–	–	35	11.28
Entada scandens Benth.	T	1	0.7	–	–	–	–	–	–
Erythrina sp.	T	1	0.73	–	–	–	–	–	–
Eucalyptus citriodora Hook.	T	–	–	–	–	–	–	2.5	0.99
Eugenia sp.	T	2	1.27	–	–	–	–	–	–

Eugenia praecox Roxb.	T	3	2.34	–	–	10	4.05	30	8.26
Ficus benghalensis Linn.	T	3	5.34	–	–	–	–	–	–
Ficus benjamina Linn.	T	13	59.33	–	–	–	–	–	–
Ficus glomerata Roxb.	T	6	5.34	38	43.4	–	–	–	–
Ficus hispida Linn. f.	T	3	2.06	115	44.12	–	–	–	–
Ficus religiosa Linn	T	–	–	3	2.74	–	–	–	–
Ficus semicordata Linn.	T	–	–	–	–	–	–	17.5	5.36
Flacourtia jangomas (Lour.) Raeusch	T	–	–	–	–	–	–	7.5	3.07
Gardenia campanulata Roxb.	T	4	2.51	98	29.81	–	–	–	–
Gmelina arborea Linn.	T	7	4.64	–	–	–	–	–	–
Heptapleurum hypoleucum Kurz	T	6	4.12	–	–	–	–	–	–
Holigarna longifolia Roxb.	T	–	–	–	–	–	–	12.5	4.55
Khajok (Local name)	T	–	–	–	–	–	–	2.5	0.97
Lannea coromandelina (Houtl.)	T	8	4.56	–	–	–	–	–	–
Lannea grandis Linn. f	T	12	9.41	8	3.26	–	–	–	–
Ligustrum robustum Blume	T	25	15.38	–	–	–	–	–	–
Litsea citrata Blume	T	10	7.93	–	–	7.5	3.76	27.5	7.85
Litsea polyantha Juss	T	19	12.49	15	7.59	15	6.68	10	3.96
Litsea sebifera Thumb. Pers.	T	–	–	–	–	–	–	15	5.64
Litsea sp. (1)	T	3	1.8	–	–	–	–	–	–
Litsea sp. (2)	T	–	–	13	6.75	–	–	–	–
Machilus sp.	T	–	–	85	52.32	–	–	–	–
Mallotus philippensis (Lamk.) Muell. - Arg.	T	18	10.93	10	5.71	2.5	1.44	5	1.86
Mangifera indica Linn.	T	16	17.75	15	14.39	–	–	–	–
Mangifera sp.	T	–	–	–	–	3	1.25	7.5	2.28
Marlea begoniaefolia Roxb.	T	11	7.1	18	7.39	–	–	–	–
Melia azedarach Linn.	T	2	1.31	–	–	2.5	1.3	–	–
Oroxylum indicum Vent.	T	19	12.75	–	–	–	–	5	2.56
Parkia roxburghii G. Don	T	–	–	–	–	5	2.47	–	–
Pasania polystachya (Wall) Schootky	T	–	–	–	–	47.5	16.8	10	2.81
Phyllanthus emblica Linn.	T	–	–	–	–	2.5	1.19	5	1.3
Pinus kesiya Royle ex. Gordon	T	–	–	–	–	690	176.27	705	153.73
Prunus sp.	T	–	–	–	–	–	–	7.5	2.13

Table 7. Continued.

Scientific name	Habit	Konthoujam Lairembi (I)		Mahabali (II)		Langol Thongak Lairembi (III)		Heingang Marjing (IV)	
		Density/ha	IVI	Density/ha	IVI	Density/ha	IVI	Density/ha	IVI
Quercus serrata Thumb.	T	–	–	–	–	40	14.97	127.5	26.73
Rhus semialata Murray	T	3	2.24	–	–	7.5	3.7	–	–
Rubia sp. (1)	T	2	1.59	–	–	–	–	–	
Rubia sp. (2)	T	6	3.65	–	–	–	–	–	–
Santalum sp.	T	–	–	–	–	7.5	1.79	–	–
Saprosma sp.	T	54	29.74	–	–	–	–	–	–
Schima wallichii (DC.) Korth.	T	16	12	–	–	53	25.57	82.5	18.74
Spondias pinnata (Linn.f.) Kurz	T	1	0.65	–	–	–	–	–	–
Syzygium jambos Linn. (Alston)	T	1	0.65	–	–	–	–	–	–
Syzygium sp.	T	–	–	–	–	30	9.36	–	–
Terminalia citrina (Gaertn.) Flem.	T	–	–	–	–	12.5	5.1	–	–
Trema orientalis (L.) Blume	T	6	4.49	–	–	–	–	5	2.04
Uha (Local name)	T	15	10.79	–	–	–	–	–	–
Vangueria spinosa Roxb.	T	17	11.3	110	43.29	–	–	–	–
Viburnum sp.	T	–	–	–	–	2.5	2.54	–	–
Wendlandia exrerta DC.	T	–	–	–	–	–	–	2.5	0.94
Wendlandia tinctoria DC.	T	–	–	–	–	15	5.33	22.5	7.42
Xylosma longifolia Clos	T	3	2.19	23	7.77	–	–	20	5.51
Zanthoxylum rhetsa Roxb.	T	4	2.9	–	–	–	–	–	–
Ziziphus jujuba Lam.	T	–	–	5	3.07	–	–	–	–
Artemisia nilagirica (C.B. Clarke) Pamp.	S	–	–	–	–	320	34.39	380	37.36
Callicarpa macrophylla Vahl	S	260	25.57	200	24.51	360	37.2	–	–
Cestrum nocturnum Linn.	S	–	–	160	19.1	–	–	–	–
Clerodendrum serratum (L.) Sprengel	S	–	–	–	–	–	–	200	24.94
Clerodendrum viscosum Vent.	S	300	28.01	–	–	–	–	–	–
Datura suaveolens Willd.	S	–	–	160	20.52	–	–	–	–
Duranta repens Linn.	S	180	21.32	–	–	–	–	–	–
Eupatorium odoratum Linn.	S	–	–	–	–	200	26.52	–	–

Ficus silhetensis Miq.	S	–	–	–	–	320	36.14	–	–
Glycosmis arborea (Roxb.) DC.	S	–	–	1180	75.99	–	–	–	–
Jasminum sp.	S	680	51.38	420	36.64	220	26.96	–	–
Lantana camara Linn.	S	560	42.86	580	46.58	440	44.05	380	37.36
Maesa indica (Roxb.) A. DC.	S	420	36.68	–	–	200	25.2	460	42.43
Melastoma malabathricum Linn	S	–	–	–	–	480	47.12	360	36.6
Mussaenda roxburghii Hook.f.	S	200	21.5	–	–	–	–	–	–
Phlogacanthus thyrsiflorus Nees	S	140	17.14	–	–	–	–	–	–
Rubus moluccanus Linn.	S	–	–	80	12.53	–	–	–	–
Sida rhombifolia Linn.	S	300	32.3	–	–	–	–	–	–
Solanum torvum Swartz	S	–	–	80	13.8	–	–	–	–
Thespesia macrophylla Blume	S	–	–	–	–	160	22.43	–	–
Tournefortia candallii Clarke	S	–	–	–	–	–	–	500	46.28
Triumetta cana Blume	S	–	–	220	26.51	–	–	960	75.01
Vitex trifolia Linn.	S	–	–	220	23.83	–	–	–	–
Xanthium strumarium Linn.	S	220	23.24	–	–	–	–	–	–
Adiantum lunulatum Burn. f	P	9500	7.34	–	–	–	–	34,500	17.65
Adiantum sp.	P	44,000	20.01	–	–	32,000	22.7	85,500	30.09
Adiantum venustum G. Don	P	–	–	–	–	–	–	35,500	17.54
Lygodium japonicum (Thumb.) Sw.	P	–	–	–	–	19,000	15.71	31,000	16.69
Lygodium microphyllum Swartz.	P	32,500	16.99	39,000	14.92	61,500	35.55	–	–
Pteris ensiformis Burm.f.	P	–	–	–	–	–	–	64,000	24.53
Achyranthes aspera Linn.	H	18,000	11.19	–	–	–	–	–	–
Ageratum conyzoides Linn.	H	40,500	19.09	–	–	37,000	25.39	31,500	15.19
Anaphalis contorta (D.Don.) Hook. f.	H	–	–	–	–	10,000	10.88	–	–
Argyreia argysophyllous	H	–	–	17,000	9.15	–	–	–	–
Bassella alba Linn.	H	–	–	51,500	19.66	–	–	–	–
Blumea hieracifolia DC.	H	–	–	–	–	–	–	64,000	25.38
Bonnaya brachiata Linn. Urban	H	13,000	8.81	–	–	3000	5.13	–	–
Cardamine hirsuta Linn.	H	11,500	8.16	–	–	–	–	–	–
Centella asiatica (Linn.) Urban	H	7500	6.26	–	–	–	–	–	–
Cissus discolor Blume	H	6000	5.45	–	–	–	–	–	–
Coix lacryma-jobi Linn.	H	–	–	–	–	4500	6.78	–	–

Table 7. Continued.

Scientific name	Habit	Konthoujam Lairembi (I)		Mahabali (II)		Langol Thongak Lairembi (III)		Heingang Marjing (IV)	
		Density/ha	IVI	Density/ha	IVI	Density/ha	IVI	Density/ha	IVI
Colocasia esculenta (L.) Scott.	H	7500	6.5	–	–	–	–	–	–
Commelina benghalensis Linn	H	6000	5.59	–	–	–	–	–	–
Costus speciosus (Koenig) Sm.	H	9000	7.13	–	–	–	–	–	–
Crocosmia sp.	H	–	–	–	–	–	–	7500	6.53
Curcuma sp.	H	10,500	7.87	–	–	–	–	–	–
Cymbopogon flexuosus Stapf.	H	–	–	–	–	14,500	13.3	–	–
Cynodon dactylon Pers.	H	–	–	15,000	8.75	–	–	–	–
Cyperus rotundus Linn	H	22,500	12.79	–	–	–	–	–	–
Dactyloctenium aegyptium Beauv.	H	–	–	117,000	32.55	–	–	–	–
Dioscorea alata Linn.	H	–	–	5500	4.43	2500	5.36	–	–
Dioscorea bulbifera Linn.	H	–	–	4000	3.64	–	–	–	–
Drymaria cordata Willd.	H	39,000	18.29	8000	5.46	–	–	–	–
Eclipta prostrata (Linn.) Linn.	H	51,500	22.37	–	–	–	–	–	–
Eupatorium cannabinum Linn.	H	–	–	–	–	105,000	53.12	–	–
Euphorbia hirta Linn.	H	–	–	–	–	–	–	15,000	9.46
Euphorbia sp.	H	–	–	–	–	10,500	11.15	–	–
Fragaria indica T. Anderson	H	15,500	10.02	19,500	10.18	–	–	–	–
Galinsoga parviflora Cav.	H	7500	7.18	–	–	9000	9.77	–	–
Gomphrena decumbens	H	23,500	13.24	5500	4.4	9500	10.23	21,500	13.19
Gynura cusimbua (D.Don) Moore	H	–	–	–	–	–	–	40,500	17.89
Habenaria sp. (1)	H	–	–	74,000	23.91	–	–	–	–
Habenaria sp. (2)	H	–	–	–	–	–	–	4000	4.37
Hemidesmus indicus (L.) Schult.	H	14,000	9.32	–	–	–	–	–	–
Houttuynia cordata Thunb.	H	–	–	11,000	6.69	–	–	–	–
Hydrocotyle javanica Thunb.	H	–	–	15,000	8.04	–	–	–	–
Imperata cylindrica (Linn.) P.Beauv.	H	–	–	–	–	29,500	21.09	95,000	32.48
Melothria maderaspatana (Linn.) Cogn.	H	–	–	21,000	10.91	–	–	–	–
Mikania micrantha Kunth	H	–	–	77,000	24.58	6000	8.15	–	–

Mucuna sp.	H	–	–	–	–	6000	10.14	–	–
Muscari commutalum Vent.	H	45,500	20.46	–	–	–	–	–	–
Oxalis corniculata Linn.	H	–	–	–	–	7500	8.89	–	–
Paederia sp.	H	8500	6.76	–	–	–	–	–	–
Paederia foetida Linn	H	9500	7.34	–	–	–	–	–	–
Panicum patens Linn.	H	68,000	27.22	–	–	11,500	11.46	34,000	15.92
Peristrophe bicalyculata Nees.	H	–	–	8500	5.97	–	–	–	–
Phyllanthus fraternus Web.	H	–	–	52,500	18.8	–	–	–	–
Piper longum Linn.	H	–	–	63,500	21.61	–	–	–	–
Plantago erosa Wall.	H	–	–	8500	5.66	–	–	–	–
Polygonum orientale Linn.	H	–	–	12,000	7.31	–	–	–	–
Ranunculus scleratus Linn.	H	–	–	76,000	24.43	–	–	–	–
Rumex nepalensis spreng.	H	–	–	4500	3.89	–	–	–	–
Sauromatum guttalum Schott.	H	–	–	3000	3.78	5000	7.06	–	–
Scutellaria discolor Colebr.	H	–	–	–	–	–	–	6500	5.89
Setaria glauca (Linn.) P. Beauv.	H	–	–	–	–	–	–	22,500	13.97
Smilax zeylanica Linn.	H	–	–	3500	3.39	–	–	17,500	10.36
Spilanthes acmella Hook.f.	H	–	–	21,000	10.8	–	–	–	–
Stephania hernandifolia Walp.	H	11,500	8.35	12,000	7.08	–	–	–	–
Thunbergia grandiflora Roxb.	H	7500	6.29	–	–	–	–	–	–
Viola pilosa Blume	H	–	–	–		–	–	17,500	10.7
Vitis sp.	H	–	–	–	–	–	–	22,500	12.18
Zeuxine sp.	H	–	–	–	–	6000	8.15	–	–

T – tree, S – shrub, P – pteridophyte and H – herb.
–, Indicates absence of species.

Table 8. Species richness (SR), species richness index (SRI), diversity index (H'), concentration of dominance (Cd) and Evenness index (E) computed in selected groves.

Sacred grove	SR			SRI			H'			Cd			E		
	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs
Konthoujam Lairembi (I)	45	10	26	2.37	0.78	0.79	3.17	2.25	3.13	0.07	0.11	0.50	0.83	0.98	0.96
Mahabali (II)	20	10	26	1.21	0.78	0.67	2.48	2.15	3.03	0.59	0.14	0.06	0.55	0.93	0.93
Langol Thongak Lairembi (III)	24	9	20	1.20	0.77	0.72	1.79	2.17	2.77	0.36	0.12	0.08	0.56	0.99	0.92
Heingang Marjing (IV)	30	7	19	1.36	0.55	0.53	2.12	1.89	2.83	0.28	0.16	0.06	0.62	0.97	0.94

Table 9. Details of the enumerated species showing their ethnobotanical importance, regeneration mode and conservation status.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Trees								
Adenanthera pavonia Linn.	Ratachandan	Mimosaceae	Used as medicine	Seed and root	Abortion of child, cough and fever	Oral	Seed	–
Albizia lebbeck Benth.	Kiyamlei	Mimosaceae	Used as medicine and rituals	Leaves, seed, bark and root	Eye troubles, bronchitis, leprosy, paralysis and helminth infections, piles and dental problems	Eye and oral	Seed	–
Albizia lucida Benth	Messi	Mimosaceae	–	–	–	–	Seed	–
Albizia odoratissima (Linn.f.) Benth.	Uyil	Mimosaceae	Used as medicine and fish poisoning	Leaves and bark	Cough, cutaneous infection, leprosy and invertebrate ulcers	Skin and oral	Seed	–
Albizia procera Benth.	Luwangkhoi	Mimosaceae	Used as medicine and fish poisoning	Plant and bark	Stomach, intestinal diseases, rheumatism and haemorrhage	Oral	Seed	–
Albizia stipulata (Roxb.) Boivin	Khok	Mimosaceae	Used as medicine and fish poisoning	Bark and leaves	Cutaneous infections	Oral	Seed	–
Alnus nepalensis D.Don	Pareng	Betulaceae	–	–	–	–	Seed	Threatened
Anthocephalus chinensis Walp.	Keli	Rubiaceae	Used as medicine	Bark	Tonic and febrifuge	–	Seed	–
Aphanamixis polystachya (Wall.) Parker	Heiranggoi	Meliaceae	Used as medicine and rituals	Fruit	Liver complaints and leucorrhoea	Oral	Seed	Endangered
Aralia sp.	–	Araliaceae	–	–	–	–	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Ardisia sp.		Myrsinaceae	–	–	–	–	Seed	–
Artocarpus lakoocha Roxb.	Harikonthong	Moraceae	Used as medicine	Bark and ripe fruit	Antiseptic, constipation and fever	Skin and oral	Seed	–
Bauhinia purpurea Linn.	Chingthrou	Caesalpiniaceae	Used as medicine	Bark	Poisonous bite, leucorrhoea, menstrual disorder and leprosy	Skin and oral	Seed	–
Bauhinia variegata Linn.	Chingthrou	Caesalpiniaceae	Used as medicine	Bark, root and buds	Leucorrhoea, cutaneous troubles, diarrhoea, dysentery and piles.	Oral	Seed	–
Bischofia javanica Blume	Uthum naroubi	Euphorbiaceae	Used as medicine	Leaves and bark	Sores and throat troubles	Oral	Seed	–
Bombax ceiba Linn.	Tera	Bombacaceae	Used as medicine	Bark, flower and young fruit	Skin diseases, female diseases and snake bite	Oral and skin	Seed	Rare and vulnerable
Caryota urens Linn.	Singkap	Palmae	–	–	–	–	Seed	–
Castanopsis hystrix A. DC.		Fagaceae	–	–	–		Seed	–
Celtis timorensis Linn.	Heikreng	Ulmaceae	Used as medicine and rituals	Leaf	Dysentery and jaundice	Oral	Seed	–
Chukrasia tabularis Andr. Juss.	Tairenmanbi	Meliaceae	Used as medicine	Young leaves and bark	Astringent	Oral	Seed	–
Cordia grandis Roxb.	Lamuk	Boraginaceae	Used as medicine	Fruits	Urinary infections	Oral	Seed	–

Delonix regia (Boj.) Raf.	Gulmohor	Caesalpiniaceae	–	–	–	–	Seed	–
Elaeocarpus sp.	Heikhou	Elaeocarpaceae	–	–	–	–	Seed	–
Engelhardtia colebrookiana Lindl	Linphop	Juglandaceae	–	–	–	–	Seed	–
Entada scandens Benth	Kangkhil	Mimosaceae	Used as medicine	Bark and seed	Stomach ulcer, fever and headache	Oral	Seed	–
Erythrina sp.	Kegemanbi	Papilionaceae	–	–	–	–	Seed	–
Eucalyptus citriodora Hook.	Nasik	Myrtaceae	Used as medicine	Leaves	Cough, cracking, loosing of limbs and hair lotion	Oral, skin and shampoo	Seed	–
Eugenia praecox Roxb.	Seleima	Myrtaceae	–	–	–	–	Seed	–
Eugenia sp.		Myrtaceae	–	–	–	–	Seed	–
Ficus benghalensis Linn.	Khonangbot	Moraceae	Used as medicine	Young prop roots and bark	Obstruction of urine flow, exudation of pus and piles	Oral and chewed	Seed	–
Ficus benjamina Linn.	Khongang loirung	Moraceae	Used as medicine	Leaves and tender shoot	Ulcer, dysentery and cough	Oral	Seed	–
Ficus glomerata Roxb.	Heibong	Moraceae	Used as medicine	Root, fruit and wood latex	Dysentery, diabetes, lung diseases and skin irritation	Oral and skin	Seed	–
Ficus hispida Linn. f.	Ashiheibong	Moraceae	Used as medicine	Leaves, bark, fruit and seeds	Ringworms, dysentery and intestinal worm infection	Oral and chewed	Seed	–
Ficus religiosa Linn.	Sana-khongnag	Moraceae	Used as medicine	Bark	Boils and gonorrhoea	Oral	Seed	–
Ficus semicordata Linn.	Heiyit	Moracaee	Used as medicine	Bark	Dysentery and liver complaints	Oral	Seed	–
Flacourtia jangomas (Lour.) Raeusch	Heitroy	Flacourtiaceae	Used as medicine	Fruit	Bleeding gum, toothache and diabetes	Oral	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Gardenia companulata Roxb.	Lam heibi	Rubiaceae	Used as medicine	Fruits	Diabetes	Oral	Seed	–
Gmelina arborea Linn.	Wang	Verbenaceae	Used as medicine	Root, leaves, flower and plant	Gonorrhoea, cough, fever, boils affections, blood diseases and poisonous bite	Oral	Seed	–
Heptapleurum hypoleucum Kurz	Chom	Araliaceae	Used as medicine	Root	Boils affections	Skin	Seed	–
Holigarna longifolia Roxb.	Kherai	Anacardiaceae	Used as medicine, Poisonous plant	Bark	Poisonous and vesicant	Oral	Seed	–
Lannea coromandelina (Houtl.)	Akman	Anacardiaceae	Used as medicine	Leaves, bark and fruit	Ulcers, eyesores, toothache, and elephantiasis	Oral and skin	Seed	–
Lannea grandis A. Rich.	Uyanggal	Anacardiaceae	–	–	–	–	Seed	–
Ligustrum robustum Blume	Sumchit manbi	Oleaceae	–	–	–	–	Seed	–
Litsea citrata Blume	Nongnang-kori	Lauraceae	Used for silkworm	Leaves	–	–	Seed	–
Litsea polyantha Juss.	Tumidla	Lauraceae	Used as medicine	Leaves, bark and seed	Diarrhoea, rheumatism body pain and fractured bones for animals	Oral and skin	Seed	–
Litsea sebifera Thumb. Pers.	Thanghidak	Lauraceae	Used as medicine	Leaves and bark	Cut and injuries for early suppuration and muscular sprain	Skin	Seed	–
Litsea sp. (1)	–	Lauraceae	–	–	–	–	Seed	–

Litsea sp. (2)	–	Lauraceae	–	–	–	–	Seed	–
Machilus sp.	–	Lauraceae	–	–	–	–	Seed	–
Mallotus philippensis (Lamk.) Muell. - Arg.	Ureiromlaba	Euphorbiaceae	Used as medicine and rituals	Fruit and seed	Cutaneous diseases and skin diseases	Oral and skin	Seed	–
Mangifera indica Linn.	Heinou	Anacardiaceae	Used as medicine and rituals	Fruit	Constipation	Oral	Seed	–
Mangifera sp.	Heinou	Anacardiaceae	Used as medicine and rituals	Fruit and leaves	Constipation	Oral	Seed	–
Marlea begoniaefolia Roxb.	Kokan	Cornaceae	Used in rituals	Leaves	During the lunar or solar eclipse		Seed	–
Melia azedarach Linn.	Seijrak	Meliaceae	Used as medicine	Leaves, flowers, gum, seed and bark	Nervous headache, removing lice, skin diseases, insect repellent, spleen enlargement, rheumatism and ascariasis	Oral and skin	Seed	–
Oroxylum indicum Vent.	Shamba	Bignoniaceae	Used as medicine	Leaves and bark	Epilepsy, muscular sprains and general weakness	Oral and skin	Seed	–
Parkia roxburghii G. Don	Yongchal	Mimosaceae	Used as medicine and vegetables	Tender pod and bark	Intestinal disorder, bleeding piles, diarrhoea and dysentery	Oral	Seed	–
Pasania polystachya (Wall) Schootky	Shaii	Fagaceae	–	–	–	–	Seed	Threatened
Phyllanthus emblica Linn.	Heikru	Euphorbiaceae	Used as medicine	Fruit	Dyspepsia and jaundice	Oral	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Pinus kesiya Royle ex. Gordon	Uchal	Pinaceae	Used as medicine and rituals	Plant	Cough, headache vertigo and mental disorder	Oral and skin	Seed	–
Prunus sp.	Heirou	Rosaceae	Used as medicine	Bark	Diabetes	Oral	Seed	–
Quercus serrata Thunb.	Uyung	Fagaceae	Sacred tree	–	–	–	Seed	–
Rhus semialata Murray	Heimang	Anacardiaceae	Used as medicine	Shoots, leaves and fruit	Intestinal worms, diarrhoea, kidney and urinary complaints, dyspepsia, stomach ulcer and hair lotion	Oral and shampoo	Seed	–
Rubia sp. (1)	Urung	Rubiaceae	–	–	–	–	Seed	–
Rubia sp. (2)	Urunglaba	Rubiaceae	–	–	–	–	Seed	–
Santalum sp.	Chanchan-dan manbi	Santalaceae	–	–	–	–	Seed	–
Saprosma sp.	–	Rubiaceae	–	–	–	–	Seed	–
Schima wallichii (DC.) Korth	Usoi	Theaceae	Used as medicine and vegetables	Bark	Expelling worms from intestinal and gonorrhoea	Oral	Seed	Threatened
Spondias pinnata (Linn.f.) Kurz	Heinning	Anacardiaceae	Used as medicine	Bark and leave	Dysentery, muscular sprain, backache and dyspepsia.	Oral and skin	Seed	–
Syzygium jambos Linn. (Alston).	Gulapjat	Myrtaceae	Sacred tree. Used as medicine	Fruit	Deficiency of calcium, vitamin B complex and phosphorous	Oral	Seed	–
Syzygium sp.	–	Myrtaceae	–	–	–	–	Seed	–

Terminalia citrina (Gaertn.) Flem.	Manahi	Combretaceae	Used as medicine	Bark and fruit	Masticatory for mild purgative and old skin ulcers	Oral and skin	Seed	–
Trema orientalis (L.) Blume	Yaon	Ulmaceae	Used as medicine	Root	Diarrhoea, presence of blood in urine and epilepsy	Oral	Seed	–
Vangueria spinosa Roxb.	Heibi	Rubiaceae	Used as medicine	Leaf	Intestinal worm and hoarseness	Oral and skin	Seed	–
Viburnum sp.	–	Caprifoliaceae	–	–	–	–	Seed	–
Wendlandia exerta Dc.	Pheijalaba	Rubiaceae	Used as vegetables	Tender shoot and inflorescences	–	–	Seed	–
Wendlandia tinctoria Dc.	Pheija	Rubiaceae	Used as medicine and vegetables	Tender shoot and inflorescence	Cramps and cholera	Oral	Seed	–
Xylosma longifolia Clos	Nongleisang	Flacourtiaceae	Used as medicine	Young leaves and plant	Piles, killing lice and dizziness, hoarseness and regulation of blood circulation	Steam on skin, skin and oral	Seed and vegetative parts	–
Zanthoxylum rhetsa Roxb.	Ngang	Rutaceae	Used as medicine	Seed and bark	Baldness and toothache	Skin and oral	Seed	–
Ziziphus jujuba Lam.	Boroi	Rhamnaceae	–	–	–	–	Seed	–
–	Uha	–	–	–	–	–	Seed	–
–	Khajok	–	–	–	–	–	Seed	–
Shrubs								
Artemisia nilagirica (C.B. Clarke) Pamp	Laibakngou	Verbenaceae	Used as medicine and insecticides	Leaves	Stomach ulcer, hair lotion and insect repellent	Oral and skin	Seed	–
Callicarpa macrophylla Vahl	Modol-panamana	Verbenaceae	Used as medicine	Leaves	Rheumatic joints	Skin	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Cestrum nocturnum Linn.	Thabanlei	Solanaceae	–	–	–	–	Seed and vegetative parts	–
Clerodendrum serratum (L.) Sprengel	Moirang khanam	Verbenaceae	Used as medicine	Leaves, root and stem	Cough, fever, dysentery, asthma, bronchitis and rheumatism and dyspepsia	Oral	Seed	–
Clerodendrum viscosum Vent.	Kuthap	Verbenaceae	Used as medicine and vegetables	Leaves, roots and flower	Diabetes, regulation of blood pressure, ascarids, tumour and poisonous bite	Oral and skin	Seed	–
Datura suaveolens Willd.	Sagol hidak	Solanaceae	Used as medicine and rituals	Leaves	Dizziness, muscular sprain and dysentery	Oral and oral	Seed	–
Duranta repens Linn.	Sambanlei	Verbenaceae	Used as insecticide	Fruit	Lethal to mosquito larva	–	Seed	–
Eupatorium odoratum Linn.	Kam-bleirei	Asteraceae	Used as medicine	Leaves	Gonorrhoea	Oral	Seed	–
Ficus silhetensis Miq.	Kanggrou	Moraceae	–	–	–	–	Seed	–
Glycosmis arborea (Roxb.) DC.	Yongkomla	Rutaceae	Used as medicine	Root and leaf	Fever, lever complaints, skin troubles, cough, rheumatism, anaemia, jaundice and hair lotion	Oral, skin and shampoo	Seed	–
Jasminum sp.	Warak kundo	Oleaceae	–	–	–	–	Seed and vegetative parts	–
Lantana camara Linn.	Nongbanlei	Verbenaceae	Used as medicine	Leaves	Constipation, fever and stopping bleeding	Oral and skin	Seed and vegetative parts	–

Maesa indica (Roxb.) A. DC.	–	Myrsinaceae	Used as medicine and insecticide	Fruit and root	Anthelmintic and syphilis	Oral	Seed	–
Melastoma malabathricum Linn.	Yachubi	Melastomaceae	Used as medicine	Leaves and bark	Skin troubles, diarrhoea, dysentery and leucorrhoea	Skin and oral	Seed	–
Mussaenda roxburghii Hook.f.	Hanurei	Rubiaceae	Used as medicine	Leaves	Lotion for hair	Shampoo	Seed	–
Phlogacanthus thyrsiflorus Nees.	–	Acanthaceae	Used as medicine	Inflorescence	Skin diseases	Skin	Seed	–
Rubus moluccanus Linn.	–	Rosaceae	Used as medicine	Leaves, fruit and root	Astringent, nocturnal micturition of children and fistula	Oral	Seed	–
Sida rhombifolia Linn.	Uhal	Malvaceae	Used as medicine	Plant	Urinary disorder, rheumatism, tuberculosis and snake bite	Oral	Seed	Endemic and vulnerable
Solanum torvum Swartz	Shing khangga	Solanaceae	Used as medicine	Leaves and fruit	Cough and tonsil complaints	Oral	Seed	–
Thespesia macrophylla Blume	–	Malvaceae	–	–	–	–	Seed	–
*Tournefortia candollii C.B.*Clarke	Hameibon	Boraginaceae	Used as medicine and vegetables	Root and inflorescence	Employed to bathe the convalescing babies	Bathing	Seed	–
Triumetta cana Blume	Samprakpi	Tiliaceae	–	–	–	–	Seed	–
Vitex trifolia Linn.	Urikshibi	Verbenaceae	Used as medicine	Leaves	Rheumatic swelling, rheumatism, sinus, hydrocele and piles	Skin, oral, nasal and steam	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Xanthium strumarium Linn.	Samprakpi	Asteraceae	Used as medicine	Leaves	Fever and cough	Oral	Seed	–
Pteridophytes								
Adiantum lunulatum Burn. F.	–	Adiantaceae	–	–	–	Frond	Frond	–
Adiantum sp.	–	Adiantaceae	–	–	–	–	Seed	–
Adiantum venustum G. Don	–	Adiantaceae	Used as medicine	Whole plant	Bronchitis, tumours, biliousness, inflammatory diseases of the chest and opthalmia	Oral	Frond	–
Lygodium japonicum (Thunb) Sw.	Lei-uri	Schizaeaceae	Used as medicine	Whole plant	Heart complaints	Oral	Frond	–
Lygodium microphyllum Swartz.	–	Schizaeaceae	–	–	–	Frond	Frond	–
Pteris ensiformis Burm.f.	Lai changkhrang	Pteridaceae	Used as medicine	Frond	Dysentery and glandular swelling of neck	Oral and skin	Frond	–
Herbs								
Achyranthes aspera Linn.	Khujum-pere	Amaranthaceae	Used as medicine	Leaves and tender shoot	Piles, menstrual disorder and skin-sores	Oral and skin	Seed	–
Ageratum conyzoides Linn.	Khongjai-napee	Asteraceae	Used as medicine	Leaves	Fresh injuries and hair lotion	Skin and shampoo	Seed	–

Anaphalis contorta (D.Don.) Hook. F	Phunin	Asteraceae	Used as medicine	Seed and young shoot	High blood pressure and intestinal disorder	Oral	Seed	Rare and vulnerable
Argyreia argysophyllous	–	Convolvulaceae	–	–	–	–	Seed	–
Bassella alba Linn.	Urokshumbal	Basellaceae	Used as medicine	Leaves	Boils and muscular pain	Skin and steam	Seed	–
Blumea hieracifolia DC	Ching-terapaibi	Asteraceae	Used as medicine	Leaves	Injuries for stopping bleeding	Skin	Seed	Rare and vulnerable
Bonnaya brachiata Linn. Urban	Kihom –maan	Scrophulariaceae	Used as medicine	Whole plant	Urinary stone case	Oral	Seed and	Rare and vulnerable
Cardamine hirsuta Linn.	Chantruk man	Brassicaceae	Used as medicine	Whole plant	Urinary problems	Oral	Seed	–
Centella asiatica (Linn.) Urban	Peruk	Apiaceae	Used as medicine and vegetables	Leaves	Stomach ulcers, urinary troubles, digestive complaint, dysentery and skin diseases	Oral and skin	Seed and vegetative parts	–
Cissus discolor Blume	Kongyouyen laba	Vitaceae	Used as medicine and vegetables	Leaves	Skin diseases, poxes, and urinary disorder	Oral	Seed and vegetative parts	–
Coix lacryma-jobi Linn.	Channing	Poaceae	Used as medicine	Seed	Menstrual disorders and gout	Oral	Seed	–
Colocasia esculenta (L.) Scott.	Paan	Araceae	Used as medicine and vegetables	Petiole	Fresh cut and injuries	Skin	Seed and vegetative parts	–
Commelina benghalensis Linn.	Wangdem-khoibi	Commelinaceae	Used as medicine	Whole plant	Boils, burns, cough and muscular sprains	Skin and oral	Seed and vegetative parts	–
Costus speciosus (Koenig) Sm.	Khongban-takhelei	Zingiberaceae	Used as medicine	Root, rhizome and stem	Urinary problems and ear-ache	Oral and ear drop	Seed and vegetative parts	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Crocosmia sp.	Oak hidak manbi	Iridaceae	–	–	–	–	Seed and vegetative parts	–
Curcuma sp.	Yaithaman	Zingiberaceae	Used as medicine	Inflorescence and rhizome	Dizziness and headache	Skin	Seed and vegetative parts	–
Cymbopogon flexuosus Stapt	Haona	Poaceae	Used as medicine	Leaves	Cut, injuries, scratches on skin and hair lotion	Skin and shampoo	Seed	–
Cynodon dactylon Pers.	Tingthou	Poaceae	Used as medicine and rituals	Whole plant	Fresh cut, injuries, cough and menstrual disorder	Skin and oral	Seed and vegetative parts	–
Cyperus rotundus Linn.	Sengban Kakthum	Cyperaceae	Used as medicine	Rhizome and tuber	Cough, fever, dyspepsia and stomach and irritation of bowels	Oral	Seed and vegetative parts	–
Dactyloctenium aegyptium Beauv.	Pungphai	Poaceae	Used as medicine and rituals	Fresh plant and grains	Fevers and small pox	Oral	Seed and vegetative parts	–
Dioscorea alata Linn.	Haa	Dioscoreaceae	Used as medicine and vegetables	Tuber	Leprosy, piles, gonorrhoea and blood pressure	Oral and chewed	Seed and vegetative parts	–
Dioscorea bulbifera Linn.	Lam-haa	Dioscoreaceae	Used as medicine	Tuber	Cough, dysentery, piles and ulcers	Oral	Seed and vegetative parts	Vulnerable
Drymaria cordata Willd.	Tandan napi	Caryophyllaceae	Used as medicine	Plant and leaves	Cough, dysentery and muscular sprain	Oral and skin	Seed and vegetative parts	–
Eclipta prostrata (Linn.) Linn.	Uchi-sumban	Asteraceae	Used as medicine	Leaves	Cough, fever and toothache	Oral	Seed	–
Eupatorium cannabinum Linn.	Langtheri-manbi	Asteraceae	Used as medicine	Whole plant	Cut and injuries	Skin	Seed	–

Euphorbia hirta Linn.	Pakhang leiton	Euphorbiaceae	Used as medicine and vegetables	Whole Plant	Worm diseases of children, skin diseases, mouth-sore, dysentery, bronchial affections and asthma	Oral	Seed	–
Euphorbia sp.	Khoiju manbi	Euphorbiaceae	–	–	–	–	Seed	–
Fragaria indica Linn.	Heirong-kak	Rosaceae	Used as medicine	Whole plant	Stone formation in urinary tracts and kidney	Oral	Seed and vegetative parts	–
Galinsaga parviflora Cav.	Hameng Sam-pakpi	Asteraceae	Used as medicine	Leaves	Fever, diarrhoea, dysentery and boils	Oral and skin	Seed	–
Gomphrena decumbens	–	Amaranthaceae	–	–	–	–	Seed	–
Gynura cusimbua (D.Don) Moore	Tera-paibi	Asteraceae	Used as medicine	Stem and leaves	Fresh wounds for stop bleeding and quick healing and stomach ulcers	Skin and oral	Seed	–
Habenaria sp. (1)	–	Orchidaceae	–	–	–	–	Seed	–
Habenaria sp. (2)	–	Orchidaceae	–	–	–	–	Seed	–
Hemidesmus indicus (L.) Schult.	Kwa-manbi	Asclepiadaceae	Used as medicine	Root	Rheumatism, urinary diseases and skin troubles	Oral	Seed and vegetative parts	–
Houttuynia cordata Thunb.	Toning-khok	Saurauiaceae	Used as medicine and vegetables	Leaves and rhizome	Dysentery, muscular sprain and stomach ulcers	Oral	Seed and vegetative parts	–
Hydrocotyle javanica Thunb.	Awa-peruk	Apiaceae	Used as medicine	Whole plant	Stomach ulcer, urinary troubles, digestive complaints, dysentery and skin diseases	Oral and skin	Seed	–

Table 9. Continued.

Species		Family	Importance/value	Plants parts used	Application	Route of application	Regeneration mode	Conservation status
Scientific name	Local name							
Imperata cylindrica (Linn.) P. Beauv.	Imom	Poaceae	Used as medicine	Root	Diarrhoea, dysentery, gonorrhoea and stop bleeding	Oral and skin	Seed	–
Melothria maderaspatana (Linn.) Cogn.	Lam-thabi	Curcubitaceae	Used as medicine	Shoot, leaves and seed	Toothache, vertigo and biliousness	Oral	Seed	–
Mikania micrantha Kunth	Uri-hingchabi	Asteraceae	Used as medicine	Fresh leaves	Ring worm and skin diseases	Skin	Seed	–
Mucana sp.	Samu Uri	Papilionaceae	–	–	–	–	Seed	–
Muscari commutalum Vent.	Napi	Liliaceae	Used as medicine and ornamentals	Leaves and fruit	Cough	Oral	Seed	–
Oxalis corniculata Linn.	Yensil	Oxalidaceae	Used as medicine	Whole plant	Stomach complaints, piles, colic, dysentery and hair lotion	Oral and shampoo	Seed	–
Paederia sp.	Uri	Rubiaceae	–	–	–	–	–	–
Paederia foetida Linn.	Oi-num	Rubiaceae	Used as medicine and vegetables	Leaves, bark and root	Stomach disorders, dysentery, piles and bone fracture	Oral and skin	Seed	–
Panicum patens Linn.	Kang mapan	Poaceae	Used in rituals	Inflorescence	–	–	Seed	–
Peristrophe bicalyculata Nees.	Khuman-langthrei	Acanthaceae	Used as medicine	Shoot and leaves	Cough, fever, liver enlargement and stomach pain	Oral	Seed	–
Phyllanthus fraternus Web.	Chakpa-heikru	Euphorbiaceae	Used as medicine	Whole plant	Leucoderma	Oral	Seed	–
Piper longum Linn.	Piper	Piperaceae	Used as medicine	Unripe fruit and root	Diseases of respiratory tract	Oral	Seed and vegetative parts	–

Plantago erosa Wall.	Yempat	Plantaginaceae	Used as medicine	Leaves and seed	Boils, fresh injuries, muscular sprain and fever	Skin and oral	Seed	–
Polygonum orientale Linn.	Chaokhong angouba	Polygonaceae	Used as medicine and poisonous to fish	Whole plant	Vulnerary, tubercular swelling and flatulence	Oral	Seed	–
Ranunculus scleratus Linn.	Kakyel-khujil	Ranunculaceae	Used as medicine	Whole plant	Urinary disorder, blisters and skin diseases	Oral	Seed and vegetative parts	–
Rumex nepalensis spreng.	Torong-khongchak	Polygonaceae	Used as medicine	Leaves	Colic and syphilitic ulcers	Oral and skin	Seed and vegetative parts	–
Sataria glauca (Linn.) P. Beauv.	–	Poaceae	–	–	–	–	Seed	–
Sauromatum guttalum Schott.	–	Araceae	–	–	–	–	Seed and vegetative parts	–
Scutellaria discolor Colebr.	Yenakhat	Lamiaceae	Used as medicine	Whole plant	Injuries, cut, wounds and menstrual disorder	Skin and oral	Seed	Rare and vulnerable
Smilax zeylanica Linn.	Keisum	Liliaceae	Used as medicine and vegetables	Root	Venereal diseases, rheumatic swelling and sores	Oral and skin	Seed	–
Spilanthus acmella Murr.	Lalu-kowba	Asteraceae	Used as medicine	Flower, leaves and seed	Toothache, jaundice, sore throat, cut and injuries and to produce salivation	Oral and skin	Seed	–
Stephania hernandifolia Walp	Thangga-uri angouba	Menispermaceae	Used as medicine	Tuber and leaves	High fever, diarrhoea and urinary complaints	Oral	Seed and vegetative parts	–
Thunbergia grandiflora Roxb.	Sambal Kundop	Acanthaceae	Used as medicine	Leaves	Stomach complaints and cough	Oral	Seed	–
Viola pilosa Linn.	Huikhong	Violaceae	Used as medicine and vegetables	Leaves	Cough and stomach ulcers	Oral	Seed	–
Vitis sp.	–	Vitaceae	–	–	–	–	Seed	–
Zeuxine sp.	–	Orchidaceae	–	–	–	–	Seed	–

environmental factors. The transition of vegetation type and habitat complexity in each grove may restrict the occurrence of similar species in different groves. Thirteen trees, three shrubs and five herbs species were common in both the groves (I and II) located in the plain. The vegetation of the two groves located in the hills (III and IV) was found to be similar. Thirteen trees, four shrubs and six herbs species with varied densities were common in both the groves. It may be due to the close altitudinal range, physiography, soil, climatic conditions etc.

Species richness, species richness index, species diversity (H′), concentration of dominance (Cd) and Evenness index (E)

The species richness is one of the major criteria in recognizing the importance of an area for conservation. In general, species richness in grove I is greater than the other three groves. Species richness, species richness index, species diversity, concentration of dominance and evenness index recorded in the four sacred groves are given in Table 8. The highest species richness for tree species was found in grove I (45 species) and lowest in grove II (20 species). In case of species richness index of tree species it was again set highest in grove I (2.37) and lowest in grove III (1.20). The number of shrub species in the groves was smaller than the tree and herb species. Groves I and II showed 10 species each, grove III recorded nine species and grove IV being the lowest number having seven species. The maximum species of herbs were recorded in groves I and II with 26 species each and the minimum in grove IV with 19 species. The species richness index of shrubs ranged from 0.55 (grove IV) to 0.78 (grove I and II), whereas for herbs it varied from 0.53 (grove IV) to 0.79 (grove I). The species richness and species richness index of the vegetation followed the order of trees > herbs > shrubs.

The values of Shannon and Wiener species diversity index for tree species varied from 1.79 (grove III) to 3.17 (grove I). For shrubs, it ranged from 1.89 (grove IV) to 2.25 (grove I), while for herb species the value was maximum in grove I (3.13) and minimum in grove III (2.77). The difference in species diversity between communities generally results from variations in site quality (Denslow 1980). Concentration of dominance (Cd) showed opposite trend as compared to species diversity in all the vegetation type i.e. trees, shrubs and herbs. High diversity and low concentration of dominance may be due to the different level of biotic influences in sacred groves. In general, species diversity and concentration of dominance are inversely related. Evenness index of trees is highest in grove I (0.83) and lowest in grove II (0.55) which indicates that the maximum of species in grove I have more or less equal number of individuals as compare with other groves. Among the trees, shrubs and herbs, shrub species showed more evenness distribution though the species richness is poor when compared to the herb and tree species.

Ethnobotanical uses of species and conservation status

Ethnobotanical use of plants has been known since time immemorial in the history of human civilization and without these medicinal plants good health in the past would have been impossible. Ethnobotany explains the holistic scope of the relationship between plant and human being. Still, the *Meitei* community of Manipur depends largely on medicinal plants and the utilization of plants and animals for medicinal purposes is closely related with their culture and ritual practices which have been developed by their forefathers through trial and error methods and passed on orally from generation to generation. Traditional knowledge systems of folk, oral tradition, and the published and unpublished manuscripts are the important sources of locating the potential of bioresources. Unfortunately, due to the lack of written data, communication and intermingling due to the varying ways of life, many of the earlier remedies that survived only by word of mouth from generation to generation are slowly disappearing. Moreover, herbal healers had a strong tendency to keep their knowledge secret without any documentation until the end of their life. The origin of using medicinal plants in Manipur is not known precisely. History reveals that they had a good description of medicinal plants and knowledge of herbal treatment for many diseases at the beginning of the 14th century. Some works on ethnobotanical studies in Manipur have been done (Sinha 1986; Kumar 1990; Singh 1996; Singh et al. 2003).

Out of the 173 species altogether recorded from the four sacred groves, 120 species (96%) are found to be of medicinal value Table 9). Indeed, it is evident that sacred groves are the storehouse of many useful medicinal plants. Therefore, protection and conservation of sacred groves is essential for the conservation of medicinal plants. Five species, *Terminalia citrina*, *Glycosmis arborea*, *Achyranthes aspera*, *Melothria maderaspatana* and *Costus speciosus* among the 120 medicinal plants, are used especially for the treatment of dog-bite (Singh and Singh 2000). Besides their medicinal values, some of the species are employed in different uses like traditional soap and detergent, hair lotion and sericulture. The products of *Flacourtia jangomas* and *Gardenia campanulata* are used in the preparation of traditional soap and detergents for washing clothes by the *Meitei* community of Manipur (Singh et al. 2002). *Ageratum conyzoides*, *Oxalis corniculata*, *Artemisia nilagirica*, *Vitex trifolia*, *Centella asiatica*, *Vanguerea spinosa* and *Phyllanthus emblica* are the species used as an ingredient for the preparation of indigenous hair lotion, locally known as '*Ching-hei*', which is used as shampoo. *Litsea polyantha*, *Litsea citrata* and *Quercus serrata* are the sericultural trees. A few of the sacred species found in the groves are associated in rituals or are believed to be the icon of the deity. Different faiths and beliefs related to the sacred species include curing sickness, purifying household, purifying of the person before entering the shrine etc. The present study reveals that sacred groves of Manipur harbour rich medicinal plants. Various medicinal plants are also used as vegetables, spices etc. Interesting information comes through interviews with the local people who reside

near the groves. Many old poeple revealed that they had never consulted any doctor till date nor taken any tablets or pills. Headache, fever, cold, body pain can easily be cured with the help of medicinal plants. These people used to consume daily a little amount of bitter, sour, sweet etc. from the plants parts which protects them from physical problems.

Many people of Manipur still depend on herbal medicine, though they are highly adjustable with the influences of modern practices and widespread use of allopathic medicine. Therefore, it is necessary to know the potential and values of medicinal plants for the improvement of health and hygiene in an eco-friendly manner. The data generated from the present study regarding the medicinal plants may be helpful for the conservation strategies of sacred groves by the government authority and other concerned organizations. Proper documentation of such plants and necessary action plans for their conservation are needed to taken up in time. It is also required to maintain a sustainable use of such plants for their natural regeneration. In this context some medicinal plants still have the privilege of sustainable natural regeneration due to their existence in the sacred groves.

So far there has been very little official documentation of conservation status (rare, endangered, vulnerable, endemic and threatened) of species of the flora of Manipur. Conservation category recorded is based on the references of the Manipur State Biodiversity Strategy and Action Plan prepared under the National Biodiversity Strategy and Action Plan, Govt. of India (2002). *Bombax ceiba*, *Anaphalis contorta*, *Bonnaya brachiata*, *Scutellaria discolor* and *Blumea hieracifolia* fall under the rare and vulnerable categories. *Dioscorea bulbifera* is the vulnerable species. *Alnus nepalensis*, *Schima wallichii* and *Pasania polystachya* are threatened species. *Sida rhombifolia* fall under vulnerable category. *Aphanamixis polystachya* is an endangered species. Any mishandling of these species will lead to the extinction of such species. Hence, conservation and protection of such species is immediately warranted.

Socio-cultural aspects and status of sacred groves

In each individual sacred grove there exists a complex inter-relationship between the indigenous cultural practices and integrity of people's knowledge, and the conservation of natural biological diversity in the landscape. '*Lai Harouba*', celebrated in honour of the sylvan deities (*Umanglais*) residing in sacred groves is still performed in most of the sacred groves. The objectives of the '*Lai Haraoba*' are to please deities by performing traditional rituals especially performed by the *Maiba* (priest man) and *Maibi* (priest woman) in order to gain their favour. It is believed that in proportion to the conduct of caring and pleasing of the deities by the local people, deities protect them from sickness, harm, natural disasters etc. A number of dances are performed in front of the ancient divinities by both men and women. The religious and cultural practices associated with the celebration and pleasing of deities in

sacred groves, act as the tool for conserving biodiversity. The '*Lai Haraoba*' mirrors the entire culture of the Manipuri people. It reveals its strength and weakness, the beliefs and superstitions, and perhaps also the charm and happiness of the Manipuri people. It reflects the people at their most intense (Singh 1961). However, placing greater emphasis on '*Lai Harouba*' in terms of cultural programmes and paying less attention to the conservation aspects of the groves may cause degradation of groves.

A variety of cultural, religious, traditional beliefs and rites of ancient Manipur are associated with their love and care of wildlife contributing to their conservation. For example, a variety of fish (*Channa* sp.), cock and even bull are released on any auspicious day or on the marriage day or during the 'Lai Harouba' for the wellbeing of the people. Recapturing of such released animals is forbidden. Various folklore and songs are sung which are related to the love and affection for wild denizens. Deeprooted cultural beliefs restrict the use of some medicinal plants on specific days. Any bitter tasting medicinal plant or vegetable is collected before noon as the Meiteis believe that their medicinal value is lost if collected in the afternoon. If these practices are analysed scientifically, it would be clear that these beliefs, practices and taboos are not only of cultural and ritual value, they also help in the conservation of biological resources. Moreover, all traditional and cultural knowledge have to be appreciated and should be incorporated with the modern scientific technique and methods while planning any programme for the conservation of biodiversity.

During the interview with the elderly people, *Maiba* (Priest or local medicine men) and others, it was clear that a few decades ago sacred groves that existed in the villages and even in the urban areas were rich in flora and fauna. In the evenings they were able to enjoy looking at birds flying back to their homes after feeding and spending the whole day in the groves. People did not dare pass near the groves alone or even in groups after sunset and in certain areas even during the noon time, as the sacred groves were mysterious in nature. But now-a-days children and youth go to the groves to play as most of the local playgrounds are encroached legally and illegally by the people and are being used for other purposes. Moreover, the younger generation does not pay much attention to the religious and cultural beliefs associated with the sacred groves and consider them to be superstition. Therefore, it is important to impart awareness among the youth regarding the importance of indigenous cultural and religious practices, and taboos in the conservation of biodiversity.

The mode of thinking has changed considerably; human population pressure has increased, and various developmental activities have been taken up in the past few decades and all this has caused destruction/degradation of forests to a considerable extent and even the sacred groves have been adversely affected. Many of the sacred groves in the urban area are vulnerable to encroachment and urbanization, and one can now find only a few surviving trees in the sacred groves or near the temples. Reconstruction or

modernization of temples in many sacred groves with addition of the temple halls at the expense of the vegetation of the groves has also led to their degradation to some extent. It is sufficiently clear that myths and beliefs associated with the sacred groves which used to be followed strictly in earlier days, have been eroded during the last few decades and the groves no longer enjoy the same privilege as they did earlier. Moreover, the advent of Hinduism during the reign of kings also contributed to the erosion of traditional beliefs of the Meiteis. On the other hand, the influence of Christianity added a new dimension in religion and culture which also acted as an important factor in causing the degradation of sacred groves. One unfortunate factor that hinders the conservation of sacred grove is that the village people living near the sacred groves are poor and less educated. They depend on the grove to meet their vital domestic necessities, such as fuel wood, vegetables, medicinal plants etc. Totey and Verma (1996) argued that the rural poor people depend upon biological resources for meeting 90% of their day to day needs. Therefore, until and unless a viable option is provided to these people for sustaining their economic condition, any step for the conservation of the sacred groves will not be successful.

Furthermore, biodiversity is the only component that keeps the ecological phenomenon in a balanced state, which is necessary for human survival. The sacred grove extends all the benefits that forests offer to mankind. These are the forest patches protected by the people and for the people. If small quantities of plant resources were extracted for the use of medicine, vegetables and ritual purposes that may not be considered as destruction. Moreover, before collecting any item from the groves, one has to request the deities by praying, offering coins, flowers, fruits etc. Fortunately, those groves that exist in the suburban and village/remote areas are in a better condition compared to those located in the urban areas. The sacred groves that exist in the inaccessible areas are well protected while the groves in poorly accessible areas are mildly disturbed but can recover from that level of infringement if the utilization of resources is regulated by the people themselves.

Considering the various dimensions of the sacred groves in Manipur it is clear that these pockets of forestlands harbouring rich biodiversity are no longer immune to human activity, but an advantage is that human interference in these groves is fairly regulated by religious prescriptions and proscriptions.

Acknowledgement

The work was supported by a research grant to M.L.K. from G.B. Pant Institute of Himalayan Environment and Development, Almora, Uttranchal. Kh Ashalata Devi is thankful to Council of Scientific and Industrial Research, New Delhi for Senior Research Fellowship.

References

Balasubramanyan K. and Induchoodan N.C. 1996. Plant diversity in sacred groves of Kerala. Evergreen 36: 3–4.

Basu R. 2000. Studies on Sacred Groves and Taboos in Purulia District of West Bengal. Indian Forester, pp.1309–1317.

Boojh R. and Ramakrishan P.S. 1983. Sacred Groves and their Role in Environmental Conservation. In: Strategies for Environmental Management. Souvenir Vol. Department of Science and Environmental of Uttar Pradesh, Lucknow, pp. 6–8.

Boraiah K.T., Vasudeva R., Shonil A.B. and Kushalapa C.G. 2003. Do informally managed sacred groves have higher richness and regeneration of medicinal plants than state-managed reserve forests? Current Science 84: 804–808.

Brandis D. 1897. Indian Forestry, Working. Oriental Institute, Working.

Burman R.J.J. 1992. The institution of sacred grove. Journal of the Indian Anthropological Society 27: 219–238.

Denslow J.S. 1980. Patterns of plant species diversity during succession under different disturbance regimes. Oecologia 46: 18–21.

Devi S. 2000. Sacred groves of Manipur. Abstract, National workshop on community strategies on the Management of Natural Resources, Bhopal, India.

Gadgil M. and Vartak V.D. 1975. Sacred groves of India – a plea of the continuous conservation. Journal of the Bombay Natural History Society 72(2): 313–320.

Gadgil M. and Vartak V.D. 1976. Sacred groves of Western Ghats of India. Economic Botany 30: 152–160.

Hajra P.K. 1975. Law Lyngdoh (sacred groves), Mawphlang. Government of Meghalaya, Shillong, India.

Haridasan K. and Rao R.R. 1985. Forest flora of Meghalaya, Vol. 1. Bishen Singh and Mahendrapal Singh, Dehra Dun.

Hughes D.J. and Chandran Subash M.D. 1997. Sacred Groves around the earth: an overview. Paper presented in the workshop on The role of sacred groves in conservation and management of Biological Resources, KFRI, Pechi.

Jain S.K. and Rao R.R. 1977. A Handbook of Field and Herbarium Methods. Today and tomorrow's printers and publishers, New Delhi.

Jamir S.A. and Pandey H.N. 2002. Status of biodiversity in the sacred groves of Jaintia Hills, Meghalaya. Indian Forester 128(7): 738–744.

Khan M.L., Menon S. and Bawa K.S. 1997. Effectiveness of the protected area network in biodiversity conservation: a case study of Meghalaya state. Biodiversity and Conservation 6: 853–868.

Khiewtam R.S. 1986. Ecosystem function of protected forests of Cherrapunji and adjoining area. PhD thesis, North-Eastern Hill University, Shillong, India.

Khiewtam R.S. and Ramakrishnan P.S. 1989. Socio-cultural studies of the sacred groves at Cherrapunji and adjoining areas in North-Eastern India. Man in India 69(1): 64–71.

King-Oliver I.E.D., Chitra V. and Narasimha D. 1997. Sacred groves: traditional ecological heritage. International Journal of Ecological Environmental Science 23: 463–470.

Kosambi D.D. 1962. Myth and Reality. Popular Press, Bombay, India.

Kumar M. and Swamy P.S. 2003. Tree diversity and regeneration status of six selected sacred groves in Tamil Nadu, South India. Paper presented in national seminar on Eco restoration, biodiversity conservation and sustainable development. 3–5 June 2003, Hostel Green Park, Visakhapatnam, India, p. 3.

Kumar O. 1990. Floristic study of Tamenglong district, Manipur with ethnobotanical notes. PhD thesis, Manipur University, Imphal, Manipur.

Kushalapa C.G., Bhagwat S.A. and Kushalapa K.A. 2001. Conservation and management of sacred groves of Hodagu, Karnataka, South India - a unique approach. In: Ganeshaiah K.N., Shaanker Uma R. and Bawa K.S. (eds), Tropical Ecosystems: Structure, Diversity and Human Welfare. Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, pp. 565–569.

MAB 1995. Sacred places and vernacular conservation. MAB 23. UNESCO, Man and Biosphere Programme, Paris, pp. 20–21.
Menhinick E.F. 1964. A comparison of some species diversity indices applied to samples of field insects. Ecology 45: 859–861.
Misra R. 1968. Ecology Work Book. Oxford and IBH publishing Company, New Delhi.
Pielou E.C. 1969. An Introduction to Mathematical Ecology. Wiley, New York.
Ramakrishan P.S. 1996. Conserving the sacred: from species to Landscapes. Nature Resources UNESCO 32: 11–19.
Rodgers W.A. 1994. The sacred groves of Meghalaya. Man in India 74: 339–348.
Shannon C.I. and Weiner W. 1963. The Mathematical Theory of Communication. University of Illinois Press, Urbana, 111. USA.
Simpson E.M. 1949. Measurement of diversity. Nature 163: 688.
Singh Nilakanta E. 1961. Lai Harouba in Marg. 14(4): 30–34.
Singh B.H. 1996. Plants used in medico-sexual purposes by the *Meitei* community in Manipur State, India. Journal Economic Taxonomy of Botany Additional Series 12: 364–366.
Singh R.N. 2001. Biodiversity mapping of sacred groves of Manipur with special references to conservation of few endangered tree species. PhD thesis, International Institute of Ecology and Environment, New Delhi.
Singh H.B., Singh R.S. and Sandhu J.S. 2003. Herbal Medicine of Manipur A Colour Encyclopedia. Daya publishing house, New Delhi, India.
Singh K.I., Singh P.K. and Singh S.S. 2002. An ethnobiological approach to the indigenous soaps and detergents of Meitei community of Manipur. Journal Economic Taxonomy of Botany 25(3): 547–552.
Singh P.K. and Singh K.I. 2000. Traditional medicinal knowledge of Dog-Bite: need for documentation, conservation and research. Seminar on Ethnobotany Northeastern India: Past, present and future. Dept. of Forestry, North-Eastern Hill University, Mizoram Campus, pp. 6–17.
Sinha B. and Maikhuri R.K. 1998. Conservation through 'socio-cultural-religious practice' in Garhwal Himalaya: a case study of Hariyali sacred grove'. In: Ramakrishan P.S., Saxena K.G. and Chandrasekhar U. (eds), Conserving the Sacred: For Biodiversity Management. UNESCO and Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, pp. 289–299.
Sinha S.C. 1986. Ethnobotanical study of Manipur. PhD thesis, Manipur University, Imphal, Manipur.
Sorensen T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Det. Kong. Danske Vidensk, Selsk Biology Skr (Copenhagen) 5: 1–34.
Sunitha S. and Rao R.P.B. 1999. Sacred groves in Kurnool District, Andhra Pradesh. In: Sivadasan M. and Philip Mathew (eds), Biodiversity, Taxonomy and Conservation of Flowering Plants. Mentor books, Calicut, pp. 367–373.
Tiwari B.K., Barik S.K. and Tripathi R.S. 1998. Biodiversity value, status and strategies for conservation of sacred groves of Meghalaya. India. Ecosystem Health 4: 20–32.
Tiwari B.K., Barik S.K. and Tripathi R.S. 1999. Sacred Forests of Meghalaya – Biological and Cultural Diversity. Regional Centre, National Afforestation and Ecodevelopment Board. North-Eastern Hill University, Shillong, pp. 120.
Totey N.G. and Verma R.K. 1996. Biodiversity conservation. Indian Forester 4: 7–10.
Tripathi R.S. 2001. Sacred groves: community biodiversity conservation model in north-east India. In: Ganeshaiah K.N., Shaanker Uma R. and Bawa K.S. (eds), Tropical ecosystems structure, diversity and human welfare (Supplement). Proceedings of the International Conference on Tropical Ecosystems, ATREE, Bangalore, pp. 104–107.
Vartak V.D. and Gadgil M. 1973. Dev Rahati: an ethnobotanical study of the forests preserved on grounds of religious beliefs. Abstract, Proceedings Indian Scientific Congress 60: 341.
Vedaja S. 1998. Manipur Geography and Regional Development. Rajesh publications, New Delhi, p. 167.