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Medicinal Plant Diversity and Ethnobotanical Significance of Sacred Groves Located in and Around Keonjhar Town, Odisha, India

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ABSTRACT

Sacred groves represent traditional community-protected forest patches that function as important reservoirs of medicinal and wild plant diversity. Keonjhar district of Odisha, inhabited predominantly by tribal communities, preserves numerous culturally significant groves maintained through customary beliefs and ecological ethics. The present study documents the medicinal plant diversity of sacred groves located in and around Keonjhar town, with emphasis on the Siddhamatha Jaheera grove. Field surveys, participatory ethnobotanical interviews, and taxonomic identification were conducted from 2024–2025 to assess floristic composition and traditional uses. A total of 76 medicinal plant species belonging to 65 genera and 34 families were recorded, with trees forming the dominant growth habit (69.7%). Fabaceae emerged as the most represented family (12 species), followed by Combretaceae and Moraceae (7 species each). Diversity analysis using the Shannon-Wiener Index ($H' = 2.97$) and Simpson's Diversity Index ($1 - D = 0.92$) indicated high species diversity and low dominance among plant families, reflecting the ecological stability of the sacred grove vegetation. Several species of cultural, medicinal, and conservation concern, such as *Saraca asoca*, *Rauvolfia serpentina*, *Pterocarpus marsupium*, and *Santalum album* was found to be preserved due to traditional taboos and ritual practices...The study highlights the continuing role of sacred groves as socio-ecological refugia despite pressures from land-use change and declining cultural adherence. Strengthening community awareness, documentation, and participatory conservation is vital for sustaining these biologically and culturally significant landscapes. The findings underscore the need for formal recognition of sacred groves within forest management and biodiversity policies, strengthening community led protection mechanisms, and integrating traditional knowledge into district level conservation planning to ensure the long-term sustainability of these biologically and culturally significant landscapes.

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1. Introduction

Sacred groves, traditionally protected forest fragments associated with deities, ancestral spirits, and ritual practices, represent one of the oldest forms of community-based conservation in India (Bhagwat and Rutte, 2006). These culturally protected landscapes function as important socio-ecological reservoirs, preserving relict vegetation, microhabitats, and species that might otherwise be lost due to habitat fragmentation (Khumbongmayum et al., 2005; Ramanujam and Cyril, 2003). Across the Indian subcontinent, sacred groves continue to safeguard significant levels of biodiversity, including medicinal plants, wild edibles, fodder species, and macrofungi (Aranha, 2024; Nayak et al., 2025). Their conservation value is strengthened by traditional ecological knowledge

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(TEK), taboos, and customary regulations that restrict resource extraction, thereby creating informal but effective conservation zones (Jeeva et al., 2006; Manna and Roy, 2021).

In many regions, particularly those inhabited by Indigenous and tribal communities, sacred groves are central to cultural identity and ecological stewardship. Studies from the Himalayas (Bhatt et al., 2023), Maharashtra (Sangale et al., 2025), Meghalaya (Jeeva et al., 2006), West Bengal (Nayak et al., 2023), and various states of India (Warrier et al., 2023) have consistently reported high medicinal plant richness and strong linkages between cultural practices and biodiversity. However, the distribution, floristic composition, and ethnobotanical significance of sacred groves in eastern India, especially Odisha, remain understudied. Although Odisha hosts a rich tribal heritage and diverse forest ecosystems, systematic documentation of its sacred groves, particularly in the districts of Keonjhar and Mayurbhanj, is sparse.

Keonjhar district, located in the northern highlands of Odisha, harbors numerous sacred groves preserved by tribal communities such as the Ho, Munda, Bhuyan, and Juang. These communities maintain ritual and seasonal practices that regulate access to sacred spaces and ensure the protection of ecologically valuable species. Yet, increasing urbanization, mining activities, and the gradual erosion of cultural traditions pose significant threats to these groves, paralleling patterns seen across India (Rana et al., 2025).

Given the lack of comprehensive floristic inventories and ethnomedicinal documentation from Keonjhar's sacred groves, this study aims to fill a critical knowledge gap. Specifically, the present investigation focuses on the Siddhamatha Jaheera sacred grove and adjoining groves in and around Keonjhar town. The objectives of this study were to:

1. Document the medicinal plant diversity of the sacred groves.
2. Analyze habit-wise and family-wise floristic composition.
3. Record traditional uses, cultural associations, and TEK.
4. Identify major anthropogenic pressures and highlight conservation implications.

By providing the first systematic account of medicinal plant diversity from the Siddhamatha grove, this study contributes essential baseline data for conservation planning, ethnobotanical research, and community-centered forest management in eastern India.

2. Methodology

2.1. Study Area

The study was conducted in the Siddhamatha Jaheera sacred grove and a cluster of smaller associated groves located in and around Keonjhar town, Keonjhar district, Odisha, India. The study area is located within Siddhamatha Temple complex in Keonjhar town, approximately at Latitude: *21.628933° N* Longitude: *85.581688 ºE*. Siddhamatha experiences a tropical to subtropical climate with average annual rainfall approximately 1535 mm. The temperature ranges from 7 °C in Winter to 40 °C in Summer. The area of Siddhamatha ranges from 0.02 to 0.65hectares. The region lies within the Eastern Ghats and is characterized by tropical semi-deciduous forests, undulating terrain, and substantial tribal population groups including the Ho, Munda, Bhuyan, and Juang communities. These communities maintain culturally protected forest patches associated with ancestral worship and ritual activities.

2.2. Field Surveys and Floristic Documentation

Field investigations were carried out between January 2024 and February 2025, covering both dry and wet seasons to ensure comprehensive species detection. The study employed a questionnaire-based survey approach to document the biodiversity and traditional ecological knowledge associated with sacred groves. Data were collected through interactions with people and local villagers especially elders, traditional healers and grove custodians having age groups ranged from 45–75 yrs. A total of 32 informants (including 8 traditional healers) were interviewed using semi-structured questionnaires after obtaining prior informed consent. Standard botanical survey methods were followed:

- Systematic transect walks and opportunistic sampling were employed to document medicinal plant species occurring within the sacred grove boundaries.
- Plants were photographed *in situ*, and morphological characters (habit, bark, leaves, flowers, fruits) were recorded.

- Specimens were collected when necessary, following local permission, for taxonomic identification.

Species identification was performed using regional floras (Saxena and Brahmam, 1994; Haines, 1921; Mooney, 1950), herbarium comparisons, and expert consultation. Scientific names were validated using The Plant List, POWO, and APG IV classification systems.

2.3. Voucher Specimens and Herbarium Deposition

Representative voucher specimens of each recorded species were prepared, labelled, and processed following the standard herbarium techniques of (Jain and Rao, 1977). Vouchers were deposited in the Department of Botany Herbarium, D.D. University, Keonjhar, Odisha for long-term reference.

2.4. Ethnobotanical Data Collection

Ethnobotanical information on medicinal uses, cultural significance, harvesting practices, and taboos associated with each plant species was obtained through a participatory, community-based approach.

2.5. Statistical Analysis of Plant Diversity

Species diversity and dominance patterns within the sacred grove vegetation were evaluated using standard ecological diversity indices. Two commonly used statistical measures were applied: Shannon–Wiener Diversity Index (H′) and Simpson's Diversity Index (1 - D). Statistical analyses were performed using IBM SPSS Statistics, R software and Microsoft Excel.

The Shannon–Wiener Index was calculated using the formula:

$$H' = -\sum(p_i \ln p_i)$$

(Shannon and Weaver, 1949; Magurran, 2004)

Where

- p_i = proportion of individuals (or species) belonging to the family relative to the total number of species
- ln = natural logarithm

This index reflects both species richness and evenness within the plant community.

The Simpson's Diversity Index was calculated as:

$$D = \sum p_i^2$$

(Simpson, 1949; Magurran, 2004) and the Simpson's Diversity of Index (1 - D) was used to interpret diversity levels. Higher values of **1 - D** indicate greater biodiversity and lower dominance of a single group.

Family level species counts recorded during field surveys were used as the dataset for these calculations.

3. Results and Discussion

During the investigation, a total of 76 medicinal plant species were recorded (Table 1). Habit-wise analysis showed trees as the dominant form (53 species, 69.73%), followed by climbers (10 species, 13.2%), shrubs (7 species, 9.2%), herbs (5 species, 6.58%), and a single creeper (1.3%) (Fig. 2). Family-level composition indicated Fabaceae as the most represented (12 species), followed by Combretaceae and Moraceae (7 species each), Apocynaceae (6 species), Lamiaceae and Anacardiaceae (4 species each), Phyllanthaceae (3 species), and Rubiaceae, Acanthaceae, Meliaceae, Poaceae, and Lythraceae (2 species each) (Fig. 3).

The documentation of 76 medicinal plant species from the sacred groves of Keonjhar underscores the ecological richness and cultural importance of these community-protected landscapes. The dominance of tree species (69.7%) closely aligns with patterns observed in sacred groves of Manipur, Pondicherry, and the Garhwal Himalayas, where preserved canopy trees form stable microhabitats that support diverse understory flora (Khumbongmayum et al., 2005; Ramanujam and Cyril, 2003; Bhatt et al., 2023). The prominence of Fabaceae, Combretaceae, and Moraceae reflects broader floristic trends across Indian sacred groves, hinting at a shared ecological structure shaped by cultural protection and selective extraction practices (Aranha, 2024). Of the recorded species, 63%were used for primary healthcare, while others were associated with ritual or food purposes.

Based on the family wise distribution of medicinal plants recorded from the sacred groves, diversity indices were calculated to quantify floristic heterogeneity.

Table 1. Medicinal plants recorded from Sacred Groves of Keonjhar district, Odisha.

Sl. No.	Scientific name	Local name	Habit	Family	Beliefs
1	*Abrus precatorius* L.	Runja	Climber	Fabaceae	Medicine/Ritual
2	*Adina cordifolia* (Roxb) Hook.f. & Benth.	Kuruma	Tree	Rubiaceae	Ritual/Timber
3	*Aegle marmelos* L.	Bela	Tree	Rutaceae	Ritual/Medicine
4	*Alangium salviifolium* (L.f.) Wang.	Ankula	Tree	Cornaceae	Ritual/Medicine
5	*Albizia lebbeck* (L.) Benth.	Sirisa	Tree	Fabaceae	Ritual/Timber
6	*Andrographis paniculata* (Burm.f.) Wall. ex Nees.	Chireita	Herb	Acanthaceae	Medicine
7	*Anogeissus acuminata* (Roxb. ex DC.) Wall. ex Guill. & Perr.	Fasi	Tree	Combretaceae	Ritual/Timber
8	*Artocarpus heterophyllus* Lam.	Panasa	Tree	Moraceae	Fruit/ Ritual/Vegetables
9	*Artocarpus lacucha* Buch.-Ham.	Jeutha	Tree	Moraceae	Fruit/Ritual
10	*Asparagus racemosus* Willd.	Shatabari	Climber	Asparagaceae	Medicine
11	*Azadirachta indica* A. Juss.	Nima	Tree	Meliaceae	Ritual/Medicine/Timber
12	*Phanera vahlii* (Wight & Arn.) Benth.	Siali	Climber	Fabaceae	Medicine/Ritual
13	*Bridelia retusa* (L.) A.Juss.	Kasi	Tree	Phyllanthaceae	Medicinal/Ritual/Timber
14	*Buchanania lanzan* Spreng.	Charkoli	Tree	Anacardiaceae	Ritual/Fruit
15	*Butea monosperma* Lam.	Palasa	Tree	Fabaceae	Ritual
16	*Capparis zeylanica* L.	Ashadhua	Climber	Capparaceae	Medicine
17	*Carissa spinarum* L.	Kshirakoli	Shrub	Apocynaceae	Fruit/Medicine
18	*Cassia fistula* L.	Sunari	Tree	Fabaceae	Ritual/Medicine
19	*Cinnamomum camphora* (L.) J.Presl.	Karpura	Tree	Lauraceae	Sacred/Medicine
20	*Clerodendrum infortunatum* L.	Kala malli	Herb	Lamiaceae	Medicine
21	*Combretum roxburghii* Spreng.	Aatundi	Climber	Combretaceae	Medicine
22	*Cryptolepis buchanania* R.Br. ex Roem & Schult.	Gopakahnu	Climber	Apocynaceae	Medicine
23	*Cymbopogon flexuosus* (Nees ex Steud.) W. Watson	Dhanwantari	Herb	Poaceae	Medicine
24	*Dalbergia sissoo* Roxb. ex DC.	Sisu	Tree	Fabaceae	Medicine/Ritual/Timber
25	*Diospyrus malabarica* (Desr.) Kostel.	Kalikendu	Tree	Ebenaceae	Sacred/Ritual
26	*Diospyrus melanoxylon* Roxb.	Kendu	Tree	Ebenaceae	Ritual/Fruit
27	*Elaeocarpus sphaericus* (Gaertn.) Heer	Rudraksha	Tree	Elaeocarpaceae	Sacred/Ritual
28	*Ficus benghalensis* L.	Bara	Tree	Moraceae	Ritual
29	*Ficus racemosa* L.	Dimiri	Tree	Moraceae	Ritual/Medicine
30	*Ficus krishnae* C.DC.	Olatabara	Tree	Moraceae	Ritual
31	*Ficus religiosa* L.	Ashwattha	Tree	Moraceae	Ritual
32	*Gardenia gummifera* L.f.	Bhurudu	Large Shrub	Rubiaceae	Medicine/Fruit
33	*Gmelina arborea* Roxb. ex Sm.	Gambhari	Tree	Lamiaceae	Medicine/Ritual/ Timber
34	*Gymnema sylvestre* (Retz.) R.Br.	Gudamari	Climber	Apocynaceae	Medicine
35	*Hemidesmus indicus* (L.) R.Br.	Anantamula	Creeper	Apocynaceae	Ritual/Medicine
36	*Holarrhena pubescens* Wall. ex G.Don.	Kuluchi	Tree	Apocynaceae	Ritual/Medicine
37	*Indigofera cassioides* Rottler ex DC.	Giliri	Shrub	Fabaceae	Medicine
38	*Jatropha curcas* L.	Gaba	Shrub	Euphorbiaceae	Medicine
39	*Justicia adhatoda* L.	Basanga	Shrub	Acanthaceae	Medicine
40	*Lagerstroemia speciosa* (L.) Martyn.	Patuli	Tree	Lythraceae	Ritual
41	*Lannea coromandelica* (Houtt.) Merr.	Jia	Tree	Anacardiaceae	Ritual/Timber
42	*Madhuca longifolia* (L.) J.F.Macbr.	Mahula	Tree	Sapotaceae	Sacred/Ritual/Timber
43	*Magnolia champaca* (L.) Baill. ex Pierre.	Champa	Tree	Magnoliaceae	Ritual
44	*Mangifera indica* L.	Amba	Tree	Anacardiaceae	Ritual/Fruit
45	*Melia azedarach* L.	Mahalimba	Tree	Meliaceae	Medicine/Ritual
46	*Mesua ferrea* L.	Nageswara	Tree	Calophyllaceae	Ritual/Medicine
47	*Oroxylum indicum* (L.) Kurtz	Phanphana	Tree	Bignoniaceae	Medicine
48	*Phyllanthus acidus* (L.) Skeels	Narakoli	Tree	Phyllanthaceae	Ritual/Fruit
49	*Phyllanthus emblica* L.	Amla	Tree	Phyllanthaceae	Medicine/Ritual
50	*Pongamia pinnata* (L.) Pierre	Karanja	Tree	Fabaceae	Medicine/Ritual
51	*Pterocarpus marsupium* Roxb.	Pia-sal	Tree	Fabaceae	Rituals/Timber
52	*Pterospermum acerifolium* (L.) Willd.	Muchukunda	Tree	Malvaceae	Ritual
53	*Rauvolfia serpentina* (L.) Benth. ex Kurtz.	Sarpagandha	Shrub	Apocynaceae	Medicine/Ritual
54	*Santalum album* L.	Chandana	Tree	Santalaceae	Ritual
55	*Saraca asoca* (Roxb.) de Wilde.	Ashoka	Tree	Fabaceae	Medicine/Ritual
56	*Schleichera oleosa* (Lour.) Oken	Kusuma	Tree	Sapindaceae	Ritual/Medicine
57	*Semecarpus anacardium* L.	Bhalia	Tree	Anacardiaceae	Ritual/Medicine
58	*Shorea robusta* C.F. Gaertn.	Sal	Tree	Dipterocarpaceae	Ritual/Timber
59	*Smilax rotundifolia* L.	Muchuri	Climber	Smilacaceae	Ritual/ Medicine
60	*Streblus asper* Lour.	Sahada	Tree	Moraceae	Ritual/Medicine
61	*Strychnos nux-vomica* L.	Kochila	Tree	Loganiaceae	Medicine
62	*Syzygium cumini* (L.) Skeels	Jamukoli	Tree	Myrtaceae	Ritual/Medicine
63	*Syzygium polycephalum* (Miq.) Merr. & L.M. Perry	Balijamu	Tree	Myrtaceae	Fruit/Medicine
64	*Tamarindus indica* L.	Tentuli	Tree	Fabaceae	Fruit
65	*Tectona grandis* L.f.	Saguan	Tree	Lamiaceae	Medicine/Timber
66	*Terminalia anogeissiana* Gere & Boatwr.	Dhaura	Tree	Combretaceae	Ritual/Medicine
67	*Terminalia arjuna* (Roxb.) Wight & Arn.	Arjuna	Tree	Combretaceae	Ritual/Medicine
68	*Terminalia bellirica* (Gaertn.) Roxb.	Bahada	Tree	Combretaceae	Medicine/Ritual
69	*Terminalia chebula* Retz.	Harida	Tree	Combretaceae	Ritual/Medicine
70	*Terminalia elliptica* Willd.	Asana	Tree	Combretaceae	Ritual/Medicine
71	*Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thomas.	Guluchi	Climber	Menispermaceae	Medicine
72	*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda.	Phulajhadu	Herb	Poaceae	Ritual
73	*Vitex negundo* L.	Begunia	Shrub	Lamiaceae	Medicine
74	*Cissus quadrangularis* L.	Hadabhanga	Climber	Vitaceae	Medicine
75	*Woodfordia fruticosa* (L.)Kurz	Dhatiki	Shrub	Lythraceae	Medicine/Ritual
76	*Ziziphus oenoplia* (L.) Mill.	Kantei koli	Shrub	Rhamnaceae	Medicine/Fruit

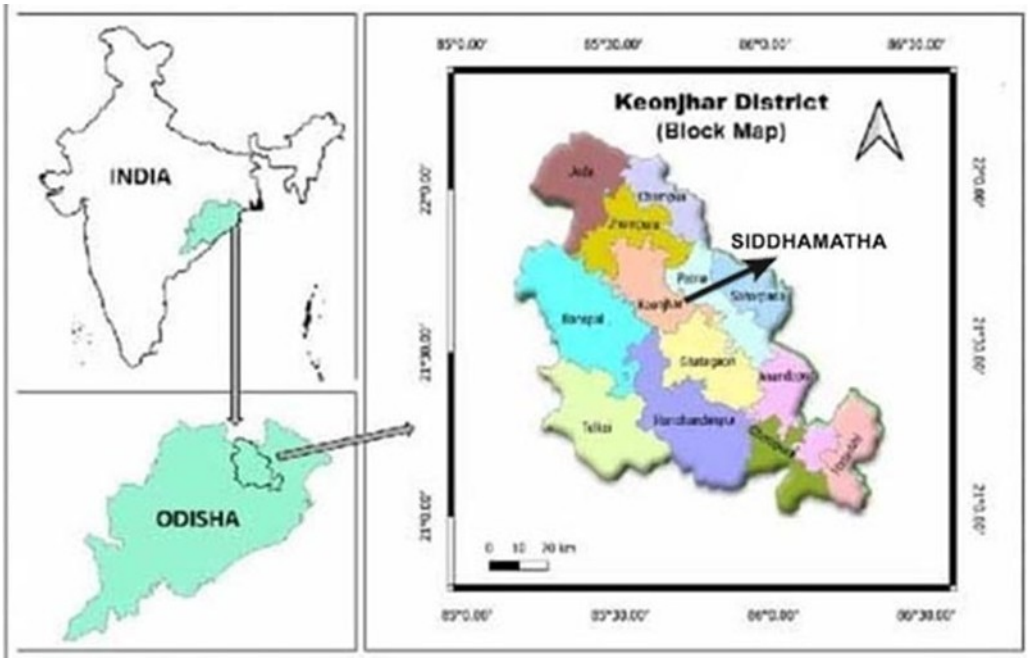

Fig. 1. Map showing the location of Keonjhar district, Odisha, India.

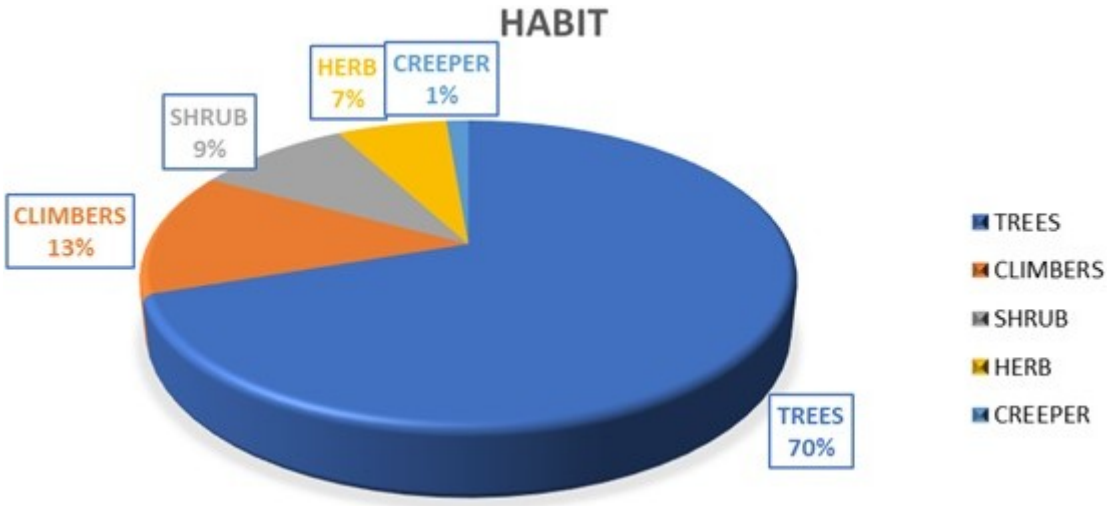

Fig. 2. Habit-wise distribution of medicinal plants (in %) in the sacred groves of Siddhamatha, Keonjhar district, Odisha.

Using the total of 76 medicinal plant species, the Shannon–Wiener Diversity Index (H′) for the sacred grove vegetation was calculated as $H' \approx 2.97$, indicating high species diversity within the grove ecosystem.

Similarly, the Simpson's Diversity Index (1 - D) was calculated as 0.92, suggesting low dominance and high diversity among plant families.

These statistical values indicate that the sacred groves of Siddhamatha maintain a well-balanced plant community structure, where no single plant family overwhelmingly dominates the vegetation. The relatively high Shannon index reflects the presence of numerous plant families with moderate representation, while the high Simpson diversity value suggests stable ecological conditions maintained through traditional protection mechanisms.

Comparable diversity values have been reported from sacred groves in Meghalaya, Maharashtra, and the Western Ghats, where cultural taboos and restricted extraction practices help maintain heterogeneous plant assemblages (Jeeva et al., 2006; Sangale et al., 2025).

The statistical results reinforce the ecological significance of the sacred groves in Keonjhar as micro-

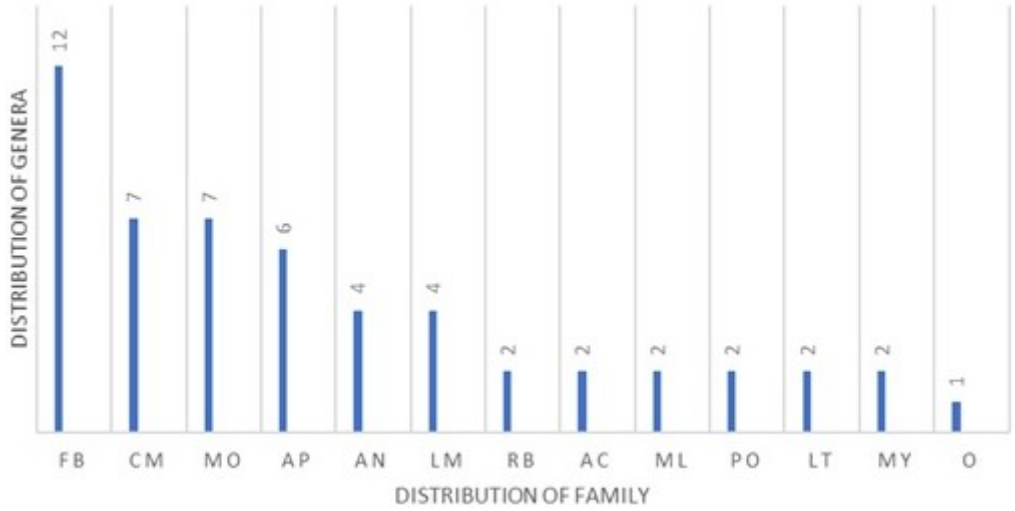

Fig. 3. Family- wise distribution of medicinal plants found in sacred groves of SiddhamathaKeonjhar district, Odisha.

refugia of medicinal plant diversity, supporting the argument that even small culturally protected forests can harbour considerable biodiversity.

Culturally important species such as *Saraca asoca*, *Rauvolfia serpentina*, *Pterocarpus marsupium*, and *Santalum album* illustrate the role of sacred groves as refugia for threatened or declining taxa. Similar findings have been reported from Meghalaya (Jeeva et al., 2006) and Maharashtra (Sangale et al., 2025), where cultural taboos and ritual prohibitions help preserve species that face pressure in surrounding landscapes. In Keonjhar, ritual cycles, seasonal festivals, and ancestral worship practices continue to regulate access to sacred groves, thereby maintaining ecological integrity despite increasing anthropogenic stress. The persistence of such cultural mechanisms aligns with studies highlighting the centrality of Traditional Ecological Knowledge in sustaining medicinal plant resources (Kala, 2017).

Comparative analysis indicates that species richness in the Siddhamatha grove falls within the typical range for Eastern Indian sacred groves but is lower than large groves reported from the Western Ghats or Central Himalayas (200–300 species). This difference likely reflects the smaller grove size near Keonjhar town, surrounding land-use change, and the semi-deciduous nature of the vegetation. Nonetheless, the presence of multiple high-value medicinal species and structurally important trees shows that even relatively small sacred groves can harbour significant biological capital, consistent with findings from West Bengal and Himachal Pradesh (Nayak et al., 2023).

Threats identified in Keonjhar such as urban expansion, mining-related disturbances, illegal resource extraction, and the erosion of traditional custodianship, mirror national trends documented across India (Warrier et al., 2023; Rana et al., 2025). The weakening of ritual authority and declining intergenerational knowledge transmission further exacerbate conservation challenges. Similar socio-ecological shifts have been highlighted in recent reviews on community forest management (Lalrinmawia, 2025), emphasizing the need for renewed engagement between local communities, researchers, and policy institutions.

Given these pressures, sacred groves in Keonjhar require a combination of cultural revitalization and modern conservation approaches. Strategies may include: i) strengthening community-led protection committees; ii) documenting TEK and integrating it into local education; iii) legal recognition of sacred groves as community heritage forests; iv) restoration planting of culturally important and native species; v) linking grove conservation with ecotourism and livelihood programs and vi) periodic monitoring of grove health, including macrofungal diversity (Nayak et al., 2025).

The application of ecological diversity indices provides quantitative support to the floristic observations recorded during field surveys. The relatively high Shannon–Wiener value ($H' \approx 2.97$) suggests substantial heterogeneity within the medicinal plant assemblage, reflecting both species richness and equitable distribution among plant families. Similarly, the high Simpson's diversity value (1 - D = 0.92) indicates minimal dominance by any single taxonomic

group. These statistical patterns confirm that sacred groves function as stable ecological niches where traditional protection mechanisms allow diverse plant species to coexist. Such quantitative assessments strengthen the ecological interpretation of sacred groves as effective community-based biodiversity conservation systems.

Overall, this study reinforces the ecological and ethnomedicinal significance of Keonjhar's sacred groves and highlights their potential role in sustaining biodiversity under changing socio-ecological conditions. By integrating traditional knowledge with participatory conservation frameworks (Ormsby and Bhagwat, 2010), sacred groves can continue to serve as resilient cultural-ecological systems supporting both biodiversity and community well-being.

Table 2. Diversity indices of medicinal plants recorded from sacred groves of Siddhamatha, Keonjhar.

Diversity Index	Value	Interpretation
Shannon-Wiener Index(H′)	2.97	High species diversity
Simpson's Index (D)	0.08	Low dominance
Simpson's Diversity (1 - D)	0.92	Very high diversity

4. Conclusion and Future perspectives

The present study provides the first systematic account of the medicinal plant diversity and cultural significance of the SiddhamathaJaheera sacred grove and associated forest patches in Keonjhar, Odisha. A total of 76 medicinal plant species were documented, highlighting the grove's role as a biologically rich and culturally protected micro-ecosystem. The dominance of native tree species, together with the presence of several culturally and medicinally important taxa, underscores the ecological stability and conservation potential of these community-managed landscapes. Ethnobotanical documentation reveals that traditional knowledge associated with these species remains strong among elders, healers, and ritual practitioners, although transmission to younger generations is gradually weakening.

The medicinal plants recorded from the sacred groves of Keonjhar exhibit varied global and local conservation statuses. Several key species fall under threatened categories of the IUCN Red List, including *Saraca asoca* (Vulnerable), *Rauvolfia serpentina* (Endangered), *Pterocarpus marsupium* (Near Threatened), and *Santalum album* (Vulnerable), reflecting pressures from overharvesssting and habitat loss. At the local level, many species not formally assessed by IUCN are considered rare, declining, or culturally protected based on community perceptions and availability trends. Traditional taboos, restricted access, and ritual significance associated with sacred groves play a critical role in conserving these species in situ, highlighting the importance of integrating IUCN-based assessments with local conservation status and indigenous knowledge for effective biodiversitymanagement in the Keonjhar region.

The statistical evaluation of species diversity further strengthens the ecological interpretation of the sacred grove ecosystem. The relatively high Shannon–Wiener diversity index ($H' = 2.97$) and Simpson's diversity value ($1 - D = 0.92$) indicate a well-balanced plant community with low taxonomic dominance and substantial species heterogeneity. These findings quantitatively confirm that the sacred groves of Keonjhar function as stable microrefugia supporting diverse medicinal flora under traditional community protection.

Additionally, the documented medicinal species offer significant scope for phytochemical screening and pharmacological validation to scientifically substantiate traditional uses, promote value addition, and support sustainable livelihood opportunities, while ensuring benefit-sharing mechanisms in alignment with national biodiversity regulations.

The study also points to growing threats including urban expansion, mining-related disturbances, resource extraction, and erosion of ritual authority, that could undermine the long-term survival of sacred groves in Keonjhar. Despite their modest size, these groves continue to function as reservoirs of medicinal plant diversity, cultural identity, and traditional ecological knowledge. Strengthening community stewardship, formal recognition of sacred groves as heritage forests, and integrating traditional practices with participatory conservation strategies are crucial steps for safeguarding these ecologically valuable systems.

Overall, the findings reaffirm that sacred groves remain vital socio-ecological assets in eastern India. Protecting them not only conserves biodiversity but also supports cultural continuity and sustainable community-based forest management. Continued documentation, monitoring, and community engagement are essential to ensure that these living cultural landscapes persist amid changing environmental and socio-economic conditions. Further exploration and scientific documentation of unexplored

sacred groves across Odisha are essential for safeguarding wild germplasm and promoting sustainable biodiversity management.

Abbreviations

FB: Fabaceae, CM: Combretaceae, MO: Moraceae, AP: Apocynaceae, AN: Anacardiaceae, LM: Lamiaceae, RB: Rubiaceae, AC: Acanthaceae, ML: Meliaceae, PO: Poaceae, LT: Lythraceae, MY: Myrtaceae. O: Others.

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AI-use disclosure statement

During the preparation of this manuscript, the authors used AI tools to improve the language and readability. After using this tool, the authors reviewed the content and made changes wherever necessary. The authors take full responsibility for the contents of this publication.

Credit statement

SA: Investigation, Formal Analysis, Writing Original draft.

KBS: Editing, Supervision.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this paper.

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