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SACRED GROVES AS COMMUNITY-BASED BIODIVERSITY CONSERVATION: SOCIO-CULTURAL PRACTICES AND ENVIRONMENTAL OUTCOMES IN INDIA

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Abstract. Sacred groves in India represent a unique model of community-based biodiversity conservation, rooted in deep religious and cultural traditions. These forest fragments, managed through customary laws and spiritual taboos, serve as refuges for rare and endemic species, contribute to ecosystem services such as soil and water conservation, and foster the transmission of traditional ecological knowledge across generations. Despite their ecological and socio-cultural significance, sacred groves face mounting threats from land conversion, resource exploitation, and the erosion of traditional values. Strengthening their protection requires integrating statutory frameworks with local governance, promoting inclusive community participation, and revitalizing indigenous knowledge systems. This article advances understanding by demonstrating how sacred groves align with contemporary global conservation frameworks-community-led conservation, climate resilience, and SDG integration-offering scalable models for biodiversity protection in India and globally.

Keywords: Sacred Groves, Community-based Conservation, Traditional Knowledge, Biodiversity.

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1. Introduction

Sacred groves are forest fragments protected by local communities due to religious or cultural beliefs, often dedicated to deities, ancestral spirits, or local guardians. These groves, which vary in size from less than a hectare to several hundred hectares, are managed through traditional practices, including unwritten rules and taboos that limit resource extraction and disturbance (Ahmed, Sharma, and Dhiman, 2023). India is estimated to have between 14,000 and 100,000 sacred groves, distributed across diverse ecological and cultural landscapes, including the Western Ghats, the northeast, central India, and arid Rajasthan (Malhotra et al., 2007; Ormsby and Bhagwat, 2010). Globally, sacred groves and analogous sacred natural sites are recognized as critical biodiversity hotspots and living repositories of cultural heritage (Bhagwat and Rutte, 2006). In India, these groves often harbor rare, endemic, and threatened species, serving as refugia amidst increasingly fragmented landscapes (Khan et al., 2008). Their continued existence is a testament to the enduring power of indigenous belief systems and collective action. The relevance of community-led conservation is growing in the face of accelerating biodiversity loss and climate change. This review advances beyond existing reviews by demonstrating how sacred groves embody contemporary conservation paradigms-community-based governance, nature-based solutions, climate resilience, and sustainable development integration-positioning them as models for achieving UN SDGs (particularly SDG 15) and the Post-2020 Global Biodiversity Framework.

2. Historical and Cultural Context

2.1. **Ancient Origins and Scriptural References.** Sacred groves in India represent a deeply rooted tradition of community-based conservation, with origins that predate recorded history and extend into the fabric of contemporary cultural and religious life through the evolution of Hinduism, Buddhism, and Jainism. The concept of sacred groves can be traced to the pre-agricultural era, where early human societies, through animistic beliefs, began to ascribe spiritual significance to patches of forests, water bodies, and specific species, thereby instituting informal protection regimes based on taboos and customary laws (Gadgil and Vartak, 1976, 1981a, 1981b, as cited in Peer and Wani, 2022). Ancient Indian texts-including the Mahabharata, Ramayana, and various Puranas-contain numerous references to sacred forests, rivers, and mountains. These references underscore the centrality of nature in spiritual and ethical discourses (Hansepi, 2017). Forests were classified in ancient India as Mahavan (wilderness), Shreevan (resource forests), Upvan (recreational groves), and Tapovan (sacred forests), reflecting an advanced understanding of

their ecological and spiritual roles. Tapovan, or sacred groves, were seen as sanctuaries for ascetics and spiritual seekers, protected by strong taboos and religious rules. Jain texts mention sacred groves as places where Tirthankaras appeared and meditated, highlighting non-violence and respect for all life. These groves were also linked to burial grounds and ancestor worship among tribal communities, serving as spiritual and social spaces (Malhotra et al., 2001).

2.2. **Regional Variations and Local Identities.** The diversity of sacred groves across India is reflected in their regional nomenclature and cultural significance. In Kerala, *kavu* refers to compact wooded areas set aside for the veneration of snake deities and indigenous goddesses, and they are typically connected with intricate ceremonial practices and celebrations, including those related to Sarpa Kavu. Rajasthan's *orans* are extensive tracts of land protected by local communities, playing a crucial role in religious practices and providing essential ecological services in arid regions. These sacred groves are closely associated with local deities and function as vital sources of fodder and water, with strict community-enforced taboos prohibiting resource extraction except during emergencies (Choudhary and Choudhary, 2023). Sarna and jaherthan are important sacred places for Adivasi communities in Jharkhand, especially during festivals such as Sarhul, which marks the blooming of the sal tree and the start of new life. Other notable regional forms include *devarakadu* in Karnataka, devrai in Maharashtra, and law *kyntang* in Meghalaya, each reflecting unique ecological, spiritual, and social functions (Malhotra et al., 2001). Despite this diversity, a common thread is the association of these groves with local deities, ancestral spirits, or mythological beings, which has ensured community stewardship and continuity of protection across generations (Hansepi, 2017).

Figure 1. Distribution of Sacred Groves in India. (Reprinted from Distribution of Sacred Groves in India [Map], by C.P.R. Environmental Education Centre, n.d., Ministry of Environment, Forest and Climate Change, Government of India)

2.3. **Rituals, Festivals, and Folklore.** Sacred groves are integral to the religious and cultural life of communities, serving as venues for annual rituals, festivals, and ceremonies that reaffirm the relationship between people, deities, and nature (Singh et al., 2017). For instance, the Sarhul festival in Jharkhand and the Kailpodh and Puthari festivals in Kodagu (Karnataka) are celebrated within sacred groves, involving offerings, dances, and communal feasts (Malhotra et al., 2001; Ramineni, Bhardwaj, and Kumari, 2024). These events are often accompanied by oral traditions, songs, and folklore that transmit ecological knowledge and cultural values across generations. Local legends and guardian spirit beliefs reinforce sacredness through oral tradition and collective memory, embedding taboo systems that discourage resource extraction (Ghai, 2024).

2.4. **Taboos, Spiritual Sanctions, and Conservation.** Taboos and spiritual sanctions define sacred groves as conservation systems, prohibiting resource extraction (tree cutting, hunting, deadwood collection) through beliefs in supernatural consequences-creating powerful informal regulatory mechanisms deeply embedded in community norms. The enforcement of these taboos is not merely religious but is embedded in the social fabric, with community elders and ritual specialists overseeing adherence to traditional norms. The revered nature of groves enables them to function as strong community-led conservation zones, where ecological balance is sustained by spiritual and cultural traditions.

2.5. **Social Functions and Knowledge Transmission.** Beyond their religious significance, sacred groves function as centers for social gatherings, dispute resolution, and the intergenerational transmission of ecological knowledge. Festivals and communal activities held in groves foster social cohesion and provide opportunities for elders to impart traditional ecological wisdom to younger generations. The joint commitment to safeguarding groves reinforces a sense of community and encourages collective care for the environment. Sacred groves today still demonstrate the harmonious connection between the natural world and cultural traditions, acting both as vital storehouses of indigenous wisdom and as examples of effective grassroots, community-driven conservation efforts.

2.6. **Sacred Groves in Contemporary Conservation Discourse.** Sacred groves represent exemplary models of community-led conservation and nature-based solutions (NbS), deeply rooted in indigenous traditions and ecological stewardship (Bhagwat and Rutte, 2006; UNESCO World Heritage Centre, 2022). Their governance systems align closely with global conservation frameworks, particularly the concept of Indigenous and Community Conserved Areas (ICCAs), which emphasize local participation and cultural values. Sacred groves contribute directly to the UN Sustainable Development Goal 15: Life on

Land, by conserving terrestrial ecosystems and promoting inclusive community engagement (Ormsby and Bhagwat, 2010; UN SDG 15). The Post-2020 Global Biodiversity Framework emphasizes the importance of indigenous peoples and local communities in biodiversity conservation, recognizing their rights and traditional knowledge as integral to achieving global targets (Convention on Biological Diversity, 2022).

The Paris Agreement reinforces this model by urging respect for Indigenous rights in climate action, recognizing their unique contributions to adaptation and resilience (UNFCCC, 2021). Sacred groves also act as nature-based solutions by providing ecosystem services such as carbon sequestration, water regulation, and soil conservation (Gokhale et al., 2011; Sharma and Kumar, 2020). Their management reflects ecosystem-based adaptation (EbA), integrating traditional knowledge with ecological practices to address climate challenges. Studies in Maharashtra show that sacred groves, such as Somjaichi Rai, have significant carbon sequestration potential, making them replicable models for landscape-scale climate resilience (Hangarge et al., 2012).

Table 1. **Alignment of Sacred Groves with Global Conservation Frameworks**

Framework	**Relevant Targets/Goals**	**Sacred Grove Contribution**	**Implementation Examples**
UN SDG 15: Life on Land	15.1: Conserve terrestrial ecosystems 15.5: Reduce degradation of natural habitats 15.9: Integrate ecosystem values into planning	Maintain biodiversity refugia Prevent habitat fragmentation Demonstrate community -based governance	Western Ghats sacred groves protecting endemic species Kerala kavu systems maintaining watershed services
Paris Agreement Adaptation	Article 7: Enhance adaptive capacity Recognize Indigenous knowledge systems	Traditional climate indicators Ecosystem-based adaptation Community resilience building	Meghalaya sacred groves providing climate refugia Rajasthan orans supporting drought resilience
Post-2020 Global Biodiversity Framework	Target 3: Protected area networks Target 20: Indigenous knowledge integration Target 21: Community participation	Community conserved areas Traditional ecological knowledge Participatory governance models	Maharashtra devarai networks Kodagu sacred forest management systems
Nature-based Solutions Framework	Address societal challenges through natural systems Provide co-benefits for biodiversity and human well-being	Carbon sequestration Water regulation Cultural ecosystem services	Urban sacred groves in Kerala Carbon storage in Central India groves

3. Ecological and Environmental Functions

3.1. **Sacred Groves as Reservoirs of Rare, Endemic and Threatened Species.** Sacred groves in India serve as vital refugia for rare, endemic, and threatened species, often preserving biodiversity that has disappeared from surrounding landscapes due to anthropogenic pressures (Jamir and Pandey, 2003). In Meghalaya, at least 50 rare plant species are exclusively confined to sacred groves, with studies documenting 91 such groves, each acting as a micro-level biodiversity hotspot in otherwise degraded areas (Upadhaya et al., 2003). In the Western Ghats, sacred groves protect climax or near-virgin forests, supporting unique and threatened flora and fauna (Chandran and Hughes, 2000). These groves commonly support species no longer found in nearby regions, serving as important living collections of genetic diversity that are critical for conservation.

3.2. **Key Ecosystem Services Provided by Sacred Groves.**

3.2.1. *Soil Conservation and Prevention of Erosion.* Sacred groves, with their dense vegetation, help maintain soil stability and reduce erosion, particularly in fragile highland regions such as the Western Ghats and the Himalayas (Sharma and Kumar, 2020). The presence of root systems and dense undergrowth helps to decrease surface runoff, improve soil structure, and lessen the risk of landslides and sediment accumulation in nearby farmlands and water sources.

3.2.2. *Water Regulation and Aquifer Recharge.* Many sacred groves are associated with springs, ponds, or streams, acting as vital catchment areas that regulate local hydrology and recharge aquifers (Agarwal, 2016). The intact tree canopy and accumulated leaf litter help reduce surface runoff, encourage water to infiltrate deeper into the soil, and support the persistence of year-round water supplies, particularly in dry regions like Rajasthan and Uttarakhand. Studies in Uttarakhand show that water from sacred groves is of higher quality and quantity than from surrounding areas, directly benefiting local communities (Agarwal, 2016).

3.2.3. *Microclimate Regulation and Carbon Sequestration.* Sacred groves help regulate local microclimates through their dense canopy cover. Research shows that groves in Central India store about 33% more carbon than nearby state-managed forests, contributing to climate resilience (Dar et al., 2022). In Sikkim, studies indicate that urban sacred groves can hold almost twice the carbon of some rural forests, though the exact percentage varies (Mongabay India, 2021). Urban sacred groves in Sikkim have been found to sequester nearly twice as much carbon as natural forests, underscoring their significance in supporting climate resilience.

3.3. **Comparative Analysis: Sacred Groves vs. Non-Sacred Forest Patches.** Comparative biodiversity assessments consistently reveal that sacred groves exhibit higher species richness, diversity, and evenness than nearby non-sacred or disturbed forests (Jamir and Pandey, 2003; Boraiah et al., 2003). In Central India, sacred groves contain 74.7% of the region's total tree diversity and 33.1% higher total carbon stock than state forests (Dar, Kothandaraman, Khare, and Khan, 2022). Sacred groves exhibit notably fewer invasive species, highlighting how traditional management approaches contribute to effective conservation.

3.4. **Sacred Groves as "Green Lungs" in Urban and Peri-Urban Areas.** In urbanizing landscapes, sacred groves serve as critical ecological buffers, mitigating air pollution, moderating heat, and sustaining biodiversity while providing cultural and recreational spaces despite increasing habitat loss. These ecological outcomes-high species richness, carbon sequestration, and ecosystem services-are not incidental but systematically produced through the socio-cultural governance systems described below. The relationship between taboos and biodiversity is mechanistic: restricted extraction directly enables canopy closure, soil development, and species recovery. Similarly, ritual and ceremonial uses create stakeholder incentives for grove protection that persist across generations. Understanding sacred groves requires recognizing this ecosystem-culture feedback loop.

4. Socio-Cultural Practices and Community Management

4.1. **Traditional Governance: Community Custodianship and Decision-Making.** Sacred groves in India exemplify community-based governance, where custodianship is typically vested in local collectives, temple trusts, or clan elders. These entities are responsible for the protection, management, and ritual upkeep of the groves, ensuring that their ecological and spiritual sanctity is maintained across generations (Chandrashekara and Sankar, 1998). Decision-making often resides with a village council or temple committee, which oversees all activities related to the grove, including the organization of festivals, resource extraction permissions, and conflict resolution (Ramakrishnan et al., 1998). This governance structure translates into measurable ecological outcomes: Ajeevali's temple trust management, combined with controlled extraction systems, sustains superior species diversity compared to adjacent state-managed forests (Kanade et al., 2008).

4.2. **Enforcement of Taboos: Religious Sanctions and Social Norms.** Taboo enforcement operates through overlapping social, religious, and economic mechanisms. Comm-

unity elders and ritual specialists oversee adherence through peer monitoring and reputational sanctions, while belief in supernatural consequences provides intrinsic motivation. This multilayered enforcement structure explains why taboo-based management often achieves conservation outcomes comparable to or exceeding formal legal protections. Taboos prohibit tree felling, hunting, and resource extraction through belief in supernatural punishment (illness, environmental disasters) enforced by guardian deities, creating powerful community compliance mechanisms. The persistence and effectiveness of these taboos are closely tied to the collective faith and traditional knowledge of the community; however, the encroachment of modernization and the erosion of indigenous belief systems have been shown to undermine these protective practices, leading to the degradation of sacred groves (Ray and Ramachandra, 2010).

4.3. **Sustainable Resource Use and Economic Incentives.** Sacred groves are not entirely closed systems; sustainable use of resources is permitted under strict regulation. Non-timber forest products (NTFPs), medicinal plants, and regulated grazing are allowed in some groves, provided such activities do not compromise ecological integrity (Chandrashekara and Sankar, 1998). In Ajeevali, the extraction of maadi (a traditional liquor from *Caryota urens*) is permitted through a controlled contract system, with the temple trust ensuring that extraction methods are sustainable and do not harm the grove's biodiversity (Kanade et al., 2008). This contractual system creates explicit incentives for resource protection: communities directly benefit from grove health through revenue, translating spiritual value into tangible economic returns. Evidence shows groves with revenue-generating sustainable use systems exhibit better long-term compliance with extraction limits than groves with absolute protection bans, indicating that aligned cultural, economic, and ecological interests strengthen conservation durability. However, the collection of leaf litter, timber, and hunting remains strictly banned, resulting in a dense canopy and high species diversity (Kumar and Sharma, 2011).

4.4. **Role of Women, Youth, and Marginalized Groups.** The participation of women, youth, and marginalized groups in sacred grove management varies regionally. While traditional patriarchal norms often limit women's formal roles, women are frequently involved in rituals, collection of medicinal plants, and the transmission of ecological knowledge within families (Malhotra et al., 2001). In some communities, youth are engaged in festivals and rituals, serving as a conduit for intergenerational knowledge transfer (Ahmed et al., 2023). Marginalized groups, such as the Katkari and Thakar tribes in Maharashtra, contribute as resource users and laborers, though their access to decision-making structures is often constrained (Kanade et al., 2008).

4.5. **Mechanisms for Intergenerational Knowledge Transfer.** Knowledge about sacred groves-taboos, species identification, medicinal uses, and ritual practices is primarily transmitted orally from elders to youth through participation in rituals, storytelling, and practical demonstration (Ramakrishnan et al., 1998). This process is reinforced during annual festivals, communal work, and religious ceremonies. However, the erosion of traditional knowledge due to urbanization and changing livelihoods poses a significant threat to the continuity of these practices (Ahmed et al., 2023). Documentation and revitalization of traditional ecological knowledge are increasingly recognized as vital for sustaining sacred grove conservation in the face of modernization (Gadgil and Vartak, 1981).

5. Policy, Legal Frameworks, and Institutional Support

The policy and legal landscape for sacred grove conservation in India reflects a complex interplay of statutory provisions, customary practices, and evolving institutional arrangements. Historically, conservation was heavily centralized under colonial and post-independence forest laws, which often marginalized local communities and weakened traditional management systems (Malhotra et al., 2001; Kandari et al., 2014). This exclusion eroded cultural ties that underpin community-based conservation and created governance gaps, including inadequate monitoring and resource constraints in government agencies, which persist today (Kandari et al., 2014; IJFMR, 2025).

5.1. **Policy.** Sacred groves in India have long been recognized for their ecological, cultural, and spiritual significance, but their formal legal status has evolved only recently. The Wildlife (Protection) Amendment Act, 2002, marked a significant step by introducing the concept of "community reserves," enabling community-managed ecosystems, including sacred groves, to be legally protected on private or community lands. This legal provision empowers local communities to participate in habitat conservation while maintaining traditional conservation values, with land-use changes subject to approval by reserve management committees and oversight by the Chief Wildlife Warden.

The National Forest Policy of 1988 further underscores the importance of community participation in forest management and biodiversity conservation, advocating for the protection of forest patches with cultural and ecological value. The policy recognizes the need to safeguard traditional knowledge and practices, aligning with the broader goals of participatory conservation.

5.2. **Legal Framework.** Key national legislation relevant to sacred groves includes the Wildlife Protection Act (1972), the Forest Rights Act (2006), and the Biological Diversity

Act (2002). While these laws provide a robust legal framework for biodiversity protection, sacred groves often remain outside formal protected area networks, leaving them vulnerable to encroachment and land-use change (Bijoy, 2025). The Biological Diversity Act, for instance, encourages the formation of Biodiversity Management Committees (BMCs) at the local level, yet the actual empowerment and effectiveness of these committees are inconsistent, particularly in regions where sacred groves are prevalent (National Biodiversity Authority, 2013).

5.3. **Institutional Support.** Institutional support for sacred grove conservation is further complicated by overlapping jurisdictions and fragmented governance. Forest departments, local self-governments, and community institutions may all claim authority, resulting in unclear mandates and weak enforcement (IJFMR, 2025; Singh, 2024). In practice, this fragmentation translates into gaps in resource allocation, monitoring, and the implementation of conservation measures. Moreover, economic pressures, urbanization, and social changes have eroded traditional knowledge and community values, further undermining the effectiveness of both statutory and customary management (IJFMR, 2025).

Recent scholarship emphasizes the need for participatory and stakeholder-driven approaches to sacred grove management. Stakeholder analysis in Gujarat, for example, demonstrates that restoration management-balancing ecological, cultural, and economic values-yields the best outcomes when multiple interests are considered and local voices are included in decision-making (Pandey, Sardana, and Gupta, 2021). Similarly, studies highlight the importance of collaborative initiatives among government bodies, NGOs, and local communities to ensure the sustainability of sacred groves.

5.4. **Gaps.** Despite the existence of comprehensive biodiversity laws, significant gaps remain in enforcement, capacity, and the reconciliation of conservation with development imperatives (Goswami and Kuri, 2024). Institutional mechanisms such as the National Biodiversity Authority and state biodiversity boards exist, but their effectiveness is limited by resource constraints, lack of coordination, and insufficient stakeholder participation (Goswami and Kuri, 2024); Singh, 2024). Innovative strategies like ecological fiscal transfers and the establishment of community reserves hold potential; however, expanding their impact depends on legislative changes and increased political commitment.

Moreover, the international conservation discourse, exemplified by frameworks like UNESCO's Historic Urban Landscape (HUL), underscores the value of integrating heritage conservation with sustainable development and participatory governance (Sharma and Gupta, 2025). In India, the effective execution of policies continues to be hindered by

increasing commercialization, infrastructure demands, and a tendency to prioritize developmental objectives above conservation efforts, especially within urban and peri-urban areas.

6. Threats and Challenges

Sacred groves in India face complex threats that undermine both their ecological integrity and cultural significance. These challenges arise from the interplay of socioeconomic pressures, environmental changes, and evolving cultural values, which collectively erode traditional conservation practices and threaten the long-term sustainability of these unique ecosystems (Bhagwat and Rutte, 2006).

6.1. Human-Induced Threats.

6.1.1. *Deforestation and Land Conversion.* Expansion of agriculture, urbanization, and infrastructure development are among the most direct threats to sacred groves. Agricultural encroachment and construction have reduced the size and ecological connectivity of many groves, especially in densely populated regions, fragmenting habitats and diminishing their biodiversity value (Khan et al., 2008).

6.1.2. *Resource Exploitation.* Economic pressures have led to unsustainable extraction of timber, fuelwood, and non-timber forest products from sacred groves, despite traditional taboos. The commercial harvesting of medicinal plants threatens rare and endemic species, and overexploitation can degrade soils and destabilize ecosystems, making recovery difficult (Chandrakanth et al., 2004).

6.1.3. *Pollution and Invasive Species.* Pollution from agriculture and urban runoff introduces chemicals that harm grove flora and fauna. Invasive species such as Lantana camara and Prosopis juliflora outcompete native vegetation, altering ecosystem structure and reducing native biodiversity (Nayak et al., 2019a).

6.2. **Climate Change Impacts.** Rising temperatures and altered rainfall patterns due to climate change pose significant risks. Many species in sacred groves have narrow climatic requirements, making them vulnerable to shifts in temperature and precipitation. Changes in hydrological cycles can disrupt ecosystem health, affecting soil moisture, pollination, and species diversity (Upadhaya et al., 2003).

6.3. Socio-Cultural Challenges.

6.3.1. *Erosion of Traditional Knowledge.* Modernization and urbanization have weakened the intergenerational transmission of ecological knowledge and spiritual practices associated with sacred groves. The diminishing role of traditional custodians and the conversion to other religions have eroded taboos that historically protected these areas (Malhotra et al., 2001).

6.3.2. *Changing Community Values.* Economic development and migration have shifted community priorities toward material gains, reducing engagement in traditional stewardship. The transformation of nature worship into formal temple worship and urban expansion have led to the clearing of groves for temple construction, particularly in Kerala (Chandrasekara and Sankar, 1998).

6.3.3. *Declining Community Involvement.* Reduced community engagement in grove management often results in neglect and increased vulnerability to harmful practices. When local perspectives are excluded from decision-making, traditional knowledge is overlooked, and conservation outcomes suffer (Ormsby and Bhagwat, 2010).

6.4. **Economic and Governance Challenges.**

6.4.1. *Economic Pressures and Competing Land Uses.* Rapid development increases the demand for land, putting groves at risk of conversion for agriculture, urban expansion, or industry. Economic incentives for development often outweigh the perceived benefits of conservation, leading to the destruction of community-protected forests (Gadgil and Vartak, 1976).

6.4.2. *Inadequate Policy and Enforcement.* Many sacred groves lack formal legal protection, leaving them vulnerable to encroachment and degradation. Even where legal frameworks exist, weak enforcement and overlapping governance create confusion and hinder effective conservation (Kandari et al., 2014).

6.5. **Institutional and Management Challenges.**

6.5.1. *Lack of Financial Resources.* Limited funding hampers monitoring, maintenance, and community engagement, undermining conservation and restoration efforts. Government and NGO resources are often insufficient for long-term management (Gokhale, Pala, Negi, Bhat, and Todaria, 2011).

6.5.2. *Conflicts in Management Approaches.* Tensions between traditional and modern conservation paradigms can result in ineffective management. National park-style approaches may neglect the cultural dimensions of sacred groves, while conflicts among managers can lead to biodiversity loss, highlighting the need for inclusive governance (Ramakrishnan et al., 1998).

Integrated conservation approaches that address both ecological and socio-cultural dimensions are essential. Collaborative efforts among government, NGOs, researchers, and communities are needed to develop solutions that balance conservation with local needs, ensuring the continued protection of India's sacred groves (Bhagwat and Rutte, 2006).

7. Conservation Outcomes and Case Studies

Sacred groves are among the most effective traditional systems for biodiversity conservation in India, providing ecological, social, and cultural benefits. Managed by local communities, these forest fragments serve as biodiversity reservoirs and offer critical ecosystem services while reinforcing cultural ties to nature. This section discusses key conservation outcomes and presents case studies that illustrate the effectiveness of sacred groves as community-based conservation models.

7.1. **Biodiversity Conservation Outcomes.** Sacred groves act as refugia for endemic, rare, and threatened species, often preserving flora and fauna that might otherwise disappear locally. In the Western Ghats, sacred groves have been shown to harbor higher tree diversity, including threatened species, than surrounding landscapes and even some formal protected areas, highlighting their complementary conservation role (Bhagwat et al., 2005). A recent ethnobotanical survey in Maharashtra documented 81 medicinal plant species within sacred groves, including rare and threatened taxa such as Gloriosa superba (critically endangered) and Hemidesmus indicus, underscoring the role of these groves in conserving regional biodiversity (Sangale et al., 2025). In Northeast India, such as Meghalaya, sacred groves (locally called "Law Kyntang") maintain unique ecological niches and support rich tropical vegetation, while in Odisha, studies have recorded notable biodiversity within small grove networks (Tiwari et al., 1998; Mohanta et al., 2012).

7.2. **Ecosystem Services and Environmental Benefits.** Beyond biodiversity, sacred groves provide essential ecosystem services. In Kerala, sacred groves help maintain hydrological balance, with many containing ponds or streams that support local water tables and aquatic diversity (Chandrashekara, 2011). Carbon sequestration is another key benefit; research in Gujarat and Maharashtra has quantified substantial carbon stocks in sacred

groves, contributing to climate mitigation (Hangarge et al., 2012). These environmental services reinforce the broader ecological value of sacred groves beyond their immediate boundaries.

7.3. **Case Studies of Successful Conservation.**

- *Western Ghats*: In Maharashtra Pune district, each sacred grove exhibits unique biodiversity, with low similarity even among nearby groves, emphasizing the irreplaceability of each site (Kulkarni et al., 2018). In Karnataka's Kodagu district, sacred forests protect threatened tree species not found in formal reserves, and a significant proportion of regenerating species are medicinally important or exclusive to these groves (Boraiah et al., 2003).

- *Northeast India*: In Meghalaya, sacred groves are preserved through customary laws and traditional beliefs, effectively safeguarding both biodiversity and cultural heritage (Ormsby, 2013). Meghalaya's sacred groves are exemplary models of community-based conservation, play a crucial role in sustainable biodiversity management, and have been recognized as potential candidates for UNESCO World Heritage status, as seen in the inclusion of the Living Root Bridges (a form of sacred grove) in India's tentative list (UNESCO, 2022).

- *Kerala*: Participatory restoration and management in Kerala have led to high biodiversity in sacred groves, with hundreds of angiosperm, butterfly, and bird species recorded, many of which are endemic (Chandrashekara, 2011). The Kerala Forest Department's initiatives, in collaboration with research institutions, have developed grove-specific management plans that integrate traditional and scientific knowledge.

- *Tamil Nadu*: Community-led restoration, such as projects by the C.P.R. Environmental Education Center, has successfully revived degraded groves, resulting in improved groundwater, reduced erosion, and increased wildlife habitat, even in small areas (Ramanujam and Cyril, 2003). These efforts demonstrate that community agreements can be as effective as physical protection measures.

7.4. **Quantifiable Conservation Impacts.** Quantitative studies show that sacred groves in Maharashtra sequester significant amounts of carbon, supporting climate goals while conserving biodiversity (Hangarge et al., 2012). In Kerala, restoration of sacred grove water bodies has improved village-level groundwater, and across the Western Ghats, sacred groves consistently show higher species richness than adjacent landscapes (Bhagwat

et al., 2005). In degraded habitats, sacred groves often provide the only remaining tree cover, acting as vital refuges for both flora and fauna (Deb et al., 1997).

Socio-Economic Outcomes: Sacred grove conservation also benefits local communities. In Tamil Nadu, restored groves and water bodies have become community spaces that foster social cohesion and cultural identity, as seen in the "Adavi" forest project (Chandrakanth et al., 2004). In Rajasthan, the Piplantari model, which links tree planting to the birth of girl children, demonstrates how sacred grove conservation can support both sustainable development and gender equity (Kasliwal, 2015).

Lessons from Conservation Outcomes: The evidence from sacred groves across India underscores the effectiveness of community-based approaches that integrate cultural values with conservation goals. These case studies show that small, culturally protected forest fragments can deliver significant ecological and social benefits, highlighting the need to recognize and support diverse governance systems and traditional knowledge in conservation policy and practice (Malhotra et al., 2001). Restoration of degraded groves further demonstrates the potential for ecological and social gains, offering a promising model for broader landscape restoration.

8. Actionable Strategies for Strengthening Sacred Grove Conservation

Recent Supreme Court directives (2024) calling for comprehensive sacred grove policy development (Sinha and Jha, 2025) provide unprecedented opportunities for scaling successful community-based conservation models. Implementation requires stakeholder-specific approaches aligned with global frameworks.

8.1. Policy Recommendations for Government Stakeholders.

8.1.1. *Immediate Actions (2025–2026).*

- Implement Supreme Court directives for nationwide sacred grove mapping and recognition under Wildlife Protection Act Section 36-C (Wildlife Protection Act, 1972).
- Establish dedicated Sacred Grove Conservation Fund with □500 crore allocation following Maharashtra EbA model (India Forum for Nature-based Solutions, 2022).
- Integrate sacred groves into National Biodiversity Strategy and Action Plan (NBSAP) updates for Post-2020 Global Biodiversity Framework compliance (Dar, Kothandaraman, Khare, and Khan, 2022).

8.1.2. *Medium-term Goals (2026–2030).*

- Develop standardized monitoring protocols linking traditional knowledge with scientific assessments (Gokhale, Pala, Negi, Bhat, and Todaria, 2011).
- Create legal framework for Community Conservation Agreements with constitutional backing.
- Establish sacred grove networks as Other Effective Area-based Conservation Measures (OECMs) under CBD guidelines (Colding and Folke, 2001).

8.2. **Implementation Guidelines for NGOs and Civil Society.**

8.2.1. *Capacity Building Programs.*

- Design participatory monitoring training combining traditional indicators with scientific methods.
- Establish Community Conservation Academies for youth engagement and knowledge transfer.
- Create sacred grove networks enabling knowledge sharing and resource pooling across regions.

8.2.2. *Technical Support Systems.*

- Develop mobile applications for community-based monitoring using blockchain transparency protocols.
- Establish restoration technical assistance programs prioritizing native species and traditional practices.
- Create grievance redressal mechanisms for conflicts between conservation and development.

8.3. **Community-Level Action Framework.**

8.3.1. *Governance Strengthening.*

- Formalize inclusive Community Conservation Committees with mandatory women and youth representation.
- Establish transparent benefit-sharing mechanisms for ecosystem services payments.
- Implement participatory management plans integrating traditional calendars with conservation planning.

8.3.2. *Economic Incentive Alignment.*

- Develop community-based ecotourism models maintaining grove sanctity while providing livelihood benefits.
- Create carbon credit aggregation systems for small sacred groves following voluntary standards.
- Establish community conservation endowment funds with diversified funding sources.

8.4. **Integration with Ecosystem-based Adaptation (EbA).** Sacred groves demonstrate natural EbA systems that can be scaled for climate resilience (Hangarge et al., 2012; India Forum for Nature-based Solutions, 2022).

8.4.1. *Climate Adaptation Integration.*

- Incorporate sacred groves into district climate adaptation plans as natural infrastructure.
- Develop climate-resilient species conservation programs based on traditional knowledge.
- Create sacred grove corridors for climate migration pathways.

8.4.2. *Disaster Risk Reduction.*

- Recognize sacred groves as natural disaster buffers in land-use planning.
- Integrate traditional weather prediction systems with early warning systems.
- Develop community-based disaster preparedness programs centered on grove institutions.

These recommendations align with SDG 15 targets (UN SDG 15: Life on Land) and support India's commitments under the Paris Agreement (UNFCCC, 2021) and Global Biodiversity Framework (Dar, Kothandaraman, Khare, and Khan, 2022).

9. **Discussion**

The conservation of sacred groves in India exemplifies the complex interplay between socio-cultural traditions, community governance, and ecological stewardship. As the preceding sections have demonstrated, sacred groves are not merely relics of spiritual heritage but dynamic, living landscapes that continue to deliver critical biodiversity and ecosystem services, even as they face mounting threats from modernization, land-use change, and shifting values (Singh et al., 2017). A key insight emerging from the literature is

the enduring efficacy of community-based management rooted in religious and cultural norms. Traditional taboos, rituals, and festivals have historically provided robust, decentralized regulatory frameworks that often outperform formal, state-led conservation models in terms of ecological outcomes and resilience (Bhagwat and Rutte, 2006). This is evident in the superior species richness, structural complexity, and carbon sequestration capacities documented in sacred groves compared to adjacent non-sacred forests (Devakumar et al., 2018). The high lichen and plant diversity in groves, such as those in West Bengal and Meghalaya, further underscores their role as biodiversity refugia, particularly for rare and threatened taxa (Kandari et al., 2014; Upadhaya et al., 2003).

However, this traditional stewardship is increasingly vulnerable. The erosion of indigenous knowledge, declining community engagement, and the weakening of spiritual sanctions-driven by urbanization, migration, and changing socio-economic aspirations-are leading to the gradual degradation of many groves (Singh et al., 2017). The perception of sacred groves as sites of superstition among younger generations, coupled with reduced transmission of ecological knowledge, threatens the continuity of these conservation systems (Gurkar, 2025). Simultaneously, external pressures such as invasive species, land encroachment, and climate variability compound these challenges, highlighting the need for adaptive, context-sensitive management approaches (Nayak et al., 2019a; Nayak et al., 2019b).

Policy and governance frameworks, while evolving, remain fragmented and often insufficiently attuned to the unique needs of sacred grove conservation. The introduction of legal categories such as "community reserves" under the Wildlife (Protection) Amendment Act, 2002, and the recognition of community rights under the Forest Rights Act, 2006, represent important steps forward (Sinha and Jha, 2025). Yet, implementation gaps, overlapping jurisdictions, and weak enforcement continue to undermine the effectiveness of these measures (IJFMR, 2025). The limited official acknowledgment of sacred groves highlights how existing legal mechanisms are not being fully leveraged.

Current research and practical examples suggest that a unified strategy-which combines formal legal safeguards with established local management practices-can help maintain the active involvement of community members in both designing and implementing conservation efforts. Collaborative governance approaches that meaningfully involve women and marginalized populations play a vital role in building institutional credibility, resilience, and flexibility in responding to challenges. Financial mechanisms, such as ecosystem

service payments and community-based ecotourism, offer promising avenues for incentivizing conservation while delivering tangible benefits to local stakeholders (Devakumar et al., 2018).

The ecological and social outcomes documented in successful case studies-from the Western Ghats to Northeast India-demonstrate that sacred groves can serve as models for landscape-scale conservation, bridging the gap between formal protected areas and human-dominated landscapes (Bhagwat et al., 2005; Chandrashekara, 2011). Such instances underscore the vital need to merge ancestral environmental knowledge with modern scientific methods in monitoring and restoration initiatives, particularly as we confront climate-related changes and the ongoing loss of biological diversity. In conclusion, the future of sacred grove conservation in India hinges on the ability to sustain and revitalize community stewardship, adapt policy frameworks to local realities, and foster collaborative, multi-stakeholder approaches. Sacred groves are not only repositories of biological and cultural diversity but also laboratories for innovative, community-driven conservation strategies that can inform broader efforts to reconcile development with ecological sustainability.

10. **Conclusion**

Sacred groves in India are not just relics of traditional conservation but dynamic, community-led systems that align with modern nature-based solutions. They serve as vital intersections of cultural heritage, biodiversity preservation, and climate adaptation.

Studies show sacred groves outperform state-managed forests in biodiversity and carbon storage, with Central India groves holding 74.7% of regional tree diversity and 33% more carbon stock. These outcomes validate traditional ecological knowledge, now recognized in global frameworks like the Post-2020 Global Biodiversity Framework (Dar, Kothandaraman, Khare, and Khan, 2022) and the Paris Agreement (UNFCCC, 2021).

Their governance-rooted in cultural sanctions and community stewardship-offers scalable models for conservation. The Supreme Court's 2024 recognition of sacred groves as part of India's forest strategy (Sinha and Jha, 2025) marks a pivotal policy shift.

Sacred groves align with UN SDG 15 by promoting community-based ecosystem protection and are acknowledged as Indigenous and Community Conserved Areas (ICCAs). Indigenous worldviews, as noted by UNFCCC, emphasize harmony with nature and intergenerational responsibility.

Future priorities include integrating traditional and scientific monitoring, valuing ecosystem services, and documenting endangered knowledge systems. Technologies like remote

sensing and blockchain can support transparent, culturally sensitive governance.

To scale conservation, India must act on legal recognition, inclusive governance, and climate integration. Sacred groves offer both inspiration and practical models for sustainable development, making them essential to India's and the world's biodiversity future.

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