

SACRED GROVES AND SERPENT WORSHIP IN KERALA: ECOLOGICAL FUNCTIONS AND THE ROLE OF INDIGENOUS KNOWLEDGE IN BIODIVERSITY CONSERVATION

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Abstract: Kerala, a state in the southwestern region of India, is renowned not only for its high levels of biodiversity but also for its deeply rooted cultural traditions. These traditions intimately link human life with the natural world. Among them, serpent worship and the maintenance of sacred groves—locally known as ‘Kavu’—stand out as powerful examples of biocultural heritage. Kerala’s sacred groves and serpent worship traditions such as *Sarpam Thullal*, represent an interface between cultural beliefs and ecological preservation. The groves have functioned for centuries as community-protected spaces that preserve remnants of the region’s forests. The unique intersection of ecological conservation and spiritual tradition in Kerala’s snake worship practices offers an underexplored biocultural model for biodiversity preservation. Unlike modern protected areas, Kavus are embedded in ritual practice, oral knowledge systems and seasonal ceremonies, creating a unique model of in-situ conservation. The rituals and prohibitions against felling trees or killing animals in these groves have indirectly led to the preservation of ecological microhabitats, especially for endemic flora and fauna. This review examines how traditional snake worship in Kerala’s sacred groves supports ecological conservation amid urbanization. Drawing from ecological, ethnographic and religious sources, it highlights the ecological and cultural value of serpent-centered groves. The study highlights this specific biocultural conservation framework that brings together Indian Knowledge Systems with modern ecological science for sustainable habitat protection. Understanding how cultural and ritual prohibitions align with modern conservation principles is an important aspect in developing sustainable ecological methods. It is high time to introduce policies that propose a replicable biocultural conservation model integrating Indian Knowledge Systems into contemporary environmental policy to be implemented for real-time conservation practices. In doing so, it positions Kerala’s traditions as a replicable model for nature–culture conservation strategies in other parts of India and the world.

An Overview of Sacred Groves (Kavus)

Sacred groves are traditionally protected forested areas, associated with religious and cultural practices. They are a prominent feature of Kerala’s landscape, playing a vital role in conserving biodiversity. Even herpetofauna, the amphibians and reptiles that thrive in these moist, undisturbed microhabitats, can be easily found in them due to the least disturbances in these areas. The establishment of Kavus marked the deliberate preservation of these areas from anthropogenic disturbances such as cutting of trees and digging, through religious beliefs, thereby allowing natural vegetation and greenery to proliferate undisturbed over time (Pillai, 2018). These groves often support high species richness and endemism, acting as a niche for taxa that are otherwise threatened by habitat fragmentation and land-use change (Meena, 2015). In Kerala, serpent worship is a deeply rooted cultural institution, with rituals and folklore centered around snakes (especially species like *Naja naja* (Indian cobra) and *Python molurus*) being performed within these sacred sites. This reflects a profound reverence for nature and highlights a long-standing, reciprocal relationship between cultural tradition and ecological preservation. The integration of Indian Knowledge Systems (IKS), such as serpent worship, with modern ecological research presents a unique opportunity to inform conservation strategies that are both culturally appropriate and scientifically grounded. Therefore, a comprehensive review on the intersection of ecology and IKS is essential to understand the ecological roles of sacred groves and to develop holistic approaches to biodiversity conservation.

The Eco-Cultural Status of Sacred Groves in Kerala

Sacred groves in Kerala that are locally known as *kavus*, which are traditionally protected patches of forest or woodland that hold religious and cultural significance (Gadgil & Vartak, 1975). They are often associated with local deities, particularly serpent gods like *Nagaraja*, *Nagayakshi* and *Akhilasarpa*. The spiritual core of the groves is marked by *Chithrakoodams* made of granite or laterite stones, believed to be the abode of the deity. Historically, these groves have functioned as socio-ecological sanctuaries, dating back to pre-Vedic traditions. They have evolved alongside Kerala's unique landscape and eco-cultural social systems. These areas were once widespread, integrated into temple complexes and ancestral homesteads (*tharavads*), reflecting a deeply embedded interconnectedness of nature and spirituality (Dudley et al., 2005). Sacred groves in Kerala exhibit considerable diversity in typology, ranging from small serpent groves maintained within household premises to larger forested tracts dedicated to multiple deities. They are integral to the religious practices of many communities in the state.

In Kerala, sacred groves are deeply connected to serpent worship, which is believed to bring prosperity, protect against diseases and ensure land fertility. A key ritual event is the *Ayilyam* festival, held in the Malayalam month of *Thulam* (October–November), where devotees offer milk, turmeric and flowers to serpent deities to seek blessings. Prominent Kavus include the Mannarasala Sree Nagaraja Temple in Alappuzha, with thousands of serpent idols; Pambummeikkattu Mana in Thrissur, associated with the serpent gods Vasuki and Nagaraja; Pattambi Nagakavu in Palakkad, known for its vibrant Ayilyam celebrations; Iringole kavu near Kochi and Nagampoozhi Mana near Vaikom in Kottayam, which hosts five sacred groves across 4.5 acres of rich greenery. The most ancient one is Vettikottu Adhimoolam Sri Nagarajaswamy Temple in Alappuzha, which is believed to be the first Nagaraja (serpent king) temple in Kerala, enshrining Ananthan, the serpent king, as its presiding deity. These sites are not only centers of spiritual devotion but also vital pockets of ecological preservation (Jayarajan, 2009; Kruzman, 2019; Chandrashekhar, 2024).

Geographically, they are distributed across the lowland coastal belts, midland and highland zones. Ecologically, these groves function as biodiversity hotspots, particularly for invertebrates, herpetofauna and medicinal plants (Pillai, 2018; Rodrigues et al., 2021; “Sacred Groves of North Kerala,” 2024). Numerous studies have documented high species richness and levels of endemism within these groves, with several endemic and rare species—such as *Raorchestes* spp. and *Indotyphlops* spp.—being reported exclusively from these microhabitats. The groves also support complex trophic interactions and microclimatic stability, reinforcing their value as critical ecological refugia amidst increasingly fragmented landscapes.

Biodiversity and Ecological Significance

Sacred groves in Kerala perform essential ecological functions. They act as microhabitat islands that contribute significantly to local and regional environmental stability. One of their critical roles is in microclimate regulation. Several studies have shown that these groves maintain lower ambient temperatures and higher relative humidity compared to surrounding degraded or urbanized landscapes, creating stable microclimatic conditions conducive to the survival of moisture-dependent taxa (Blicharska et al., 2013; R., 2017; Parthasarathy & Kanda, 2019). The anthills and clay mounds in them are reserves for endemic plant and animal species. These groves serve as vital habitats for a wide range of organisms, including insects, amphibians, snakes, birds, bats and rare, endemic and medicinal plant species (Gadgil & Vartak, 1975). Species such as *Euphlyctis*, *Hoplobatrachus*, *Minervarya*, and *Dendrelaphis* find refuge within these protected patches. These areas provide varied vertical structure and leaf litter layers essential for breeding, foraging and thermoregulation (Rodrigues et al., 2021). A high level of nutrient availability is maintained in them, through rapid litter decomposition. The dense surface root mat supports large biomass and prevents nutrient leaching. This tightly regulated nutrient cycle also fosters rich microbial and invertebrate life (Malhotra et al., 2001).

In contrast to degraded landscapes, where biodiversity loss and ecological homogenization are prevalent, sacred groves retain intricate ecological networks and functional diversity. Furthermore, these groves contribute to climate resilience by buffering against extreme weather events. Through their persistent vegetation cover and organic matter

accumulation, they act as carbon sinks. Their potential in carbon sequestration, although underexplored in formal carbon accounting frameworks, suggests a valuable role in local-level climate change mitigation.

The Sacred Groves play a vital role in supporting local ecosystems through water conservation. Many sacred groves contain ponds, springs and laterite wells, helping maintain the groundwater recharge and underground water tables. Their dense canopy helps to recharge groundwater and reduces evaporation. The natural springs, ponds and streams within the groves provide reliable water sources for both humans and wildlife, especially during dry periods. The groves act like sponges, storing water in wet seasons and slowly releasing it during droughts. Additionally, the moisture and transpiration from the vegetation help create a cooler, more humid microclimate and may reduce the risk of forest fires (Malhotra et al., 2001; Chandrashekhara, 2024). Collectively, the ecological functions of sacred groves reinforce their importance not only as cultural heritage sites but also as keystone components in Kerala's environmental sustainability and conservation planning.

Biocultural Conservation: Integrating IKS with Ecology

Biocultural conservation is an interdisciplinary approach that recognizes the interwoven link between biological diversity and cultural heritage, emphasizing that the conservation of ecosystems is networked with the preservation of Indian Knowledge Systems (IKS), languages, spiritual beliefs and traditional practices. Globally, this framework has gained relevance as a response to the limitations of top-down conservation strategies, particularly in regions where local communities have long acted as stewards of biodiversity through culturally embedded practices ("Sacred Groves of North Kerala," 2024). In Kerala, sacred groves demonstrate biocultural conservation, where belief systems—such as serpent worship and rituals honoring local deities—have historically ensured the protection of small forest patches rich in endemic flora and fauna (Jeeshna, 2021). These culturally protected spaces continue to serve as *de facto* conservation areas, even in the absence of formal legal status. The worship of snakes (*naga aradhana*), for example, not only reinforces taboos against habitat disturbance but also coincides with ecologically significant practices like water conservation and soil protection. Emerging conceptual models in biocultural conservation seek to bridge traditional ecological knowledge with modern scientific frameworks by integrating ethnoecological data, participatory mapping and co-management strategies. Such models advocate for a conservational approach that values different viewpoints and types of knowledge for protecting the environment. This is where scientific ecology and culturally rooted stewardship coexist, reinforcing both ecological integrity and cultural continuity. In the context of Kerala, recognizing and formally integrating these traditional belief systems into policy and conservation planning offers a resilient, community-based approach to biodiversity protection.

The conservation of these areas in Kerala reflects the deeply embedded socio-ecological knowledge systems. These sacred groves have historically been preserved through customary religious and socio-cultural norms, which have effectively restricted anthropogenic disturbances. The perception of divine sanctity associated with these forest patches has functioned as a socio-spiritual mechanism for conserving biodiversity and preventing habitat degradation. In recent decades, however, anthropogenic pressures such as urban expansion, agricultural intensification and environmental pollution have emerged as substantial threats to their ecological integrity. In response, local stakeholders and conservation groups are increasingly engaging in awareness campaigns and participatory conservation initiatives aimed at safeguarding these culturally and ecologically significant ecosystems.

Threats and Challenges

Sacred groves in Kerala are increasingly under threat due to a complex interplay of socio-cultural and environmental pressures. One of the most significant challenges is the rapid pace of urbanization, which has led to the fragmentation, commercial forestry, encroachment and outright destruction of many groves, especially in peri-urban and coastal regions. As land values rise, groves are often repurposed for real estate, infrastructure, or agricultural expansion, resulting in the conversion of such lands (Chandrashekhara, 2011; Jones et al., 2023). Compounding this is the growing religious neglect driven by shifting belief systems and modernization, where younger generations are less engaged

in traditional rituals and stewardship practices that historically ensured the protection of these spaces. The decline in ritual observances such as *Sarpam Thullal* and seasonal offerings has led to the loss of inter-generational knowledge transfer with sacred ecological knowledge. The regional species-specific taboos and management practices are found to be rapidly fading. Invasive species and pollution are also threatening the biodiversity in these groves. Furthermore, a persistent disconnect between policymakers and traditional custodians—often local communities and families—has resulted in conservation strategies that fail to notice the cultural dimensions of these groves. Governmental and institutional frameworks typically emphasize legal protection or ecological metrics while neglecting the intangible cultural heritage and customary governance structures that underpin the survival of sacred groves (Chandrashekar & Sankar, 1998). Addressing these challenges requires inclusive, culturally sensitive conservation policies that empower local communities. There should be suitable measures to revitalize traditional ecological knowledge and formally recognize sacred groves as integrated socio-ecological systems.

Research Gaps and Future Directions

Despite growing recognition of the ecological and cultural importance of sacred groves in Kerala, several critical research gaps hinder their effective integration into broader biodiversity conservation frameworks. One major limitation is the lack of ecological data; most studies to date are spatially and temporally limited, offering only snapshot assessments of species composition, especially for lesser-studied taxa such as herpetofauna, bryophytes and soil microfauna. This constrains our ability to evaluate long-term ecological trends, such as successional dynamics, climate impacts, or species turnover in response to habitat isolation. Several NGOs and government initiatives are working to document, compile and protect these places promoting eco-cultural restoration. The Kerala High Court's directive to preserve sacred serpent groves underscores the growing recognition of their cultural and ecological value. However, such interventions remain isolated, revealing a significant gap in consistent, government-led conservation efforts for sacred groves across India. This highlights a critical research gap in understanding and evaluating the role of policy and governance in sacred grove protection. Future research should focus on formulating and assessing government-driven initiatives to ensure their systematic preservation (Mathrubhumi, 2023).

Furthermore, the potential of digital tools remains vastly underutilized. Geospatial mapping, participatory GIS, the creation of oral history archives and ethnobotanical databases can be done. It will greatly enhance documentation, accessibility and community engagement (“Data Bank on Sacred Groves of Kerala,” n.d.). Integrating these tools with citizen science platforms also holds promise for bridging traditional knowledge and formal ecological monitoring. Future research should prioritize interdisciplinary approaches that combine ecological science, cultural anthropology and digital humanities. It will create holistic, community-driven conservation models tailored to the unique biocultural landscapes of Kerala's sacred groves.

Conclusion: Toward a Biocultural Framework for Sacred Grove Conservation in Kerala

Sacred groves (*kavus*) of Kerala represent a unique convergence of ecological richness and cultural heritage, serving as both sanctuaries of spiritual practice and reservoirs of biodiversity. These forest fragments are not merely relics of a bygone religious past but are living embodiments of an integrated worldview in which nature and divinity coexist. They play dual role—as cultural sanctuaries and as ecological assets. As sanctuaries, they preserve ritual practices, oral histories and community identities whereas, as ecological assets, they sustain endemic flora, herpetofauna and microhabitats. This positions them as vital nodes in Kerala's environmental and cultural landscape. However, in the face of urban expansion, changing socio-religious values and policy disconnects, the sustainability of these groves demands urgent attention. They offer a low-cost, community-led conservation model integrating the traditional beliefs with modern ecological awareness.

This chapter has underscored the need to systematically integrate Indian Knowledge Systems (IKS) into environmental conservation planning. The ecological functions of *kavus*—from microclimate regulation and habitat provisioning to climate resilience—are inseparable from the ritual knowledge and traditional stewardship that have

safeguarded them for centuries. Recognizing sacred groves as socio-ecological systems, rather than isolating their ecological or religious aspects, enables a more nuanced and effective conservation model. This calls for interdisciplinary research, inclusive policy frameworks and participatory governance that elevates the voices of traditional custodians and marginalized communities, often neglected in formal conservation discourse.

Kerala, with its dense network of sacred groves, strong local governance institutions and a rich legacy of community-led environmental ethics, offers a scalable and replicable model for biocultural resilience in India. The integration of digital tools, oral history archives and ethnoecological mapping can further enhance the visibility and viability of these groves in contemporary conservation strategies. As India moves towards more sustainable and culturally sensitive environmental policies, the *kavus* of Kerala stand as compelling testaments to the power of biocultural conservation, where safeguarding biodiversity goes hand in hand with preserving the spiritual and cultural fabric of communities.

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