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Nurturing Tradition and Nature through Odisha's Shraddha Rituals

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Abstract

Purpose of the Study: This research investigates the use of plant species in Odisha's Shraddha rituals, aiming to highlight the interplay between cultural traditions and biodiversity conservation. It seeks to understand how these rituals contribute to the preservation of the region's botanical heritage and the broader environmental sustainability. **Methodology:** The study employed qualitative methods, including semi-structured interviews, discussions with key informants, and direct observations, across both rural and urban areas of Odisha's coastal districts. A total of 167 informants from diverse backgrounds participated, providing comprehensive insights into the rituals and their associated flora. The research also involved collecting plant specimens and photographic documentation to enrich the understanding of these practices. **Main Findings:** Thirty-nine plant species across 24 families, crucial to the Shraddha rituals, were identified. Notable species like *Areca catechu* and *Cocos nucifera* emerged as symbols of the spiritual-nature bond in Odia culture. The study uncovers challenges such as overharvesting and habitat destruction, emphasizing the urgent need for sustainable harvesting practices and biodiversity conservation. **Applications of this Study:** The findings are instrumental for cultural preservation, environmental conservation, and sustainable resource management. They provide a framework for local communities and religious leaders to engage in sustainable practices and for conservation bodies to develop strategies that balance cultural traditions with ecological preservation. **Novelty/Originality:** This research is unique in its ethnobotanical approach to exploring the role of religious rituals in environmental conservation. Integrating cultural anthropology with botanical science offers new insights into how traditional practices can support biodiversity preservation. Its comprehensive analysis across both rural and urban settings in Odisha adds depth and relevance to the understanding of these rituals in contemporary society, making it a novel contribution to the field.

Keywords: Biodiversity conservation; Cultural traditions; Ethnobotany; Odisha's Shraddha rituals; Sustainable harvesting

Introduction

Religion is a powerful tool that can motivate a community for a particular cause and has a significant and pervasive influence on various aspects of human society, including ideology, culture, and customs (Kaneff, 2018). In India, diverse socio-religious and cultural groups uphold their distinct traditional concepts, norms, and customs, which are expressed through rituals, taboos, songs, traditional foods, and healthcare systems (Upreti et al., 2017). Human culture is a dynamic fusion of ideas, behaviours, and artifacts that can be acquired and transmitted among individuals and evolve over time (Cavalli-Sforza & Feldman, 1981). The historical connection between culture and biodiversity has endured for centuries (Pretty et al., 2009). Notably, among various elements of biodiversity, plants play a pivotal role in cultural activities (Badoni & Badoni, 2001). Their life-saving attributes, as well as their essential roles in healthcare systems, dietary traditions, and numerous religious ceremonies, form the basis for their conservation and veneration (Mehra et al., 2014). The interplay between ethnobotanical knowledge and local practices has significant consequences for ecosystems and the plant populations within them. The knowledge, perceptions, and values held by local communities regarding various components of ecosystems play a crucial role in the conservation of biodiversity (Caballero-Serrano et al., 2019; Teka et al., 2020). By harmonizing this local wisdom and practices with scientific research, we can effectively enhance ecosystem management (Raj et al., 2022).

Life cycle rituals in India are profoundly significant, marking key milestones in one's journey. Rooted in tradition, religion, and social customs, these rituals vary across regions and communities, weaving together the spiritual, social, and cultural fabric of Indian society (Dalmia, 2001). The *Namkaran* ceremony, conducted shortly after birth, is a social gathering where family and friends bless the newborn, with the chosen name often carrying cultural or religious significance. As the infant grows, the *Annaprashan* ceremony, around six months of age, celebrates the introduction of solid food. Marriage rituals, intricate and diverse, culminate in the *Vivaha* ceremony symbolizing the sacred union of two individuals (Fuller, 2004). In times of sorrow, death rituals, like *Antyeshti*, involve cremation. The mourning period, with rituals like *Shraddha*, pays homage to ancestors, fostering a connection between the living and the deceased for peace (Obeyesekere, 2019). Beyond religious observances, these rituals strengthen familial relationships, shaping a sense of identity and cultural heritage, constituting an intrinsic part of Indian society, and providing individuals with a roadmap through life's significant moments.

In Hinduism, the concepts of birth, death, and rebirth are deeply ingrained in the philosophy, as highlighted in the Bhagavad Gita. The eternal soul, or Atman, is believed to persist through cycles of life and death. Hindu funerary customs are shaped by these profound beliefs, regional variations, and social considerations (Priya Uteng, 2021). A central aspect of Hindu funeral practices is cremation, viewed as both a spiritual and hygienic process. The swift cremation, ideally within 24 hours of death, is thought to alleviate the suffering of the departed soul and the grieving family (Firth, 2003; Laungani, 1996; Priya Uteng, 2021; Rugg & Parsons, 2018). However, exceptions exist for young children and religious ascetics, who may be interred rather than cremated. The rituals surrounding death include cleansing the deceased, dressing them in white as a symbol of mourning, a procession to the cremation ground, prayers, offerings, and presenting rice balls (*Pinda*) symbolizing the planets. These rituals aim to ensure the soul's reunion with ancestors and eventual liberation from the cycle of rebirth, known as moksha. Hindu

cremation services are inclusive, welcoming those connected to the deceased or their family (Laungani, 1996; Rugg & Parsons, 2018). The community often supports the grieving family by providing meals during the mourning period and assisting in the preparation of the concluding feast of the Shraddha ceremony, marking the culmination of the funerary rites (Firth, 2003).

Ancient Vedic texts describe the post-death journey leading to *Devaloka* or *Pitruloka*, realms of deities and ancestors. The Rig Veda emphasizes the pursuit of the highest heaven for immortality and escapes from re-death. Hindu cremation symbolizes self-offering to gods, particularly Agni, the fire deity, signifying spiritual transformation and rebirth. The act involves the living witnessing and engaging in the process, releasing the soul from the body for a favourable rebirth (Caixeiro, 2005; Firth, 2005; Hadders, 2023). Post-cremation rituals hold profound significance. The picking of the *Asthi* involves collecting bone fragments and ashes, with remains often disposed of in the Ganges or other sacred rivers (Firth, 2003). This act symbolizes the soul's purification and liberation, with family members and priests discerning signs of the departed soul's fate. The shraddha ritual nurtures and assists the deceased spirits in transitioning to higher realms, facilitating eventual reincarnation. In this intricate tapestry of beliefs and practices, Hindu funerary customs provide solace, continuity, and a sense of spiritual purpose to the bereaved.

While various research papers have delved into funeral rituals in different regions, including Odisha (Bhatt et al., 2015; McDaniel, 2023; Sahoo, 2014), there is a notable gap in the literature regarding studies on the Shraddha rituals (Prasad, 1995). Particularly, there is a lack of comprehensive reports specifically addressing Shraddha rituals in Odisha. This study seeks to address this gap by shedding light on the significance of Hindu 'Shraddha' rituals in the coastal districts of Odisha, India. Simultaneously, it aims to explore the utilization of plant diversity associated with these rituals. The overarching objective of the research is to establish connections between these rituals and the respective plant species, with the ultimate goal of enhancing ecosystem service management and fostering the conservation of plant diversity.

Research Methods

Odisha, formerly known as Orissa, is located on the eastern coast of India. It lies between the parallels of 17° 49' N and 22° 34’ N latitude and meridians of 81° 27' E to 87° 29' E longitude (Figure 1). The state is bordered to the north by Jharkhand, to the west by Chhattisgarh, to the south by Andhra Pradesh, to the northeast by West Bengal, and to the southeast by the Bay of Bengal, boasting a picturesque coastline stretching for 482 kilometres. In terms of land area, the state covers 155,707 square kilometres, contributing approximately 4.87% of India's total land area. As of the 2011 census, Odisha is home to a total population of 4.2 crores. This population is dispersed across 51,349 villages and 138 urban centres. Notably, the state comprises 62 distinct scheduled tribe communities, accounting for 22.85% of the population, and 93 types of scheduled caste communities, constituting 17.13% of the total population. These communities primarily reside in the hilly and rural areas of the state, where they continue to sustain their livelihoods through time-honoured traditional practices. Geographically, the coastal districts of Odisha, situated in close proximity to the Bay of Bengal, are prone to periodic earth tremors, thunderstorms during the monsoon season, and dust storms in April and May.

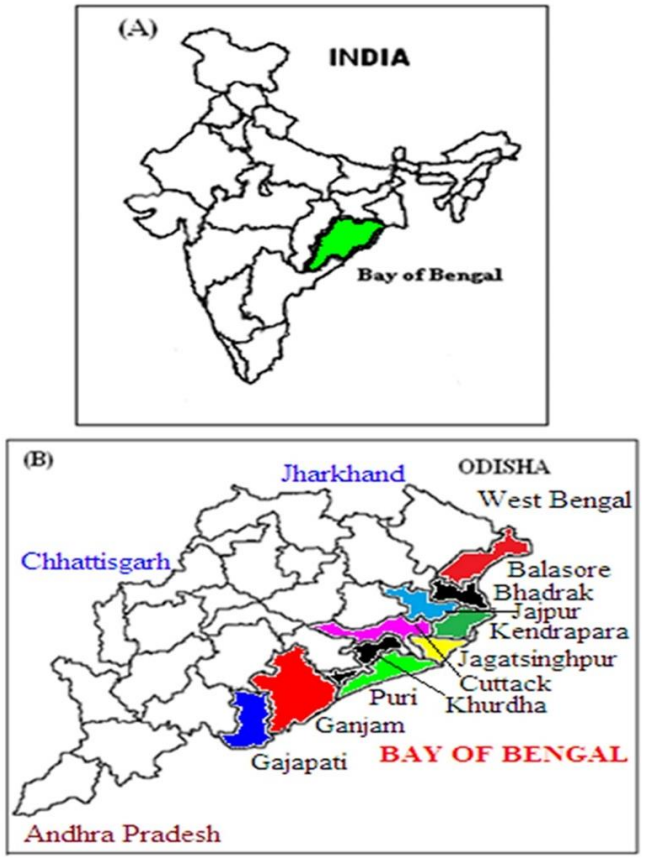

Figure 1 (A) Location of Odisha state in the eastern region of India (B) Study area showing different coastal districts

An extensive field survey was carried out between April 2021 and June 2023, focusing on ten coastal districts in the state, namely Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Puri, Khurdha, Ganjam, and Gajapati (Figure 1). Before commencing the field study, the objectives, methodologies, and expected benefits of the research were communicated to the local community members in their native language (Odia). Their informed consent and cooperation were obtained to document the plant species used in shraddha rituals. To gain a better understanding of local customs, beliefs, and the utilization of plants, we conducted interviews with knowledgeable informants. Information was collected from individuals of various age groups residing in different villages, employing methods such as participant observation, open-ended conversations, and semi-structured questionnaires, following Martin (1995). A total of 167 informants (89 male and 78 female) participated in these interviews. Key informants for this study were typically elderly individuals selected based on their experience and their current involvement in shraddha rituals. The interviews were conducted both individually and in group settings with local community members in each of the villages we visited. These interviews were conducted in the local language, ensuring effective

communication with the participants. During these interactions, we collected and recorded valuable information concerning the use of various plant species in the shraddha rituals. To ensure the accuracy and authenticity of the information obtained, we employed a systematic approach. Personal interviews and group discussions were held with the local inhabitants, which yielded specific details about the plants and their sociocultural significance. The data collected from these interviews were crosschecked and validated, following Cunningham (2001). In addition to the interviews, systematic inquiries were made to gather more comprehensive insights about the plants and their societal acceptance. Herbarium sheets for all ethnobotanical significant plants were prepared following established herborizing practices (Jain & Rao, 1977). These herbarium sheets were then identified with the assistance of regional flora (Choudhury et al., 1997). Furthermore, we gathered information related to the ecology of the area and documented details about the flowering and fruiting seasons of the identified plant species. This holistic approach allowed us to obtain a well-rounded understanding of the plant species and their significance within the context of the Shraddha rituals.

Results and Discussion

1. Plant Diversity and Medicinal Applications in Shraddha Rituals

Table 1 Plant species used for Shraddha rituals in coastal districts of Odisha

No.	Botanical name of the plants	Local name	Parts used
1.	*Areca catechu* L. Arecaceae	Gua	Fruit
2	*Aescynomene aspera* L. Fabaceae	Sola	Stem
3.	*Artocarpus heterophyllus* Lam. Moraceae	Panasa	Leaf
4.	*Azadirachta indica* A. Juss. Meliaceae	Nimba	Leaf
5.	*Bambusa arundinacea* L. Poaceae	Baunsa	Stem
6.	*Brassica juncea* (L.) Czem. Brassicaceae	Dhalasorisa	Seed
7.	*Cascabela thevetia* (L.) Lippold Apocynaceae	Kaniara	Flower
8	*Citrus reticulata* Blanco Rutaceae	Kamala	Fruit
9	*Clitoria ternatea* L. Fabaceae	Aparajita	Flower
10.	*Cocos nucifera* L. Arecaceae	Nadia	Fruit, leaf
11.	*Corchorus capsularis* L. Malvaceae	Nalita	Stem
12.	*Crateva magna* (Lour.) DC. Capparaceae	Varuna	Bark
13.	*Curcuma longa* L. Zingiberaceae	Haladi	Rhizome
14.	*Cynodon dactylon* (L.) Pers. Poaceae	Duba	Whole plat
15.	*Desmostachya bipinata* (L.) Stapf Poaceae	Kusa	Stem/leaf
16.	*Ficus religiosa* L. Moraceae	Osta	Bark, leaf, wood
17.	*Flacourtia indica* (Burm. f.) Merr. Salicaceae	Baincha	Bark
18.	*Gossypium herbaceum* Mast. Malvaceae	Kapa	Flower
19.	*Hordeum vulgare* L. Poaceae	Jaba	Grain
20	*Jasminum sambac* (L.) Aiton Oleaceae	Malli	Flower

No.	Botanical name of the plants	Local name	Parts used
21	*Magnolia champaca* (L.) Baill. ex Pierre Magnoliaceae	Champa	Flower
22.	*Malus domestica* (Suckow) Borkh. Rosaceae	Sewo	Fruit
23.	*Mangifera indica* L. Anacardiaceae	Amba	Twig
24.	*Musa* × *paradisiaca* L. Musaceae	Kadali	Fruit, leaf
25.	*Ocimum sanctum* L. Lamiaceae	Tulasi	Twig, leaf
26.	*Oryza sativa* L. Poaceae	Dhana	Grain
27.	*Piper betel* L. Piperaceae	Pana	Leaf
28.	*Prosopis cineraria* (L) Druce Fabaceae	Shami	Bark, twig
29.	*Psidium guajava* L. Myrtaceae	Pijuli	Fruit
30.	*Rosa indica* L. Rosaceae	Golap	Flower
31.	*Sachharum munja* Roxb. Poaceae	Anukha	Stem
32.	*Sachharum offinarum* L. Poaceae	Akhu	Stem
33.	*Santalum album* L. Santalaceae	Chandana	Stem
34.	*Sesamum indicum* L. Pedaliaceae	Khasa	Seed
35.	*Tagetes erecta* L. Asteraceae	Gendu	Flower
36.	*Tabernaemontana divaricata* R.Br. ex Roem. & Schult. Apocynaceae	Tagara	Flower
37.	*Vigna mungo* (L.) Hepper Fabaceae	Biri	Seed
38.	*Zingiber officinale* Rosc. Zingiberaceae	Ada	Rhizome
39.	*Zizyphus mauritiana* Lam. Rhamnaceae	Barakoli	Leaf

The conducted study identified 39 plant species, spanning 38 genera and 24 families, that were utilized in Shraddha rituals (Table 1; Figure 2-4). Among these, seven species belonged to the Poaceae family, three species to the Fabaceae family, while the Arecaceae, Apocynaceae, Malvaceae, Moraceae, Rosaceae, and Zingiberaceae families each contributed two species. These plants, categorized as herbs, shrubs, trees, and climbers, employed various parts such as roots, stems, leaves, flowers, fruits, seeds, or the entire plant in rituals.

In coastal Odisha, the cultural and religious tradition of using *Areca catechu*, also known as betel nut palm or supari, as a representative of God was deeply embedded. The cultural significance of *Areca catechu* was likely tied to local beliefs, myths, and historical practices, contributing to the diverse and rich religious tapestry of Odisha. Similarly, the *Artocarpus heterophyllus* leaf assumed a crucial role in the Shraddha ritual, serving as the platform for placing *'Pinda'* (rice balls). Moreover, this plant was acknowledged for its utilization in herbal remedies, particularly its latex, which had demonstrated efficacy in addressing glandular swellings. Likewise, plants like *Cocos nucifera* (coconut), *Curcuma longa* (turmeric), *Cynodon dactylon* (Bermuda grass), *Desmotachya bipinnata* (kusha grass), *Mangifera indica* (mango), *Ocimum sanctum* (holy basil), and others (Table 1) played distinctive and significant roles in the intricate tapestry of Shraddha rituals. Each of these botanical elements held a specific function, contributing to the ritualistic practices and symbolism associated with Shraddha ceremonies. In addition, the reported plants were also used by the locals for the treatment of various ailments like stomach-ache, blood purification, digestion, arthritis, chest pain, diarrhoea, jaundice, vomiting, liver problems,

urolithiasis, rheumatism, and diabetes. Key events like Mahalaya Shradha, Paya Shradha, and Pitru Paksha emphasized ancestral reverence. The Tarpan ritual during specific Tithis in the Ashwin Maas was pivotal, believed to grant salvation to departed souls. Performing Shraddha before the first anniversary at sacred sites like Allahabad, Gaya, Puri, and Jajpur held cultural importance. Coastal Odisha's Vaarshika Shraddha, an annual ritual, transformed the departed into ancestors. Puri's "*Dwadasha Dwara Bhitar Shradha*" at the Jagannath Temple's 22nd step paid homage to ancestors, intertwining spiritual practices with cultural heritage. Jajpur's rituals along the Viraja Tirtha and Baitarani River traced back to the 4th century AD, showcasing the enduring cultural legacy. The unique "Bada Badua Daka" or 'Paya Shradha' on Deepavali echoed heartfelt tributes to ancestors. These practices, deeply woven in local traditions, reflected a strong belief system and contributed to the socio-cultural fabric.

Rituals constitute a cornerstone in Hindu tradition, intricately weaving throughout the lifecycle from birth to death (Drabu, 1990; Geertz, 2017; Pratama, 2023). These practices represent Intangible Cultural Heritage, embodying culturally defined behaviours that convey profound symbolic meanings, acting as a mode of social communication (Leach, 1968). According to Eliade (1987), rituals are repetitive, stylized symbolic actions centered on cosmic structures or sacred presences, often incorporating verbal expressions like chants and prayers. By intentionally engaging the body in established forms, rituals forge connections between individuals and the transcendental, shaping cultural identities and fostering enduring communities rooted in shared historical models. In Hindu belief, the "Shraddha" ritual, translating to 'an offering made with reverence,' holds great significance. It is a sacred practice conducted by a son with the assistance of a priest to honour and provide salvation to the souls of departed ancestors (Prasad, 1995).

The diversity of plants highlighted in the present study finds resonance in various rituals, including Shraddha, across different regions of India (Bhatt et al., 2015; Chandra, 2023; Lata et al., 2022). The cultural importance of *Areca catechu* as a representative of God in coastal Odisha is also well-documented (Bhatt et al., 2015; Sahu & Panda, 2017). This sacred symbol plays a pivotal role in various rituals, including Shraddha, where it symbolizes the presence of deities. Adorned with reverence, the nut serves as a symbolic offering during religious ceremonies, with practices varying across traditions and communities. The use of latex of *Artocarpus heterophyllus* for treating glandular swellings is supported by previous studies (Gogte, 2000). In Hinduism, the coconut (*Cocos nucifera*) symbolizes purity, fertility, and prosperity, serving as a common offering in diverse religious ceremonies, spanning prayers, marriage rituals, temple worship, harvest festivals, and Shraddha rituals (Devi & Ghatani, 2022; Verenkar & Sellappan, 2018). Apart from its ritualistic use, coconut water is employed to address various ailments such as thirst, fever, and digestive issues (Ahuja et al., 2014; Lima et al., 2015). Turmeric (*Curcuma longa*), known as "Haldi," occupies a sacred position in Hindu culture, being considered highly auspicious in Odisha. It features prominently in socio-religious rituals, including bathing deities, marriage ceremonies, housewarming events, and shraddha rituals. In coastal Odisha, turmeric also finds application in traditional medicine, addressing issues like stomach-ache, blood purification, digestion, arthritis, chest pain, and diabetes (El-Saadony et al., 2023; Luthra et al., 2001; Prasad & Aggarwal, 2011). *Cynodon dactylon* holds spiritual significance in local communities, symbolizing prayers and blessings. Placed at home entrances to attract positive energies, the plant's juice is used for treating diabetes, piles, menstrual issues, and even applied to chronic wounds. Its leaves and sugar candy are utilized to alleviate diarrhoea, jaundice, and vomiting in children while addressing liver problems, urolithiasis, and rheumatism. The

Hajong community in Assam employs it to ward off evil spirits and sins (Sharma et al., 2012). This herb is integral to Hindu religious rites and widely embraced as a traditional medicine in India for dysentery, diarrhoea, diabetes dropsy, and catarrhal ophthalmia (Jolly & Narayanan, 2000; Singh et al., 2011; Singh et al., 2008). In the current study, *Desmotachya bipinnata* was used from birth to death. The plant holds sacred significance in North Indian tribal communities (Kandari et al., 2014) and plays a crucial role in Brahmin rituals in Nepal, representing different deities (Niroula, 2016; Sharma, 2020; Thapa, 2015).

The study also highlights the use of the entire plant of *Ficus religiosa* in religious and spiritual practices, aligning with findings in Nepal (Kunwar & Bussmann, 2006; Mallik et al., 2020). *Ficus religiosa* is employed in traditional systems like Ayurveda and Unani for various medical purposes, officially recognized as a medicinal plant in the Ayurvedic pharmacopeia (Kite et al., 1995; Singh et al., 2011). *Mangifera indica* leaves are used for religious purposes, as noted in the current study and a previous report from Uttarakhand (Sharma & Joshi, 2010). In a neighbouring district in Uttarakhand, Rudraprayag, the leaves are used to repel evil spirits (Kumar, 2009). Besides its spiritual significance, *M. indica* is renowned for its medicinal properties, including antioxidant, antidiabetic, antiviral, hypotensive, anti-inflammatory, and cardiotonic effects (Shah et al., 2010). *Ocimum sanctum*, commonly known as 'basil' but revered as 'Tulsi' in India, is a highly medicinal plant deeply integrated into Hindu religious rituals. The soil around this plant is considered sacred, emphasizing its significance. Traditionally, Tulsi has been used to treat anxiety/depression, cold, asthma, bronchitis, diabetes, diarrhea, eye disorders, fever, insect bites, snake bites, malaria, and a variety of skin disorders (Chatterjee et al., 2011; Cohen, 2014). Tulsi is also known for its antibacterial, antifungal, antiviral, antidiabetic, anticancer, antifertility, anti-inflammatory, adaptogenic, analgesic, cardioprotective, and hepatoprotective properties (Singh et al., 2012; Srichok et al., 2022). *Ziziphus mauritiana*, commonly known as Indian Jujube, holds a central role in the cultural and traditional rituals of coastal Odisha. The leaves of this tree are utilized in various ceremonies, including during Shraddha, symbolizing ancestral spirits. It's noteworthy that this is the same tree beneath which Guru Nanak received his spiritual enlightenment. In the coastal regions of Odisha, the local community believes that presenting *Ziziphus mauritiana* leaves during these rituals is a heartfelt way to pay tribute to departed family members and ensure their well-being in the afterlife.

2. Cultural Fabric and Ritualistic Significance in Coastal Odisha

In Coastal Odisha, diverse Shraddha rituals, rooted in customs and beliefs from the Matsya Purana, unfold with rich cultural significance (Vasu, 1916, 1917). Prominent events like Mahalaya Shradha and Pitru Paksha emphasize ancestral respect. The pivotal Tarpan ritual in Ashwin Maas bestows peace upon those who have passed away. Performing Shraddha before the first anniversary at sacred sites holds cultural importance (Nayan, 2023). Coastal Odisha's Vaarshika Shraddha annually honors ancestors, reflecting a robust belief system deeply embedded in local traditions. The distinctive Paya Shradha on Deepavali echoes sincere tributes to ancestors. These entrenched customs in local traditions underscore a robust belief system, enriching the socio-cultural heritage.

The sacred landscape of Coastal Odisha intertwines with indigenous beliefs, emphasizing the sacredness of specific plants, rivers, and mountains. Shraddha rituals passed down through generations, incorporate offerings of bark, leaves, flowers, fruits, and seeds. This age-old system, deeply embedded in local traditions, relies on a strong

belief system, time-tested experiences, and the use of inexpensive, locally available raw materials. Totemism, practiced by various indigenous communities, protects specific plants, animals, and natural features, considering them as sacred ancestors. As ecological degradation and deforestation threaten natural vegetation globally, these rituals highlight the vital role of plants in worship and well-being across diverse human societies. The preservation of sacred plants near religious institutions becomes crucial in the face of these challenges, preserving both cultural and ecological heritage.

Shraddha rituals, deeply embedded in Hindu tradition, serve as a profound mechanism for fostering relationships on various levels. Anchored in the belief in honouring ancestors, these ceremonies weave a tapestry that connects the living with the departed souls. The ritualistic expressions of gratitude and reverence contribute to a sense of continuity, anchoring individuals to their roots and fostering an enduring ancestral connection. Beyond personal reflection, Shradha rituals catalyze family unity, bringing members together in a collective experience that reinforces bonds and cultivates togetherness. This communal aspect not only provides emotional and spiritual support but also transforms into a shared journey of remembrance and homage. Culturally, Shradha rituals play a pivotal role in passing down values, instilling identity, and encouraging virtuous behaviour within the community. As a spiritual practice, Shradha encourages virtuous behaviour, promoting positive actions within the community. It is an eloquent expression of love and respect for ancestors, creating an environment that nurtures familial harmony. Moreover, Shradha rituals offer a structured avenue for emotional catharsis, aiding individuals in navigating the complexities of grief and finding closure. In a broader societal context, these rituals contribute to social cohesion, creating a supportive network that extends beyond the family unit. As a generational bridge, Shradha rituals ensure the transmission of traditions, fostering a continuum of relationships that endure across time.

3. Environmental Implications and Conservation of Sacred Flora

This study successfully identified 39 plant species across 38 genera and 24 families, integral to the Shraddha rituals of coastal Odisha, as detailed in Table 1 and Figures 2-4. Notably, seven of these species belong to the *Poaceae* family, and three to the Fabaceae family, with significant contributions from families like *Arecaceae*, *Apocynaceae*, *Malvaceae*, *Moraceae*, *Rosaceae*, and *Zingiberaceae*. These plants, varying from herbs and shrubs to trees and climbers, are used in their entirety - roots, stems, leaves, flowers, fruits, and seeds - in these rituals. The study underscores the deep cultural and religious significance of certain species, such as *Areca catechu* (betel nut), *Artocarpus heterophyllus* (Jackfruit), and *Cocos nucifera* (coconut), which are revered and employed in various forms in these rituals. Additionally, these plants are recognized for their medicinal properties, treating ailments ranging from diabetes to skin disorders, which underscores their dual role in the cultural and health practices of the region. Key Shraddha events like Mahalaya Shraddha and Paya Shraddha emphasize ancestral reverence, with rituals such as Tarpan being pivotal for spiritual offerings. This research highlights the intricate connection between traditional religious practices and biodiversity conservation, reflecting the rich cultural tapestry and the profound belief systems deeply rooted in the local communities of coastal Odisha.

Furthermore, the study reveals that certain species, such as *Desmotachya bipinnata* and *Flacourtia indica*, are facing imminent threats due to rapid urbanization, marked by the construction of roads, industries, and increased anthropogenic activities. This study

underscores the critical impact of urban expansion on biodiversity, aligning with global concerns highlighted in recent environmental studies. Studies project that urban land will increase globally, resulting in a loss of natural habitats and threatening biodiversity (Ren et al., 2023). By 2030, an additional 1.2 billion people are forecasted to live in urban areas, leading to the conversion of natural habitats to urban land (McDonald et al., 2019). Urbanization negatively affects biodiversity through habitat loss and fragmentation (Elmqvist et al., 2015). The expansion of urban areas near protected areas and biodiversity hotspots further exacerbates the impact on biodiversity (Güneralp et al., 2015; Li et al., 2022).

The community's active participation in Shraddha rituals reflects a profound respect for the environment, contributing significantly to the conservation of these medicinal plants. As awareness of the therapeutic value of these plants increases at both local and broader levels, there is a corresponding rise in efforts to preserve them in their natural habitats. Consequently, this study illuminates the unique connection between cultural practices and ecological preservation established by the Shraddha ritual, highlighting the critical interdependence between human traditions and the natural environment. This symbiotic relationship not only fosters a sense of responsibility towards sustainable use and conservation of plant resources among local communities but also contributes to broader conservation efforts, positively shaping attitudes towards nature and its preservation.

These findings illuminate the profound interplay between cultural practices and ecological preservation, a synergy that extends far beyond the specific context of this study. They underscore the critical role of cultural landscapes, as recognized and protected by entities like the US National Park Service, in not only preserving cultural heritage but also in managing natural resources effectively (Melnick, 2023). This study echoes the sentiment that social solidarity and emotional drivers such as religion, art, song, myth, and storytelling are potent motivators for environmental stewardship and sustainable ecosystem management (Anderson, 2016). Furthermore, the historical influence of indigenous groups in ecosystem shaping through practices like agriculture, hydrological engineering, and controlled burning highlights the invaluable insights these practices offer for current ecological restoration efforts (Evans & Davis, 2018). This rich tapestry of cultural practices, deeply embedded in human history and tradition, thus emerges as a crucial guardian of biodiversity and a key to sustainable ecological management.

To safeguard cultural heritage and biodiversity, critical steps include promoting sustainable harvesting practices, encouraging cultivation efforts, and raising awareness about the ritual and ecological significance of these plants. Preserving these plant species and associated cultural traditions requires collaborative efforts involving local communities, religious authorities, and conservation organizations. Through shared responsibility and coordinated initiatives, it becomes possible to ensure the continued existence of these invaluable ritual plant species while mitigating the adverse effects of urbanization on our rich cultural and ecological tapestry.

Conclusion

The belief systems of Odisha's coastal communities are closely tied to their reliance on nature for survival. The Shraddha rituals in Odisha reveal a profound connection between humans, plants, and ancestors. Plants act as messengers and offerings to honour ancestors, emphasizing the pivotal role of nature in the cultural and spiritual lives of

Odisha's people. These rituals symbolize the bridge between the earthly and spiritual realms, using plants as intermediaries for communication with ancestors. This also inadvertently safeguards local plant diversity as sacred plants are protected. These rituals blend traditional medicinal knowledge with religious practices, showcasing the symbiotic relationship between humans and the environment. In the context of global biodiversity conservation, the integration of cultural and conservation values within these rituals highlights the potential for local communities to act as custodians of their natural surroundings. However, challenges such as poverty, cultural shifts, and modernization threaten these traditions. To address this, informal interactions and education, including indigenous knowledge in school curricula, can help preserve these beliefs. Collecting and preserving folklore and oral traditions related to biodiversity conservation can also make this knowledge more accessible. Supporting indigenous communities in preserving their belief systems can significantly contribute to sustainable natural resource management and biodiversity preservation in Odisha's coastal regions. Armed with data-driven inference, our study has stressed the notion that shraddha rituals could be a strong base for traditional knowledge which can be complemented in local healthcare programs as a part of the national health mission agenda.

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Appendix

Figure 2 a. Tilatarpan by first author T. Panda, in river Jamuna and Pinda daan at Prayagraj near Jamuna River b. Pinda daan at Gaya in Falgu River by the first author T. Panda and his spouse (2nd author), c, d. Shraddha rituals at Siddheswar temple of Jajpur district during Mahalaya, e. Shraddha rituals near Baitarani River of Jajpur district

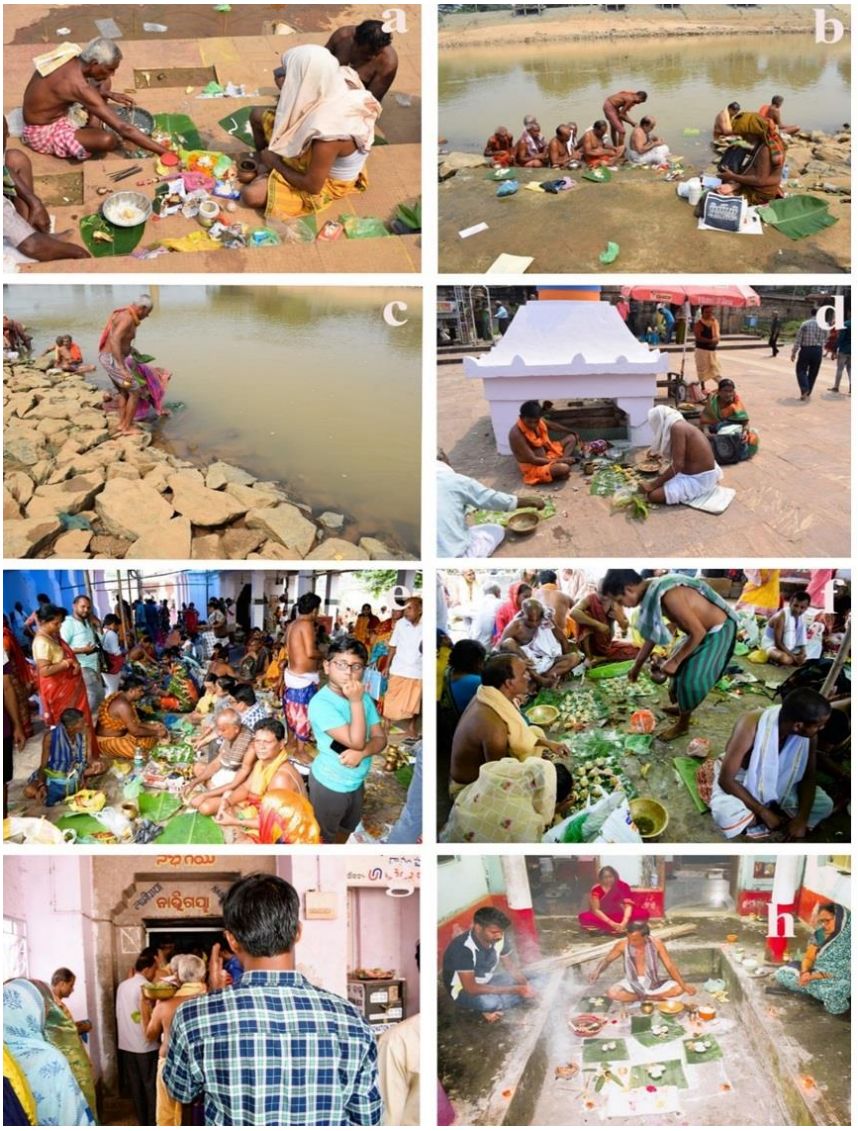

Figure 3 a. Shraddha rituals at Daswamedha Ghat, Jajpur, during Mahalaya, b. Tila tarpan at Daswamedha Ghat, Jajpur, c. Throwing the Pinda to Baitarani River, d. Pinda daan inside the temple, e, f. Mass Pinda daan inside Biraja temple premises, Jajpur, during Mahalaya, g. Throwing the Pinda to Navigaya, a sacred place inside Biraja temple premises, h. Pinda daan during Paya shradha

Figure 4 Some plant species used during Shradha rituals a. Artocarpus heterophyllus Lam. b. Curcuma longa L. c. Cynodon dactylon (L.) Pers. d. Ocimum sanctum L. e. Piper betel L. f. Prosopis cineraria (L) Druce g. Oryza sativa L. h. Sachharum offinarum L. i. Santalum album L. j. Sesamum indicum L. k. Tagetes erecta L. and l. Zizyphus mauritiana Lam.