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Oil Sludge Ecotourism: Promoting Conservation in the North Coastal Area of Bintan Island

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Abstract

The northern coast of Bintan Island, Indonesia, faces recurring oil sludge pollution during the northeast monsoon, primarily due to illegal discharges from ships in the Singapore Strait. This environmental threat has degraded coastal ecosystems, reduced fishery yields, and weakened tourism-based livelihoods. Currently, there is no coordinated response involving multiple stakeholders. Cleanup efforts are limited and fragmented. This study explores ecotourism as a strategic response to environmental and economic challenges. In response, the study introduces oil sludge ecotourism as a dual-purpose strategy that integrates coastal clean-up with sustainable tourism. By reframing remediation as a conservation-oriented experience, this model aligns with ecotourism principles emphasizing ecological restoration, community participation, and low-impact engagement with nature. It offers the potential to raise environmental awareness, diversify local incomes, and strengthen stewardship. If implemented effectively, oil sludge ecotourism could transform pollution-affected coastal zones into resilient, conservation-driven destinations. This model may serve as a replicable solution for other regions facing similar challenges, demonstrating how environmental degradation can be converted into opportunities for sustainable development.

Keywords: Bintan Island; Ecotourism Development; Oil Sludge; Pollution Response

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INTRODUCTION

Oil sludge pollution is a persistent environmental challenge on Bintan Island, particularly during the northern monsoon season (November–March), driven by maritime activities in the Singapore Strait such as illegal discharges from ship tank cleaning. Ocean currents and intensified rainfall transport these pollutants to Bintan's northern coastline (Syofyan et al., 2023). Consequently, threatens ecologically sensitive zones and undermines tourism, conservation, and fisheries. The region's coastal habitats—mangroves, seagrass beds, and coral reefs—hold significant potential for marine-based tourism, especially in Teluk Sebong and Gunung Kijang (BPS Kabupaten Bintan, 2024). However, recurring oil sludge contamination has led to declining tourist arrivals and reduced fishery yields, exacerbating economic vulnerability among coastal communities (Negara, 2020). Public perception increasingly views oil sludge as an intractable issue, despite emerging efforts to repurpose it as a resource for ecological restoration and economic development. Beyond immediate economic losses, oil sludge introduces toxic substances into the marine food web, threatening biodiversity and the viability of tourism reliant on pristine coastal environments (Nelson et al., 2018) These interlinked ecological and socioeconomic impacts highlight the urgent need for integrated environmental management strategies to rehabilitate affected areas and promote long-term resilience.

Despite the severity of oil sludge, a shift in local perception has begun to emerge, with stakeholders increasingly viewing the issue not solely as an environmental threat but as a potential driver for ecological transformation. This evolving outlook has catalyzed interest in ecotourism initiatives that integrate marine restoration with community development. By engaging both residents and visitors in rehabilitation efforts, such programs foster shared responsibility and empower local communities to manage their natural resources while deriving economic benefits from sustainable tourism. With adequate institutional support and infrastructure, Bintan Island could transition toward a resilient model where conservation and tourism are mutually reinforcing. The integration of local ecological knowledge—such as traditional fishing and coastal resource management practices—into ecotourism strategies enhances both ecological outcomes and cultural preservation. This participatory approach aligns with the core principles of ecotourism, which emphasize the protection of natural and cultural heritage while promoting sustainable livelihoods for host communities.

Ecotourism has emerged as a rapidly expanding sector within the global tourism industry. These interconnected elements collectively support the overarching objective of ecotourism—promoting environmental conservation while generating economic benefits for local communities (Hussain, 2022). In recent years, ecotourism has evolved from passive observation into a proactive mechanism for ecological restoration (Karimov et al., 2024) Bintan Island's ecological richness and vulnerability to oil sludge pollution present a unique context for developing site-specific ecotourism models. Notably, the seasonal visibility of oil sludge during the northern monsoon has sparked visitor curiosity, offering a strategic entry point for community-led and government-supported ecotourism initiatives. These programs can simultaneously raise environmental awareness and generate revenue to support local welfare. By channeling tourism income into conservation efforts, ecotourism contributes directly to ecosystem recovery. Its educational dimension fosters visitor engagement and responsible behavior, while also promoting community participation in restoration activities (Panwanitdumrong & Chen, 2022). In doing so, ecotourism not only enhances environmental stewardship but also creates sustainable employment opportunities for coastal populations.

The 2019 oil sludge incident at Trikora Beach, Bintan Island, exemplifies the acute vulnerability of tourism-dependent coastal regions to marine pollution. During the northern monsoon, oil waste accumulated along the shoreline, severely degrading the beach's aesthetic and ecological value. Once celebrated for its scenic appeal, Trikora Beach experienced a sharp decline in tourist arrivals following the event. In response, local authorities and community stakeholders initiated cleanup and ecosystem rehabilitation programs, emphasizing participatory restoration to enhance environmental awareness. These efforts contributed to physical recovery and public

engagement with the ecological consequences of oil sludge. However, despite continued interventions, the area faces persistent environmental degradation, declining fishery yields, and reduced tourism revenue. The Trikora Beach experience highlights the urgent need for sustainable environmental management in tourism-dependent coastal regions. By reframing pollution as an opportunity for ecological education and responsible tourism, degraded destinations can recover and evolve into resilient, conservation-oriented hubs. Strategic ecotourism planning offers a viable pathway to address oil sludge pollution while generating economic benefits and enhancing environmental awareness among visitors. This case illustrates how conservation-based tourism can restore affected ecosystems and support community livelihoods, as demonstrated by initiatives on Bintan Island. In this context, ecotourism principles are particularly relevant for managing coastal zones vulnerable to marine pollution. While previous studies have examined the ecological and economic impacts of oil sludge and mitigation through policy and community action (Nelson et al., 2018; Negara, 2020; Purnaweni et al., 2022), they have not explored ecotourism as an integrated solution.

In addition to addressing the existing research gap, this study emphasizes the critical need for a robust legal framework to ensure the long-term sustainability of oil sludge ecotourism. Previous initiatives have largely depended on community participation and short-term mitigation strategies; however, in the absence of formal legal structures, such efforts often remain fragmented and lack continuity. To address this issue, the study proposes a staged legal framework as a policy recommendation, comprising three key components:

1. Preventive Regulation – Focused on strengthening monitoring systems and enforcing penalties for illegal oil discharges, thereby reducing the risk of future pollution events.
2. Adaptive Regulation – Integrates ecotourism into coastal management policies, positioning it as a dual-purpose tool for environmental conservation and economic development.
3. Collaborative Regulation – Promotes coordinated action among local communities, government agencies, and international stakeholders to address the transboundary nature of oil sludge pollution.

By introducing this staged regulatory approach, this study introduces the concept of oil sludge ecotourism, a novel framework that integrates environmental conservation, active tourist engagement, and coastal community empowerment. By reframing pollution as a catalyst for sustainable development, the approach addresses a critical gap in the literature and offers new insights into managing oil-affected regions.

RESEARCH METHODOLOGY

This study focuses on the northern waters of Bintan Island, an area affected by oil sludge pollution. Geographically, Bintan Island is situated between 0°6'17" and 1° 34' 52" North Latitude, and between 104°12'47" and 108° 2' 27" East Longitude. Figure 1 below presents an aerial representation of these areas.

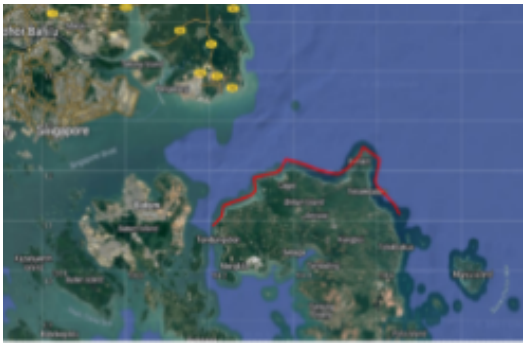

Fig. 1. The Area of the North Coastal Area in Bintan Island is represented by a red Line.
(Research Documentation 2024)

This research used a qualitative approach with a descriptive research design. According to Deckert & Wilson, (2023), descriptive research aims to present an objective and factual representation of a specific variable, event, or condition, typically applied to understand characteristics, contexts, and phenomena as they naturally occur. Data collection involves both primary and secondary sources. Primary data collection techniques included observation, interviews, and documentation. Interviews were conducted using a semi-structured format. As defined by Barrick, (2019) an interview is a dialogic process between two parties intended to exchange ideas and construct shared understanding. A core set of questions guided the interviews, but the researcher adapted follow-up inquiries based on informant responses to ensure depth and contextual relevance. Informants were selected using purposive sampling, targeting individuals with direct experience or knowledge of oil sludge pollution and its local impacts. Secondary data were collected through a literature review, which included government publications, long-term coastal management plans, and prior research related to Pulau Bintan. The data analysis process followed three key stages: data reduction, data display, conclusion drawing, and verification. This systematic approach ensured that the findings were grounded in both empirical evidence and contextual understanding.

RESULT AND DISCUSSION

The northern waters of Bintan Island, Indonesia, face persistent environmental degradation due to recurring oil sludge pollution during the northeast monsoon season. This pollution stems from the illegal discharge of oil waste by vessels operating in the Singapore Strait, where high ship tank cleaning costs incentivize illicit dumping. Operators often exploit the monsoon's strong winds and turbulent seas to disperse oil into fine droplets, complicating detection via satellite imagery (Negara, 2020). The ecological consequences are severe, disrupting marine ecosystems, threatening fisheries, and posing health risks to coastal communities (Pratama & Akbar, 2020) Teluk Sebong District, one of the most affected areas, comprises seven villages with a combined population of 19,558. Five of these villages are coastal, two rely heavily on fisheries (figure 2), and four are engaged in waste management and recycling initiatives. A strong culture of cooperation (gotong royong) characterizes all seven communities (BPS Kabupaten Bintan, 2024). The tourism infrastructure in Teluk Sebong includes 33 restaurants, 24 hotels, and 6 guesthouses, contributing to the 222,118 tourist arrivals recorded in Bintan Regency in 2023 (figure 5). However, oil sludge pollution (figures 3 and 4) has led to multifaceted economic losses. Fishermen report damaged gear, reduced catch yields, and rising operational costs (Negara, 2020), while the tourism sector suffers from declining visitor numbers due to environmental degradation and a tarnished destination image (Akbar et al., 2020).

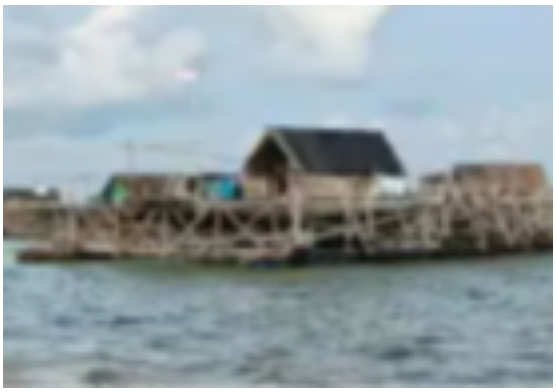

Fig. 2. Kelong Apung is used by local communities as traditional fishing equipment.
(Research Documentation 2024)

Fig. 3. Example of oil sludge found on the beach on the northern coast of Bintan Island *(Research Documentation 2024)*

Fig. 4. Oil sludge contamination along the shoreline, highlighting the environmental impact on coastal sediments *(Research Documentation 2024)*

Fig. 5. Tourism and local economic activities documented in the oil-impacted shoreline. *(Research Documentation 2024)*

Addressing oil sludge pollution in the northern seas of Bintan Island presents considerable complexity, primarily due to jurisdictional ambiguities arising from its transboundary nature. Since the pollution originates in international waters, enforcement efforts are significantly constrained, thereby necessitating coordinated international cooperation to ensure effective mitigation (Rahmawati et al., 2023). The region's designation as a conservation zone further complicates management, given the ecological sensitivity and variable recovery rates of affected ecosystems (Akbar et al., 2020). Effective cleanup strategies must consider multiple factors, including oil type, coastal geomorphology, hydrodynamics, and biological vulnerability. Ecosystems such as mangroves, seagrass beds, and coral reefs are especially susceptible to oil toxicity (Negara, 2020). Oil sludge disrupts marine reproductive cycles, reduces biodiversity, and compromises ecosystem health. Coral reefs, reliant on clear water for photosynthesis, are particularly vulnerable; oil deposits obstruct light penetration and damage coral structures. Similarly, seagrass beds experience inhibited growth and reproductive failure when exposed to

hydrocarbons (Bertella et al., 2020). These ecological disruptions also threaten local fisheries, which depend on healthy marine food webs for sustainable yields. Although oil spill response plans and rehabilitation programs have been implemented, recovery remains slow and fragmented. A more robust, integrated management approach is urgently needed, one that combines regulatory enforcement, ecosystem restoration, and stakeholder collaboration. Integrating environmental protection into the tourism sector offers a promising pathway. By aligning conservation with ecotourism, stakeholders can reduce ecological footprints while advancing long-term restoration goals. These efforts should prioritize sustained, community-based restoration projects alongside pollution mitigation (Bertella et al., 2020) In this context, ecotourism emerges as a viable strategy to address environmental degradation while supporting local economies. On Bintan Island, ecotourism can play a pivotal role in marine conservation, particularly in oil-affected areas. Embedding environmental education and conservation activities such as beach cleanups, coral reef restoration, and sustainability-focused tours into tourism programs fosters visitor awareness and engagement. Moreover, ecotourism generates revenue that can be reinvested in habitat restoration, pollution control, and biodiversity protection. By promoting ecotourism practices and community participation, Bintan Island can develop a more resilient tourism model that supports both ecological recovery and socioeconomic development. Ecotourism offers a strategic platform for community empowerment by enabling residents to engage directly in the stewardship of natural resources. Community-based initiatives foster a sense of ownership in conservation efforts and generate employment within the tourism sector, thereby enhancing local livelihoods. On Bintan Island, the success of ecotourism depends on effective collaboration among government agencies, private enterprises, and local communities. Such partnerships are vital to ensure that tourism development aligns with ecological objectives and promotes long-term sustainability. This integrated model not only mitigates the impacts of oil sludge pollution but also supports the transition toward resilient and environmentally responsible tourism.

Coastal oil spill remediation involves a range of techniques selected based on environmental conditions and the physical-chemical properties of the spilled oil. These methods are generally classified into mechanical/manual approaches, chemical and bioremediation techniques, and advanced monitoring technologies.:

1. Mechanical/Manual Cleaning: This method offers rapid response and requires minimal specialized equipment, making it suitable for accessible areas. Natural and synthetic sorbents are commonly used to absorb oil from water surfaces, particularly in hard-to-reach locations (Owens et al., 2021; Kończewicz et al., 2019).
2. Chemical and Bioremediation Techniques: Surface-Washing Agents (SWA) are effective for beach cleanup and are considered environmentally friendly alternatives. Bioremediation employs natural biological processes to degrade oil contaminants, supporting ecological recovery (Wang et al., 2023; Azhura et al., 2022).
3. Remote Sensing Technologies: These tools enhance oil spill detection and monitoring by providing real-time data on dispersion patterns, thereby improving response efficiency and mitigation planning (Puspitasari et al., 2020; Yusup, 2024).

Existing oil sludge remediation techniques require careful planning to avoid exacerbating damage to ecologically sensitive areas. Effective cleanups must balance operational efficiency with environmental protection. In the northern seas of Bintan Island, current mitigation efforts remain limited, primarily consisting of informational campaigns and manual collection methods led by government agencies and local communities. These responses—such as gathering oil sludge into drums—are constrained by insufficient coordination, limited technical capacity, inadequate funding, and the absence of standardized operational protocols (Putri & Kamila, 2023; Purnaweni et al., 2022). The impacts of oil spills in tourism-dependent regions are multifaceted and difficult to quantify, encompassing both ecological degradation and economic losses (Kiessling et al., 2017). Oil sludge diminishes the visual appeal of coastal areas, disrupts marine ecosystems, and undermines the viability of tourism-related businesses, including accommodations, restaurants, and transport services. Moreover, negative media coverage and visitor experiences can damage the destination's public image, further deterring tourism. Maintaining beach cleanliness is thus

critical not only for enhancing visitor satisfaction but also for conserving the natural assets upon which tourism depends. Tourists increasingly value environmental sustainability and are drawn to destinations that demonstrate ecological integrity and responsible management (Bertella et al., 2020). This underscores the need for integrated remediation strategies that support both environmental recovery and the long-term resilience of tourism economies.

Ecotourism Potential

Ecotourism is a form of tourism that prioritizes environmental preservation and the empowerment of local communities (Ballad et al., 2021; Hussain, 2022). It offers economic opportunities to populations residing near tourist destinations, promotes the protection of natural and cultural heritage, and encourages active tourist participation in conservation efforts (Halim, 2017; Bertella et al., 2020). Unlike conventional nature-based tourism, ecotourism is designed to minimize environmental degradation while delivering environmental education and tangible benefits to host communities (Fennell, 2020). According to Hussain, (2022), responsible ecotourism not only reduces negative environmental impacts but also fosters environmental awareness, supports biodiversity, and strengthens local economies. It must require the active involvement of local communities in planning and implementation to ensure equitable benefit-sharing and long-term sustainability. Ecotourism also serves as a tool for ecological restoration by attracting visitors to engage in conservation activities, support community initiatives, and contribute financially to environmental programs (Karimov et al., 2024). One accessible avenue for such engagement is voluntourism—volunteer-based tourism—which enables tourists to participate in restoration efforts such as beach cleanups, coral reef rehabilitation, and environmental education campaigns (Fennell, 2020; Janitra & Muis, 2023). These programs not only raise awareness of marine pollution but also foster collaboration among tourists, local stakeholders, and tourism operators (Adam, 2021; Bertella et al., 2020). When designed as part of the tourism product, coastal clean-up initiatives can enhance visitor experience, generate environmental benefits, and attract broader stakeholder participation (Lintangkawuryan, 2018; Zielinski et al., 2019).

Ecotourism principles emphasize low-impact travel, biodiversity protection, and community involvement from upstream to downstream in tourism operations. (Hussain, 2022). These align with sustainable governance models that advocate for inclusive decision-making, cross-sector collaboration, and long-term ecological accountability (Harilal et al., 2021; Nuraini et al., 2022). Moreover, the integration of relational environmentalism—where tourists are invited to interact with and care for the environment—offers a transformative approach to conservation tourism (Hjalager & Kwiatkowski, 2019). However, as several studies caution, poorly managed ecotourism can lead to resource overuse, social exclusion, and environmental degradation (Widener, 2009;Cirer-Costa, 2015). Therefore, ecotourism must be implemented with careful planning, stakeholder coordination, and adaptive management to ensure it contributes meaningfully to sustainable development and post-disaster recovery in oil-affected coastal regions (Putri & Kamila, 2023; Hassan et al., 2017).

Human Resources, Economic Potential, and Community Activities

The socioeconomic conditions of the community around northern Bintan Island are highly conducive to the development of regional ecotourism. Drawing on the principles of community-based ecotourism, which emphasize local participation, environmental stewardship, and equitable benefit-sharing, the region's demographic composition, predominantly coastal communities engaged in fisheries and small-scale commerce, offers a foundational asset for sustainable tourism initiatives. The community's proactive involvement in beach cleanup programs and aspirations among residents to serve as ecotourism guides reflect a latent social capital that aligns with the participatory governance models advocated in sustainable development literature (Bramwell & Lane, 2011). However, despite these promising indicators, empirical findings reveal a dissonance between environmental engagement and economic optimism. According to Pratama & Akbar

(2020), fewer than 4% of respondents anticipated improvements in their economic conditions, with even lower expectations for health and family well-being. This pervasive pessimism underscores the need for a governance framework that not only mobilizes community assets but also addresses structural vulnerabilities through targeted policy interventions. From a sustainable livelihood's perspective, the oil sludge issue, while environmentally detrimental, could be recontextualized as a transformative opportunity for diversifying income sources and enhancing resilience, provided that institutional support mechanisms are in place.

The integration of environmental challenges into ecotourism planning is consistent with adaptive governance theory, which emphasizes flexibility, stakeholder collaboration, and learning in managing socio-ecological systems. In this context, the community's response to oil sludge can be interpreted as an emergent form of adaptive capacity. Although only a minority currently perceives the oil sludge as an economic opportunity, this perception may evolve with increased awareness, capacity-building, and demonstration of successful ecotourism models. The potential for scaling such adaptive responses hinges on the presence of enabling institutions that can facilitate knowledge transfer, provide financial incentives, and ensure regulatory coherence. Moreover, the availability of human resources in Bintan's coastal zones, characterized by a high degree of environmental awareness and informal economic activity, offers a strategic advantage for implementing ecotourism. This model advocates for a balance between economic viability, environmental integrity, and social equity. To operationalize this framework, local governance structures must prioritize inclusive planning processes, equitable benefit distribution, and the institutionalization of environmental education within tourism programming.

Governmental support, particularly in the form of conservation grants, infrastructure investment, and vocational training, is essential to catalyze this transition. Such interventions align with the principles of polycentric governance, which advocate for multi-level coordination among local, regional, and national actors to address complex sustainability challenges. For instance, state-led initiatives to improve waste management, promote sustainable fisheries, and professionalize ecotourism services would not only enhance the region's appeal to environmentally conscious travelers but also reinforce community ownership and accountability.

Development of The Attractions and Facilities

Around Bintan Island, local communities and private groups are taking the lead in managing tourism areas. This marks a shift toward more community-driven and flexible ways of managing ecotourism. Their approach fits well with the principles of ecotourism described by Hassan et al., (2017), which focus on protecting nature, appreciating its beauty, and avoiding harmful activities. These principles also stress the importance of involving local people in every step of tourism planning and making sure tourism brings real environmental and economic benefits.

Fig. 6. The presence of corner stores nearby supports local economic activities. (Research Documentation 2024)

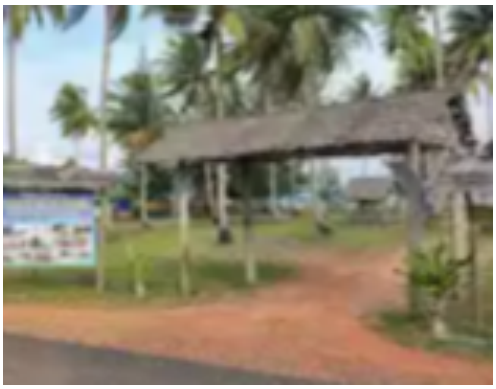

Fig. 7. The beach entrance gate was identified as a supporting infrastructure for ecotourism development. (Research Documentation 2024)

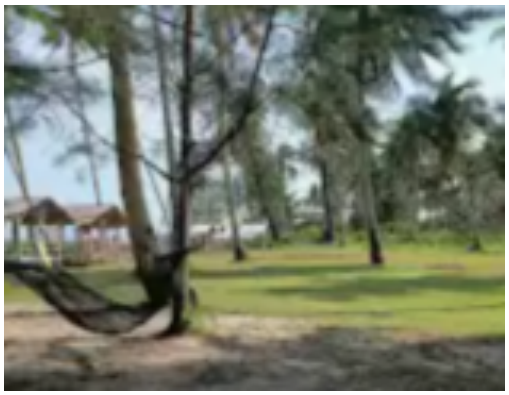

Fig. 8. Hammocks and green views enhance the recreational experience for tourists. (Research Documentation 2024)

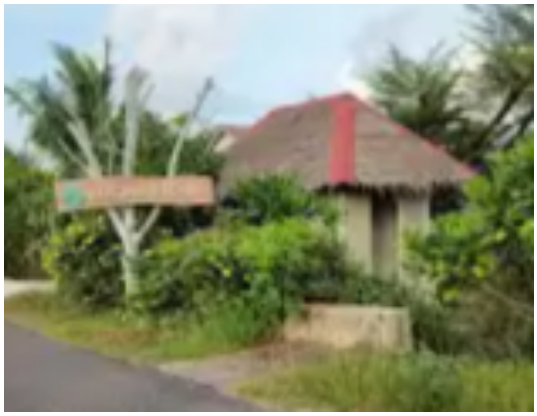

Fig. 9. Local resort facilities as essential infrastructure in supporting tourism development. (Research Documentation 2024)

Empirical insights from Figures 6 through 9 demonstrate how locally driven interventions around Bintan Island can be effectively aligned with ecotourism principles and sustainable governance strategies. The appearance of small-scale commercial stalls (Figure 6) reflects (Bhushan et al., 2024) alternative income hypothesis, which views ecotourism to support both conservation and local livelihoods. These stalls not only meet basic tourist needs but also offer opportunities to showcase local food and crafts. To ensure long-term success, their integration into tourism circuits should follow key ecotourism principles such as cultural authenticity, minimal

environmental impact, and fair distribution of benefits to avoid exploitation and exclusion. The beach entrance gate (Figure 7) serves as both a visual landmark and a symbolic entry point, playing a key role in shaping tourist impressions and movement. Its visibility and appeal suggest that joint efforts between local communities and government agencies could enhance its function as a sustainable attraction. Such collaboration is vital for protecting the landscape and strengthening local ownership. Figure 8 highlights shaded green spaces within a coastal setting, which offer valuable opportunities for diversifying tourism activities and building resilience. These areas can act as ecological buffers during environmental disruptions like oil sludge pollution and be repurposed for low-impact recreation, such as birdwatching or nature walks that align with ecotourism's focus on learning and immersion. Their development should be part of broader land-use planning that balances conservation goals with visitor experiences. Tourist accommodations shown in Figure 9 indicate that the region is ready for expanded ecotourism. However, sustainable lodging requires careful planning to avoid overcrowding and environmental harm. This includes assessing ecological limits, sharing benefits fairly, and involving both local and state actors in decision-making. Without such coordination, tourism growth could undermine the very ecosystems it depends on.

To further strengthen Bintan Island's ecological and educational value, installing interpretive signage and promoting eco-friendly transport options like bicycle rentals and guided nature tours are recommended. These efforts support low-carbon tourism and help visitors understand the local environment, reinforcing Bintan's identity as a regenerative tourism destination. By embedding conservation goals into tourism planning and encouraging collaboration among stakeholders, Bintan Island has the potential to turn environmental challenges such as oil sludge pollution into opportunities for sustainable development and long-term socio-ecological resilience.

Legal Frameworks for Supporting Oil Sludge Management and Ecotourism Development

Oil sludge pollution along Bintan Island's northern coast is a serious problem that needs strong legal solutions. These laws should go beyond general environmental rules and include clear limits on waste discharge, strict enforcement, and penalties for violations. By controlling how ships dispose of oil sludge, the government can hold the shipping industry accountable and reduce damage to the sea. As Petriello et al., (2025) point out, clear laws and good coordination between local governments and private companies are key to managing waste sustainably. These legal frameworks should also support ecotourism as part of environmental protection. Laws that connect tourism with conservation can help local communities take part in eco-friendly tourism while earning income. This supports the two main goals of ecotourism: protecting nature and improving livelihoods. (Humphries, 2025) stresses that tourism must be carefully managed to avoid making pollution worse, especially in sensitive coastal areas.

To encourage cleaner practices, laws can offer financial rewards—like tax breaks or subsidies—for companies that invest in better oil sludge treatment and waste systems. As (Santarém, 2021) explains, linking financial tools with environmental goals helps reduce the long-term damage from oil spills. Making pollution control part of business operations also protects local economies that rely on healthy coastal environments. Ecotourism laws can also require projects to include environmental restoration, wildlife protection, and care for natural heritage. These rules would help tourism support long-term conservation and attract funding from outside sources. Community-based conservation laws are also important. They give local people the right to manage natural resources and share in tourism benefits. This builds local ownership and ensures that tourism income supports ecological and community development.

Finally, since oil sludge pollution often comes from international shipping, global cooperation is needed. Strengthening international agreements like MARPOL Annex I and aligning them with local laws can improve enforcement and share best practices. With strong legal support and teamwork across different levels, Bintan Island can become a leading example of sustainable coastal management—where law, nature, and community work together to solve environmental challenges.

CONCLUSION

The northern coastal waters of Bintan Island face growing risks from oil sludge pollution, yet there is no coordinated response involving multiple stakeholders. To address this, the study introduces the idea of "oil sludge ecotourism"—a strategy that combines environmental clean-up with sustainable economic development. This concept turns pollution remediation into a form of conservation-focused tourism, in line with ecotourism principles that promote ecological restoration, community involvement, and non-destructive interaction with nature. If successful, this model could raise environmental awareness, create new income sources for locals, and support long-term care for coastal ecosystems.

However, this idea is still theoretical. It lacks real-world testing, assessments of community and institutional readiness, and studies on how tourists might respond to such experiences. Without these, it's hard to know if the concept would work in practice. To move forward, interdisciplinary research is needed, bringing together environmental science, tourism studies, and governance to evaluate whether this type of tourism can truly help reduce pollution and support local development. Future research should focus on pilot projects to test how well oil sludge ecotourism works in real settings. These projects must involve local communities not just as participants, but as co-creators. Strong policies are also needed to support this approach, including legal recognition of ecotourism as a tool for environmental clean-up, and systems for monitoring and adapting over time. With the right mix of innovation, evidence, and community involvement, oil sludge ecotourism could become a practical model for other coastal areas facing similar pollution challenges.

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