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Protecting Underwater Paradise: A Multi-Stakeholder Collaboration to Address Illegal Sand Mining in Wakatobi, Indonesia

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Abstract

Wakatobi, an archipelagic region in Southeast Sulawesi, Indonesia, is home to some of the world's most pristine coral reefs, making it a crucial marine biodiversity hotspot. Illegal sand mining increasingly threatens these coral ecosystems, causing significant ecological and socio-economic damage. This research examines the extent and impacts of illegal sand mining in Wakatobi, focusing on its effects on coral reefs, the local economy, and marine biodiversity. The study employs a sociological–juridical approach, using primary interview data and secondary legal and scientific sources, analyzed qualitatively to assess enforcement practices, ecological impacts, and stakeholder roles. Although Indonesia has regulatory frameworks prohibiting sand extraction in conservation zones, weak enforcement, limited community awareness, and the absence of sustainable livelihood alternatives hinder effective control. The study proposes a multi-stakeholder cooperation agreement involving the government, local communities, NGOs, and the private sector to regulate sand mining, restore damaged ecosystems, and promote sustainable development. This collaborative approach is intended to provide a sustainable model for coral reef conservation that could be replicated in other coastal areas. The cooperation agreement is a crucial step toward protecting marine ecosystems and aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 14 and SDG 15, which focus on conserving marine life and protecting biodiversity.

Keywords

Wakatobi; Coral reef conservation; Illegal sand mining; Multistakeholder cooperation; Sustainable development

Introduction

Indonesia, with more than 17,504 islands spread from Sabang to Merauke, is the world's largest archipelagic country

(Martasudjita, 2015). Of these, approximately 13,466 are small islands that are vital to Indonesia's biodiversity and culture (Praptiwi et al., 2021). Indonesia's coastline stretches 108,000 kilometers, making it one of the countries with the longest coastlines in the world (Handiani et al., 2022). With an estimated 2.5 million hectares of coral reefs identified through satellite imagery under the One Map Policy (Law No. 4/2011), the country is globally recognized as a center of tropical marine biodiversity (Afdal et al., 2024).

One island renowned for its marine natural resources, particularly its coral reefs, is Wakatobi, located in Southeast Sulawesi Province, Indonesia, which is known as one of the regions with the richest marine natural resources in the world**.** Coral reefs are an integral part of the region's marine ecosystem (Harahap *et al*., 2025; Mellin *et al*., 2016; Wally, Williamson and Dunning, 2024). The coral reefs in Wakatobi are among the richest and most preserved in Indonesia and the world. Coral reefs are a complex ecosystem built mainly by marine life that produces lime and other biota that live at the bottom and in the water column (Giyanto, 2017).The diversity of Wakatobi's coral reefs places the region at the heart of the Coral Triangle, a globally recognized center of marine biodiversity. The Wakatobi Sea is endowed with an incredible coral reef ecosystem and is dubbed an underwater paradise (Karim Mukhlis and Aziz, 2024).

Wakatobi's underwater ecosystems and rich biodiversity have positioned the area as an internationally renowned diving and marine-ecotourism destination, hosting more than 10 tourism sites and contributing significantly to local livelihoods (Bisri, 2023). Beyond tourism, coral reefs support commercial fisheries, sustain coastal communities, and serve as natural laboratories for scientific research and education. Their conservation is therefore critical to both environmental sustainability and regional economic development.

Coral reef ecosystems are among the most biodiverse coastal systems. This ecosystem has great benefits for life as well as for human needs. Coral reefs have both ecological and economic functions. The ecological function of coral reefs includes nutrients for marine aquatic life, physical protection (from waves), spawning grounds, and habitat for marine organisms. Meanwhile, the economic function is a habitat for reef fish, crayfish, algae, sea cucumbers, and pearl shells, as a tourist attraction, as well as a natural laboratory to support education and research (Tuwo, 2011). Given their importance, maintaining the sustainability of coral reefs in Indonesia is vital. However, coral reefs are extremely vulnerable to degradation, particularly due to human activities. Major drivers of reef decline in Indonesia include sedimentation, pollution from industrial and domestic waste, coral extraction for construction materials, and destructive fishing practices such as blast fishing and poison use. In Wakatobi, one of the key threats to coral reef ecosystems is illegal sand mining.

Illegal sand mining, mining activities conducted without official permits, has both socio-economic and environmental consequences. Although it provides livelihood opportunities and increases household income, thus contributing to poverty reduction, it also results in water and air pollution, as well as occupational hazards due to the lack of proper safety equipment (Nurcahyo, 2020). Moreover, mining activities that do not comply with spatial planning regulations are prohibited. Therefore, illegal mining needs

to be a shared concern for all parties, as emphasized by the Ministry of Energy and Mineral Resources, in order to prevent wider environmental impacts and ensure compliance with regulations (Ministry of Energy and Mineral Resources, 2022). According to Southeast Sulawesi Provincial Regulation No. 9/2018 on Coastal and Small Islands Zoning, Wakatobi Regency is designated as a capture fisheries zone, fishing port sub-zone, and national park sub-zone — areas where mining activities are strictly prohibited.

Despite these regulations, illegal sand mining continues as a primary livelihood strategy for some coastal communities (Mensah and Mattah, 2023; Salam *et al*., 2025). Although such activities are banned under Law No. 1 of 2014 on the Management of Coastal Areas and Small Islands. In practice, however, sand extraction persists, leading to coastal abrasion and degradation of marine water quality, particularly in areas used for seaweed cultivation (Nugraha, 2017). This issue aligns with Sustainable Development Goal (SDG) 14, which emphasizes the protection of marine ecosystems and coral reefs from destructive human practices. To address this challenge, multi-stakeholder cooperation agreements involving government authorities, local communities, NGOs, and the private sector are essential. Such agreements ensure clear regulatory frameworks, strengthen monitoring and enforcement efforts, and promote community awareness regarding the importance of coral reef conservation. Collaborative governance offers a sustainable pathway to control illegal sand mining, protect marine biodiversity, and safeguard the long-term economic welfare of Wakatobi residents.

The novelty of this study lies in integrating multi-stakeholder cooperation agreements as a legal and governance strategy for coral reef conservation, an approach that has not been systematically explored in Indonesia, particularly in Wakatobi. The research therefore seeks to answer two key questions: (1) What are the current realities and impacts of illegal sand mining on coral reefs in Wakatobi? and (2) What forms of cooperation agreements can prevent illegal sand mining and ensure the ecological sustainability of coral reefs? Unlike previous studies that primarily emphasize environmental law enforcement or governmental policy interventions, such as studies in Malaysia calling for comprehensive planning and management frameworks for sand mining (Ali, Gan and Asmawi, 2025)and analyses in Indonesia advocating improved policy implementation to protect human life and environmental quality (Haq, Handayani and Ahmad, 2023) this research offers a unique contribution. It empirically examines a collaborative environmental law model centered on multi-stakeholder agreements as a core instrument for controlling illegal sand mining and restoring coral reef ecosystems in the Wakatobi Conservation Area.

Research Methods

This legal research adopts a sociological-juridical approach. Sociological-juridical research is legal research that begins with secondary data and is followed by primary field data collected from communities (Amiruddin, 2012). Primary data were obtained through in-depth interviews with government officials, representatives of the Wakatobi National Park Agency, local community leaders, and environmental organizations. Secondary data were obtained from legal documents, regulatory reports, reports from related agencies, and scientific literature. The data collection techniques used were

literature and field studies. Furthermore, the analysis was qualitative. Data and legal materials are presented descriptively.

Study Area

Wakatobi Regency is located in Southeast Sulawesi Province, Indonesia, and forms part of the Coral Triangle, the global epicenter of marine biodiversity. The region consists of four main islands, Wangi-Wangi, Kaledupa, Tomia, and Binongko, along with numerous smaller islands, covering a total area of approximately 823 km² of land area and over 18,000 km² of marine jurisdiction. Wakatobi was declared a National Park in 2002 and later recognized as part of the UNESCO World Biosphere Reserve Network in 2012 due to its exceptional marine ecosystems and cultural heritage. The region hosts more than 750 coral species and 940 fish species, making it one of the most diverse reef systems in the world.

With regards to the socio-economic context, coastal communities in Wakatobi largely depend on marine resources for subsistence and income. While tourism development has created new opportunities, benefits remain unevenly distributed, particularly in remote island settlements. For some households, sand mining remains a supplemental livelihood, especially where market access and employment prospects are limited.

Research Design

This study employs a sociological–juridical research approach, which combines doctrinal legal analysis with empirical field investigation. In this approach, secondary legal sources form the foundation for understanding the legal framework, while primary data from the field are used to examine how laws operate in practice and how communities respond to them (Amiruddin, 2012).

Data Sources

The research utilizes both primary and secondary data: Primary data were collected through in-depth semi-structured interviews with key stakeholders, including government officials at local and provincial levels, representatives of the Wakatobi National Park Authority, community leaders and traditional custodians, environmental NGOs, and civil society actors. The interviews focused on understanding enforcement challenges, community reliance on sand mining, perceptions of coral conservation, and opportunities for multi-stakeholder cooperation. Secondary data consisted of: National and regional legislation and regulatory documents, policy reports and government publications, academic literature and peer-reviewed studies, and environmental impact reports related to Wakatobi.

Data Analysis

All qualitative data were analyzed using a descriptive-interpretative method, which involved identifying themes related to legal enforcement, ecological impacts, stakeholder roles, and collaborative governance mechanisms. Legal materials were examined using content analysis to evaluate the effectiveness of existing regulations

and identify gaps in implementation. Field data were triangulated with documentary sources to ensure credibility and validity.

Results and Discussion

The Reality and Impact of Illegal Sand Mining in Wakatobi on Coral Reefs

The Wakatobi area is a strategic area of national priority in the tourism sector (Moerwanto and Junoasmoro, 2017). Located in Southeast Sulawesi, it is one of the largest marine conservation areas in Indonesia, with an area of approximately 1.39 million hectares (BPK RI Prov. Sulawesi Utara, 2020). The region has exceptionally high marine biodiversity, with more than 942 fish species and 750 coral species, nearly the entire global total of 850 (Kementerian Koordinator Bidang Kemaritiman Dan Investasi, 2017). The geographical conditions of Wakatobi, which consists of four main islands (Wangi-wangi, Kaledupa, Tomia, and Binongko) with shallow and clear waters, make it an ideal habitat for coral reef growth. However, this geographical condition also makes the Wakatobi area vulnerable to illegal sand mining activities because of the easy access and high economic value of the coral sand found in the area.

Wakatobi's strategic geographical condition and rich coral reefs increasingly face severe challenges regarding illegal sand mining. This practice is intensifying as the demand for sand increases for construction, coastal reclamation, and artificial island construction. Despite offering seemingly abundant resources, sea sand mining presents unique challenges in terms of environmental and social impact. Sea sand mining has become an increasingly important issue in coastal and marine resource management. These activities, often viewed as a source of income for local communities, have long-term environmental, social, and economic impacts in the long run. Sea sand mining offers short-term economic benefits through the provision of raw materials for the construction and reclamation industries. Furthermore, sea sand mining can also affect the livelihoods of coastal communities that depend on marine resources, such as fishers and tourists (Halim, Waskitho and Prakosa, 2019).

Although it provides short-term economic benefits, it causes widespread environmental impacts. For example, the dynamics of the natural physical properties of the sea, such as the movement of currents, waves, and tides, along with sea sand excavation activities, result in changes in coastal morphology, sedimentation, and the ecological balance of the coastal area (Joseph and Sugiri, 2014). Given these impacts, stricter monitoring and a coordinated governance mechanism are needed to ensure the sustainability of the ecological function of coral reefs in the Wakatobi Area.

Unlicensed or illegal sand mining is mining carried out without a permit to mine in accordance with Law No. 4 of 2009 concerning Minerals and Coal; Local Government Regulations. Illegal mining activities have a significant negative impact, one of which is damage to the coast, which can cause the beach to slowly sink. Despite legal prohibitions under Law No. 4 of 2009 on Mineral and Coal Mining and regional regulations, Illegal mining persists due to economic pressures, limited livelihood alternatives, low environmental awareness, and weak enforcement capacity. Interviews with officials from the Wakatobi National Park Authority indicate that sand mining has been a

persistent issue since at least 2022 and remains challenging to resolve due to community reliance on sand for basic infrastructure needs. The lack of locally available legal sand supplies reinforces this dependency and creates a governance dilemma: stopping mining risks depriving communities of essential construction materials.

Field observations identified Patua Village (Tomia Island) and Kampa Beach (Dete Village) as long-standing extraction sites, operating as informal community mines since 2007 and 1997, respectively. While these activities have contributed to household income, they have simultaneously degraded coastal zones and increased sedimentation levels. Excess sediment transport into nearshore waters reduces water clarity, inhibits coral photosynthesis, and disrupts seagrass and mangrove ecosystems. Consequently, coral reef degradation reduces fish abundance, undermining small-scale fisheries and affecting food security and local livelihoods. Tourism, an emerging economic pillar in Wakatobi, also faces threats, as coral reef decline diminishes the attractiveness of the region as a diving destination.

Law enforcement efforts by the Wakatobi National Park Authority and environmental agencies have included patrols, community engagement, and complaint reporting systems. However, enforcement effectiveness remains low due to limited personnel and monitoring infrastructure across the vast marine area, covert mining practices, and community resistance driven by economic necessity. Structural governance issues further constrain regulation, including overlapping institutional authority, the absence of specific provisions regulating sand mining in marine protected areas, and relatively weak sanctions.

Overall, illegal sand mining in Wakatobi reflects a pronounced trade-off between short-term economic survival and long-term ecological and socio-economic sustainability. While extraction offers temporary income, it causes irreversible coral reef damage, threatens fisheries and tourism, and deepens coastal vulnerability (Kurniawan, Supriharyono and Sasongko, 2014; Safrizal and Widyastuty, 2024; Urianti and Tomi, 2024). The impacts also extend to the tourism sector, which is an important source of income for the region (Taufik et al., 2020; Yandy, 2024).

Therefore, it is important to carry out sustainable management that involves structural and nonstructural mitigation, including regulatory enforcement, ecosystem restoration, and local community empowerment. Through this approach, the community and local government can ensure the preservation of the coastal environment and support the welfare of communities that depend on marine ecosystems (Azuga et al., 2025; Filho et al., 2021). Effective mitigation, therefore, requires an integrated and collaborative governance approach. Strengthened law enforcement, community-based monitoring, sustainable livelihood alternatives, and ecosystem restoration efforts are essential to safeguarding Wakatobi's coral reef ecosystems and sustaining local welfare. A formal multi-stakeholder cooperation mechanism linking government authorities, communities, NGOs, and tourism actors is urgently required to address this complex challenge comprehensively.

Form of Illegal Sand Mining Control Cooperation Agreement to Reduce Coral Reef Damage to Maintain Coral Reef Function in Wakatobi

Wakatobi National Park, which includes four main islands (Wangi-wangi, Kaledupa, Tomia, and Binongko), has an incredible wealth of marine biodiversity. The coral reef ecosystem in this region not only serves as a habitat for various marine species but also provides ecosystem services in the form of coastal protection from abrasion, a source of livelihood for residents, and ecotourism attractions with high economic value. Wakatobi National Park has a lot of tourism potential; therefore, management and protection are needed to maintain its sustainability (Marlina, 2020). However, illegal sand mining poses a significant threat to these coral reefs. The extraction process not only physically destroys reef structures but also increases sedimentation, reducing light penetration required for coral symbiosis with zooxanthellae, thereby inhibiting growth and accelerating coral mortality Doloksaribu, Barus and Sebayang, 2020). In addition, mining disturbances degrade dune systems, coastal soils, and nearshore biota (Rangel-Buitrago et al., 2023), threatening local livelihoods dependent on fisheries and marine tourism.

In response, the Wakatobi Regency Government has attempted to mitigate mining activities by prohibiting the use of locally sourced sand in public construction projects and directing dredging only toward navigational channels. However, these measures have proven insufficient. The ban applies only to government projects, while community-driven construction — largely unregulated — continues to create strong demand for sand. Limited enforcement capacity and opportunities for misuse of navigational dredging permits have further reduced policy effectiveness. As a result, illegal sand extraction persists due to high local demand, lack of alternative building materials, and weak supervision.

Given these conditions, a more comprehensive, collaborative, and enforceable governance mechanism is needed. A multi-stakeholder cooperation agreement can provide the institutional framework required to control sand mining, ensure reef protection, and balance ecological and socio-economic interests. Indonesian contract law, as stipulated in Article 1313 of the Civil Code, defines an agreement as an act by which one or more parties bind themselves to others. Black's Law Dictionary similarly defines a contract as an agreement creating enforceable obligations (Garner, 1990). These principles form the legal foundation for establishing a formal cooperation framework.

The regulation of sand mining control in Indonesia is based on a hierarchy of laws and regulations, including Law No. 4 of 2009 concerning Mineral and Coal Mining, Law No. 32 of 2009 concerning Environmental Protection and Management, and Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands. At the regional level, the Wakatobi Regency Government has issued Regional Regulation No. 5 of 2015 concerning Coral Reef Management and Regional Regulation No. 3 of 2018 concerning the Prohibition of Sea Sand Mining. However, the implementation of this regulation still faces obstacles in coordination between agencies, limited law enforcement resources, and gaps in enforcement, which require a collaborative approach through multi-stakeholder cooperation agreements. This legal framework provides legitimacy to the establishment of a legally binding and accountable cooperation agreement.

Based on this legal basis, the identification of the parties who must be involved in the cooperation agreement is a fundamental aspect of the design of the agreement. The main parties include: the central government, represented by the Ministry of Maritime Affairs and Fisheries, Wakatobi National Park Authority, and the Ministry of Environment and Forestry, which is interested in implementing national policies and achieving conservation targets. Local governments include the Southeast Sulawesi Provincial Government and Wakatobi Regency Government, which are interested in regional autonomy and local economic development. Civil society consists of traditional fishermen with an interest in access to marine resources, indigenous communities with an interest in the preservation of local wisdom, and environmental organizations that focus on conservation. The private sector includes marine tourism operators with commercial interests and construction companies with raw material requirements. From a treaty law perspective, this diversity of interests must be accommodated through a check-and-balance mechanism that ensures that no party dominates or is harmed, in accordance with the principle of balance in treaty law. Such multi-stakeholder engagement is essential to ensure social legitimacy and can be effectively implemented.

Given the number of stakeholders involved, the cooperation agreement must be systematically designed to accommodate the interests and roles of each stakeholder. The most appropriate form of agreement is a Memorandum of Understanding (MoU), which is then described in a more detailed and technical Cooperation Agreement (PKS). A Memorandum of Understanding (MoU) is a preliminary agreement made by the parties who want to make an agreement. However, if the Memorandum of Understanding (MoU) also refers to Article 1320 of the Civil Code, then it has the same legal force as the legal force based on the agreement contained in the Indonesian legal system, namely, the Civil Law system (Pratama, 2016).

The MoU serves as a general framework that governs the basic principles of cooperation, shared vision and mission, and political commitment of all parties. Meanwhile, the Cooperation Agreement regulates the division of duties, responsibilities, coordination mechanisms, reporting systems, and other operational technical aspects. This structure allows flexible implementation while maintaining long-term commitments. The agreement must also have periodic review and evaluation clauses to ensure its relevance and effectiveness in dealing with the dynamics of ever-evolving problems. Given the complexity of the existing legal framework, the establishment of a cooperation agreement to control illegal sand mining must adhere to the fundamental principles of treaty law, as outlined in the Civil Code. Article 1313 of the Civil Code defines an agreement as an act in which one or more individuals bind themselves to one or more other parties. In the context of multi-stakeholder cooperation agreements, this definition expands to encompass multiple parties, each with diverse interests but united by common goals, particularly in the conservation of coral reefs. As per Article 1320 of the Civil Code, four essential conditions must be met for the validity of an agreement: (1) consent from the parties involved; (2) the legal capacity of the parties to enter into agreements; (3) a certain object of the agreement; and (4) valid reasons for the agreement. In the case of a cooperation agreement aimed at controlling illegal sand mining, these four conditions must be carefully considered and satisfied.

First, the consent of all parties must be explicit. In a multi-stakeholder setting, this involves negotiating and ensuring mutual understanding and agreement among all parties involved, whether they are government bodies, private sector entities, or non-governmental organizations, each bringing different perspectives and interests to the table. Second, the parties must have the legal capacity to enter into agreements, which in this case refers to the ability of both public and private legal entities to sign the agreement. The parties involved, therefore, need to be legally competent to engage in a binding agreement under the relevant national and international laws. Third, the object of the agreement must be clear and measurable. In this context, the objective is the control of illegal sand mining in the Wakatobi region. This requires defining specific actions, targets, and measurable outcomes related to sand mining control, ensuring that the agreement has a tangible and observable impact on the ground. Finally, the agreement must be based on valid reasons, or *halal causa*, which refers to the purpose or rationale behind the agreement. For this cooperation agreement, the underlying cause is environmental protection—specifically, preserving the Wakatobi ecosystem for future generations. This purpose aligns with broader environmental and sustainable development goals, ensuring that the agreement serves the public interest and the protection of natural resources.

Therefore, for the cooperation agreement to be legally valid and effective, it must meet these conditions by incorporating clear, measurable objectives, ensuring all parties are legally capable and fully consenting, and basing the agreement on legitimate environmental protection goals. The agreement must be crafted with careful consideration of these legal principles to ensure its enforceability and success in controlling illegal sand mining while safeguarding the Wakatobi ecosystem. Cross-sector collaboration is a fundamental prerequisite for realizing environmental sustainability. Cooperation agreements between parties are based on the principles of shared responsibility and local wisdom, which is in line with the theory of collaborative governance that emphasizes the importance of joint decision-making and policy implementation by various stakeholders through active participation, deliberative dialogue, and equal sharing of responsibilities, so that environmental management results become more inclusive, effective, and sustainable (Amantha, 2025).

Based on the legal foundation of the agreement according to the Civil Code, the implementation of the cooperation agreement must refer to the principles of the treaty law. The implementation of the principle of consensualism, especially the terms of agreement of the parties, for the occurrence of an agreement in general, the conformity of the will that meets certain requirements is a valid contract according to the law (Herlien, 2001). This principle requires a *consensus ad idem* from all stakeholders involved, which, in the context of a multi-stakeholder agreement, requires an intensive and transparent negotiation process. In addition, the principle of pacta sunt servanda obliges all parties to implement the agreement in good faith, meaning they must act honestly, fairly, and not use fraud or fraud (Priyono, 2024). In the context of an environmental agreement, this means a long-term commitment from the parties involved to the conservation of coral reefs.

The established legal framework determines the structure and essential components that must be present in a cooperation agreement. From the perspective of contract law, the

structure of the agreement must fulfill the elements required in Article 1338 of the Civil Code regarding the binding nature of an agreement. Each of these components plays a crucial role in ensuring that the agreement is fair, valid, and legally enforceable. The essential components of the agreement include: first, a preamble that outlines the background and legal basis for the formation of the agreement. This preamble provides context for the agreement's creation and ensures it binds the parties legally. Second, a clear definition and scope clause regarding the protected coral reef areas, in line with the principle of legal certainty. This clause ensures there is no ambiguity regarding the boundaries of the protected areas, which is critical for the protection of the coral reef ecosystem.

Third, the identification of the parties with clear legal standing, roles, and responsibilities. The parties involved in the agreement must be clearly identified, with their rights and obligations explicitly stated to avoid any overlap or conflict of interest. Fourth, measurable and verifiable specific objectives related to preventing illegal sand mining. These objectives must be clearly articulated, with concrete and realistic indicators that can be monitored and evaluated to ensure the agreement effectively addresses the issue. Fifth, mechanisms for coordination and communication among stakeholders that implement the principle of good faith. This is essential to ensure transparency and effective cooperation between all involved parties.

Sixth, a transparent and accountable monitoring and evaluation system, designed to ensure that all actions taken align with the provisions of the agreement and achieve the intended outcomes. This system must be accessible to all relevant parties and allow for regular assessments of progress. Seventh, effective and efficient dispute resolution mechanisms to resolve conflicts that may arise between the parties involved. A robust dispute resolution process is critical to prevent issues from escalating or causing prolonged tensions. Eighth, provisions concerning financing and the fair and proportional allocation of resources. An unequal distribution of resources could lead to injustice and imbalance, so clear terms regarding financial arrangements must be set to ensure fairness for all parties.

Ninth, balanced and proportional sanctions and incentives, which will act as deterrents for violators while rewarding those who adhere to the agreement. Disproportionate sanctions could harm one party, while inadequate incentives could reduce motivation to comply with the agreement. Finally, the inclusion of review and adaptation clauses allows for adjustments in response to changing circumstances. Environmental and socio-economic conditions are subject to change, and the agreement must be flexible enough to accommodate these changes. Each of these components must be designed with consideration for the unique characteristics of the Wakatobi ecosystem and the socio-economic dynamics of the local community, while also ensuring enforceability within the Indonesian legal system.

In addition, efforts must be made to rehabilitate and restore coral reef ecosystems damaged by illegal mining. Cooperation agreements should regulate coral transplantation programs by involving local communities, students, and volunteers in coral-planting activities. The establishment of *marine protected areas* in pristine locations must be regulated by clear zoning and strict utilization rules. The artificial reef

program can be an alternative to accelerate habitat restoration while creating new tourist attractions in the area. Research and monitoring of coral reef health conditions must be carried out periodically by universities and research institutions. The agreement should also set out a long-term funding system for restoration programs through contributions from various parties, including possible payments for ecosystem services. Databases and documentation of restoration processes must be well-maintained for learning and replication in other regions.

The establishment of a joint secretariat or special coordination unit is necessary to manage the day-to-day implementation of the agreement, with a clear organizational structure and dedicated personnel. The monitoring system should include measurable performance indicators, such as the number of illegal mining cases successfully prevented, the rate of coral cover recovery, the increase in community income from alternative economies, and the level of community participation in conservation programs. Periodic evaluations of operational aspects and annual evaluations of strategic aspects must be conducted by independent evaluators. The agreement should have adaptive clauses that allow for adjustments to strategies and approaches based on the results of the evaluation and changing conditions on the ground. Dispute resolution and mediation mechanisms between parties should be clearly regulated to address potential conflicts of interest in the study. Finally, the agreement should have a long-term roadmap with *clear milestones* to achieve the goal of maintaining the function of the Wakatobi coral reef as a healthy and productive ecosystem for future generations.

Harmonization with the national legal system and international best practices shows that the cooperation agreement to control illegal sand mining in Wakatobi significantly contributes to the achievement of the Sustainable Development Goals (SDGs) that Indonesia has adopted as a global commitment. The purpose of law enforcement for illegal sand mining perpetrators is to maintain sustainability and natural ecosystems to implement the principles of sustainable development goals (SDGs), which must reach all levels of society without exception (no one left behind) (Disemadi & Nababan, 2021). This agreement contributes to SDG 14 (Life Below Water) through the conservation and sustainable use of marine ecosystems, especially target 14.2 on the sustainable management and protection of marine and coastal ecosystems, and target 14.5 on the conservation of at least 10% of coastal and marine areas. The protection of the Wakatobi coral reef also supports SDG 15 (Life on Land) target 15.5 on reducing the degradation of natural habitats and halting biodiversity loss.

Conclusion

The research conducted on illegal sand mining in Wakatobi has highlighted significant ecological and socio-economic challenges, particularly in relation to coral reef degradation and the decline of biodiversity. Wakatobi, a region famous for its rich marine biodiversity and coral reefs, faces severe damage due to unregulated sand mining activities, which not only harm the marine ecosystem but also jeopardize the livelihood of local communities. The mining activity, driven by high demand for sand for construction and coastal reclamation, disrupts sedimentation patterns, causing coastal erosion and damaging vital marine habitats. The practice also exacerbates social

conflicts as local communities, dependent on sand mining for economic survival, often ignore government regulations.

The lack of effective enforcement mechanisms, coupled with weak legal frameworks and overlapping authorities, has made it difficult to curtail illegal sand mining activities. Despite stakeholder efforts, including local governments and environmental organizations, the activities continue largely unchecked, causing irreversible damage to coral reefs and marine life. Moreover, the short-term economic benefits from sand mining are overshadowed by the long-term environmental losses that further harm the livelihoods of coastal residents, particularly fishermen whose sources of income are dwindling due to the destruction of marine ecosystems.

A collaborative approach involving multiple stakeholders, government bodies, local communities, NGOs, and the private sector, is essential to address this issue. The research proposes a multi-stakeholder cooperation agreement as a viable solution, providing a framework for regulating sand mining activities, restoring damaged ecosystems, and developing alternative livelihoods for local communities. The agreement should be legally binding, with clear roles and responsibilities for all parties involved, as well as mechanisms for monitoring and evaluation to ensure its effectiveness. It must also incorporate strategies for community involvement, education, and awareness-building to foster long-term environmental stewardship.

The cooperation agreement should be grounded in a comprehensive legal framework that aligns with national and international environmental standards, particularly the United Nations Sustainable Development Goals (SDGs). It must aim to protect marine and coastal ecosystems (SDG 14) and reduce the degradation of natural habitats (SDG 15), ensuring that Wakatobi's coral reefs remain vital to the region's biodiversity and economy for generations to come. Through this integrated approach, Wakatobi can secure both its environmental and socio-economic sustainability, benefiting not only the local communities but also contributing to global conservation efforts.

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Conceived and designed the research or analysis	Yes	No
Collected the data	Yes	No
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