Governing Biodiversity in Indonesia: Evaluation of Current Policies, Implementation of the Nagoya Protocol, and Sustainability Challenges

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Article Info	ABSTRACT
	Biodiversity is a fundamental component for maintaining ecological balance and sustaining life on Earth. However, accelerating anthropogenic pressures, including deforestation, pollution, climate change, and resource overexploitation, have intensified biodiversity loss in Indonesia as one of the world's megadiverse countries. This study employs a policy evaluation and qualitative analytical approach, integrating ecological and evolutionary biodiversity frameworks to examine Indonesia's biodiversity governance through an analysis of national environmental policies, the implementation of the Nagoya Protocol, and emerging sustainable resource governance instruments such as Payment for Ecosystem Services (PES), carbon taxation, and emissions trading systems. The findings reveal that while Indonesia has made significant progress in integrating biodiversity protection into national development through legal, fiscal, and conservation mechanisms, implementation challenges remain, particularly in enforcing benefit-sharing regulations under the Nagoya Protocol. Addressing these challenges requires enhanced institutional coordination, community-based participation, and international cooperation. This study contributes by providing a comprehensive governance-oriented assessment of biodiversity management in Indonesia, highlighting critical institutional and regulatory challenges while offering insights relevant for strengthening sustainable development policies in megadiverse countries

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1. INTRODUCTION

Biodiversity is a fundamental element in maintaining ecological stability and environmental sustainability (Butchart et al., 2010; Chen et al., 2024; Tilman et al., 2006). Biodiversity refers not only to genetic and species diversity, but also encompasses the entire dynamic interaction within ecosystems that support human life(Jeronen, 2023). As a megabiodiversity country, Indonesia has a major responsibility to preserve and manage its rich biodiversity, which is spread across tropical forests, peatlands, coastal areas, and unique marine ecosystems (Gunawan et al., 2024; Prasetyo et al., 2025). However, in recent decades, pressure on biodiversity has increased sharply due to anthropogenic activities such as deforestation, land conversion, environmental pollution, unsustainable resource exploitation, and the impacts of global climate change (Hallaj et al., 2024).

The consequences of biodiversity loss extend beyond ecological degradation to include social, economic, and governance challenges (Wetzel et al., 2015). Declining biodiversity threatens the livelihood resilience of local and indigenous communities, increases vulnerability to climate-related risks, and raises concerns over genetic resource sovereignty, particularly in contexts where regulatory and institutional mechanisms remain weak (Butchart et al., 2010; De Guzman et al., 2025; Ertem & Çiçek, 2025; Gunawan et al., 2024; Jeronen, 2023). In response, Indonesia has strengthened its legal and policy frameworks, including conservation regulations, green economy strategies, and international commitments such as the Nagoya Protocol on Access and Benefit Sharing (ABS). Nevertheless, gaps in policy implementation, institutional capacity, and biodiversity information management continue to constrain the effectiveness of these efforts.

Despite the growing body of research and policy initiatives addressing biodiversity conservation, existing studies and regulatory documents remain fragmented across ecological, socio-economic, and governance perspectives. Empirical findings, policy frameworks, and international commitments are often discussed in isolation, limiting a comprehensive understanding of how biodiversity loss, community impacts, and governance mechanisms interact. In this context, a systematic review becomes essential to synthesize dispersed evidence, identify recurring patterns and gaps, and assess the coherence between scientific knowledge and policy implementation. By applying a systematic document analysis, this study responds to the need for an integrated and evidence-based synthesis that can inform more coherent biodiversity governance and support effective decision-making at both national and international levels. These challenges have created an urgent need to formulate systematic, adaptive, and equitable strategies for natural resource and environmental management. The Indonesian government has adopted various strategic policies to strengthen biodiversity protection, ranging from Payment for Ecosystem Services (PES) schemes, carbon taxes, emissions trading, to the 2030 FOLU Net Sink target. In addition, the ratification of the Nagoya Protocol through Law No. 11 of 2013 provides an important legal basis for regulating Access and Benefit Sharing (ABS) of national genetic resources, although its implementation still faces various challenges at the operational level.

This study aims to examine the dynamics of natural resource and environmental management in Indonesia by highlighting the synergy between national policies and the international legal framework, particularly the Nagoya Protocol. Through a descriptive analysis approach based on biodiversity theory and policy evaluation, this article provides a comprehensive overview of the effectiveness of biodiversity management in Indonesia, implementation challenges in the field, and recommendations for strengthening a sustainable conservation system based on ecological justice and community participation.

2. RESEARCH METHOD

This study uses a qualitative descriptive approach through a narrative literature review and an analysis of relevant education and sustainability policy documents. The purpose of the review is interpretative and contextual, aiming to synthesize regulatory developments, policy directions, and conceptual insights relevant to biodiversity governance and the implementation of the Nagoya Protocol in Indonesia. The data used are sourced from various national legal documents, Indonesian government policy reports, reports from international organizations such as Convention on Biological Diversity (CBD), United Nations Environment Programme (UNEP), and United Nations Framework Convention on Climate Change (UNFCCC) as well as relevant national and international scientific publications on biodiversity, natural resource management, and the implementation of the Nagoya Protocol in Indonesia.

All legal and policy documents analyzed in this study represent valid and officially enacted regulations, not policy projections. These include Law No. 11 of 2013, Ministerial Decision No. 22 of 2024, and Ministerial Regulation No. 2 of 2025, all of which have been formally issued by the Government of Indonesia and are currently in force, and data from international institutions related to climate change and biodiversity conservation.

The analysis process was carried out using a thematic content analysis approach, identifying key themes such as conservation policies, ABS implementation, energy transition strategies, and challenges in implementing conservation policies at the national and local levels. Data validity was strengthened by triangulating sources from various types of literature to ensure consistency between theory, policy, and practice in the field. Thematic categories were identified through iterative reading and comparative interpretation. Literature was identified using targeted keyword searches such as *"biodiversity governance," "Nagoya Protocol," "access and benefit sharing (ABS)," "payment for ecosystem services (PES)," "FOLU Net Sink,"* and *"Indonesia."* The review prioritized publications from the 2010–2025 period, corresponding to Indonesia's post-ratification and implementation phases of biodiversity-related international agreements.

Table 1 presents an overview of the literature sources reviewed, outlining their types, origins, and analytical relevance to the study.

Table 1. literature sources outlining their types, origins, and analytical relevance to the study.

Source Type	Institution / Publisher	Time	Analytical Focus	Relevance to Study
National laws and regulations	Government of Indonesia (e.g., Ministry of Environment and Forestry)	2010–2025	Biodiversity governance, ABS implementation, conservation policy	Provides legally binding regulatory framework
Ministerial regulations and decisions	Ministry of Environment and Forestry (KLHK)	2013–2025	Operationalization of ABS, PES mechanisms, FOLU Net Sink strategies	Links international commitments to national policy instruments
International policy reports	CBD, UNEP, UNFCCC	2010–2024	Global biodiversity and climate governance frameworks	Contextualizes Indonesia within international agreements
Peer-reviewed journal articles	International & national journals	2010–2025	Biodiversity governance, ecosystem services, socio-ecological systems	Provides analytical and empirical grounding
Policy-oriented research reports	Research institutions and NGOs	2015–2025	Implementation challenges, governance practices	Bridges policy design and field-level realities

Following source identification, the selected literature was examined using a narrative analytical approach. Key concepts and policy instruments recurrently appearing across sources were coded and compared, with particular attention to how biodiversity governance is operationalized at the national level while responding to international environmental commitments. Figure 1 show core thematic categories were identified by clustering recurrent policy instruments and governance mechanisms and interpreting them within Indonesia's biodiversity and climate governance framework.
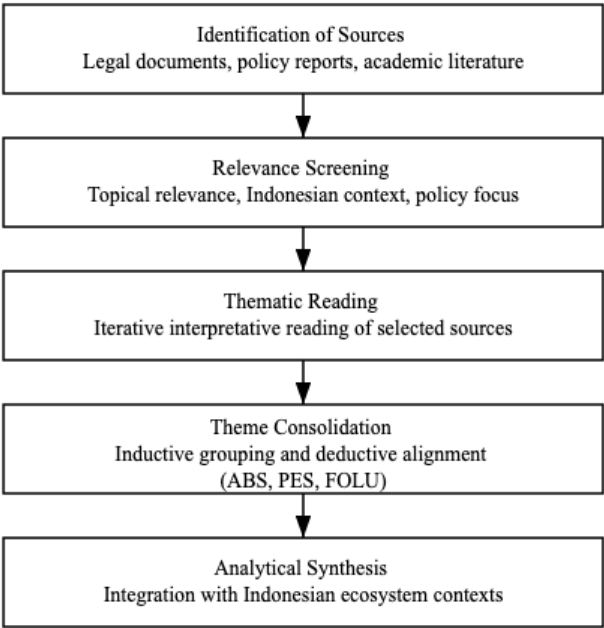
Figure 1. Literature Sources Used for the Analysis

3. RESULTS AND ANALYSIS

3.1 BIODIVERSITY

Biodiversity is the main foundation for balance and sustainability of life on earth (Priyono Dwi Sendi et al., 2023; Shen et al., 2024). Biodiversity encompasses all forms of life, from the genetic level, species, to ecosystems that form a complex network of interactions in the natural system (Hoban et al., 2021; Johari & Rahmawati, 2023). Every living organism occupies a unique ecological niche and is interconnected (Dang et al., 2025), creating stability that ensures the functioning of various ecosystem services, such as food production, climate regulation, access to clean water, and human health resilience. In a good ecosystem, biodiversity creates a resilient buffer system against various environmental disturbances (Wu, 2025). For example, the presence of pollinating insects enables optimal plant reproduction, while natural predators keep pest populations under control.

Biodiversity Theory in Interpreting Governance and Ecosystem Dynamics
The results of this study indicate that biodiversity governance in Indonesia reflects the interaction of multiple ecological mechanisms rather than a single theoretical process. High levels of biodiversity persistence observed in several ecosystem contexts can be interpreted through speciation theory, where geographic and ecological isolation contribute to differentiated species assemblages. This pattern is particularly relevant in fragmented terrestrial and coastal ecosystems, supporting insights from island biogeography theory, which emphasizes the importance of habitat size and connectivity in sustaining species diversity.

Furthermore, the analysis reveals that biodiversity maintenance is shaped by niche differentiation and competition dynamics, especially in multi-use landscapes where resource partitioning enables species coexistence despite increasing anthropogenic pressure. In more disturbed or transitional ecosystems, however, biodiversity patterns appear less deterministic and align with neutral biodiversity theory, suggesting that stochastic processes such as migration and local extinction increasingly influence community composition (Enquist et al., n.d.; Pranata et al., 2022; Tilman, 2004).

Importantly, the findings reinforce the ecosystem biodiversity function relationship, as areas experiencing biodiversity decline also exhibit reduced ecosystem stability and service provision. These patterns are closely associated with land-use change, deforestation, pollution, climate change, overexploitation, and invasive species, indicating that anthropogenic drivers have begun to override natural ecological regulation. Consequently, the literature highlights that effective biodiversity management in Indonesia requires integrative conservation strategies that combine habitat protection, ecosystem restoration, sustainable resource use, invasive species control, and climate-adaptive, nature-based solutions.

Socio-Ecological Systems and Ecosystem Services in Indonesia's Biodiversity Governance

The findings of this study indicate that Indonesia's biodiversity governance cannot be adequately understood through sectoral or purely regulatory perspectives, but is more appropriately interpreted through a socio-ecological systems (SES) framework. In practice, biodiversity management in Indonesia particularly in forest, peatland, mangrove, and watershed ecosystems is characterized by strong interdependencies between ecological processes, community livelihoods, and multi-level governance structures. For example, conservation outcomes in peatland and mangrove areas are closely tied to land-use practices, tenure arrangements, and local economic dependence, reflecting core SES principles of feedback, adaptability, and resilience (Adams & Sandbrook, 2013; Efriyeldi et al., 2023).

Within this context, ecosystem services theory provides an explanatory bridge between ecological functions and policy instruments. The emergence of Payment for Ecosystem Services (PES) schemes and forest carbon initiatives illustrates how regulating and provisioning services such as carbon sequestration, water regulation, and coastal protection are increasingly framed as governance mechanisms rather than abstract ecological benefits. However, the effectiveness of these instruments remains uneven, as ecological complexity often exceeds the simplifying assumptions embedded in policy design.

Furthermore, insights from landscape ecology help explain persistent governance challenges in Indonesia's Forest and Other Land Use (FOLU) sector, where habitat fragmentation, land-use change, and spatial mismatches between administrative boundaries and ecological systems undermine policy coherence. Taken together, these findings suggest that Indonesia's biodiversity governance reflects an ongoing negotiation between ecological theory and institutional practice, highlighting the need for policies that better align ecosystem dynamics with socio-economic and governance realities.

3.2 NAGOYA PROTOCOL

Biodiversity is a vital asset for maintaining ecosystem balance and serves as a foundation for sustainable development (Gunawan et al., 2025; Wetzel et al., 2015). Amid increasing pressures from natural resource exploitation, conservation efforts have become essential strategies for safeguarding biodiversity. In response to these challenges, the international community, through the Convention on Biological Diversity (CBD), developed the Nagoya Protocol as a legal instrument regulating the Access and Benefit-Sharing (ABS) mechanism, intended to bridge biodiversity conservation with the sustainable utilization of genetic resources.

Indonesia ratified the Nagoya Protocol through Act No. 11 of 2013, and subsequent sectoral regulations have progressively translated ABS principles into administrative procedures governing access to genetic resources. These include requirements for Prior Informed Consent (PIC), Mutually Agreed Terms (MAT), and Material Transfer Agreements (MTA), which constitute the core compliance mechanisms for accessing biological materials. While comprehensive national data on benefit-sharing outcomes remain limited, available documentation indicates that ABS has begun to be operationalized through permit-based access and contractual arrangements, particularly in research and bioprospecting activities.

Global biodiversity conservation efforts rely not only on field-based interventions but also on the strengthening of legal and institutional frameworks governing the use of genetic resources (Palenova et al., 2007). The Nagoya Protocol, as a supplementary instrument to the CBD, is designed to regulate access to genetic resources and ensure fair and equitable sharing of benefits among stakeholders. This legal initiative is particularly relevant for biodiversity-rich countries such as Indonesia, where effective implementation has the potential to reduce biopiracy and promote sustainable conservation practices.

a.   Access and Benefit Sharing (ABS) Mechanism

The Nagoya Protocol emphasizes access and benefit-sharing (ABS) as a fundamental principle in the utilization of genetic resources. This mechanism requires prior consent from resource owners, including states and local or indigenous communities, as a prerequisite for access and utilization. As noted by Yulia and Zinatul Ashiqin Zainol (2013), ABS is intended not merely to regulate commercial exploitation but also to safeguard ecological values and local knowledge systems embedded in genetic resources.

In Indonesia, ABS implementation has been translated into national regulations following Law No. 11 of 2013, which governs genetic resources and their utilization. Empirically, ABS-related procedures have been applied in the context of medicinal plant research, where access to plant genetic material for pharmacological or ethnobotanical studies is subject to PIC and MTA requirements, particularly when materials are transferred to research institutions or international collaborators. Although systematic reporting of benefit-sharing outcomes remains scarce, these arrangements illustrate early-stage operationalization of ABS principles in controlling access and regulating material use.

In addition, ABS-like mechanisms have been applied in marine bioprospecting activities, especially in research involving marine microorganisms and bioactive compounds. Access to marine genetic resources has increasingly required institutional permits and MTAs that specify use limitations and potential benefit-sharing arrangements. However, existing studies indicate that most documented cases remain procedural in nature, with limited publicly available evidence on realized monetary or non-monetary benefits, highlighting a significant gap between regulatory intent and measurable outcomes.

b.   Contribution of the Nagoya Protocol to Local and National Conservation

The implementation of the Nagoya Protocol enables biodiversity-rich countries to reclaim control over the use of their genetic resources. Based on the findings of Indrayati and Triatmodjo (2017), this step provides dual benefits. First, as an effort to protect genetic resources from harmful biopiracy practices, and second, as a means to ensure that any financial or non-financial benefits do not only flow to foreign entities but are also directly utilized for the empowerment and conservation of local ecosystems. This model, based on principles of justice and sustainability, has inspired environmental management policies in several developing countries.

In the Indonesian context, ABS-related regulations have been positioned as instruments to align conservation objectives with national interests, particularly in safeguarding traditional medicinal knowledge and preventing unauthorized patenting of bioactive compounds derived from local biodiversity. Although empirical evidence on benefit redistribution remains limited, the regulatory framework itself reflects a normative shift toward justice- and sustainability-oriented biodiversity governance.

c.   Challenges and Opportunities in Implementing Conservation Policies

Despite the robustness of the Nagoya Protocol's legal framework, its implementation in Indonesia faces substantial practical challenges. These include difficulties in identifying custodians of genetic resources, documenting biodiversity boundaries, and navigating complex bureaucratic procedures for establishing benefit-sharing agreements. Limited institutional capacity and uneven human resource distribution further constrain consistent implementation, particularly at the local level.

Looking forward, integrating conservation policies with the Nagoya Protocol presents significant opportunities for strengthening biodiversity governance. The development of information- and communication-technology–based monitoring systems, alongside empirical, outcome-oriented research on ABS implementation, could help bridge existing evidence gaps. Policy recommendations derived from evaluations of ABS practices emphasize the need for improved transparency, institutional coordination, and capacity building to support equitable and effective conservation outcomes (Widjaja et al., 2020)

3.3 NATURAL RESOURCE AND ENVIRONMENTAL CONSERVATION POLICIES

a. Conservation and Green Economy Policy

In the last decade, the Indonesian government has strengthened its ecosystem-based conservation policy by integrating a green economy approach. One of the key policy instruments is the Payment for Ecosystem Services (PES) scheme, which provides financial compensation to individuals or communities that preserve strategic ecosystem functions. Through Ministerial Regulation No. 2 of 2025, the government promotes incentive mechanisms for forest managers, forest farmer groups, and indigenous communities involved in maintaining hydrological functions, biodiversity, and carbon sequestration.

For example, in some areas such as Klaten Regency and Lampung Province, the implementation of PES has successfully reduced carbon emissions by more than 17,000 tons of CO_2 per year. This scheme not only impacts emission reduction but also provides direct economic incentives to forest-managing communities. This approach also reduces pressure on illegal deforestation and internalizes the value of environmental services into regional development mechanisms.

Decentralization in environmental management has also been strengthened, particularly through Minister of Environment and Forestry Decision No. 22 of 2024, which grants local governments the authority to approve AMDAL and UKL-UPL. This delegation of authority is expected to accelerate the permitting process, increase local participation in environmental monitoring, and improve the governance of natural resource permits.

b. Natural Resource Management and Fiscal Policy

As the economic value of natural resource exports increases, the Indonesian government has introduced strategic policies for managing natural resource foreign exchange. Through Government Regulation No. 8 of 2025, the government requires all foreign exchange earnings from natural resource exports (non-oil and gas) to be deposited in a special foreign exchange account within the country. This policy aims to strengthen national foreign exchange reserves, stabilize the exchange rate, and ensure that natural resource export surpluses are maximally utilized to support sustainable development financing in the environmental sector.

In terms of forest conservation, the Indonesian government continues to implement the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) 2050, as well as the medium-term Folu Net Sink 2030 policy. Data from the Ministry of Environment and Forestry shows that Indonesia's deforestation rate declined significantly between 2018 and 2020, from 0.46 million hectares per year to 0.12 million hectares. This decline was influenced by the implementation of the REDD+ scheme, result-based payments, and the strengthening of the moratorium on permits for clearing primary and peatlands.

Sustainable forest management certification has also shown positive results. Approximately 76% of Indonesia's production forest area has obtained sustainable management certification, either in the form of PHPL (Sustainable Production Forest Management) or FSC (Forest Stewardship Council). This achievement reflects the government's commitment to balancing the economic utilization of forest products with ecological conservation aspects.

c. Renewable Energy Transition and Carbon Policy

Energy transition is a key pillar in managing Indonesia's natural resources toward carbon neutrality. The government has gradually implemented a carbon tax since 2022, starting with the coal-based electricity sector. The carbon emissions trading scheme (Emission Trading System - ETS) officially began in 2024 and is now the primary market instrument for regulating greenhouse gas emissions.

Indonesia's emissions reduction targets were updated in the 2022 Nationally Determined Contribution (NDC), with a commitment to reduce emissions by 32% independently and 43% with international assistance. In the national energy mix, the government targets an increase in the share of new and renewable energy to 23-31% during the 2025–2030 period, with a focus on solar power plants, geothermal power plants, and large-scale hydroelectric power plants.

This policy also synergizes with plans to phase out coal-fired power plants. Under the Just Energy Transition Partnership (JETP) framework, Indonesia is committed to gradually reducing its dependence on coal over the next 15–20 years, while ensuring that the energy transition is fair to affected workers and communities.

d. Implementation of Policies Derived from the Nagoya Protocol

The Nagoya Protocol on Access and Benefit Sharing (ABS) has been ratified by Indonesia through Law No. 11 of 2013. However, until 2025, the implementation of legal instruments derived from this protocol still faces serious challenges. The absence of operational derivative regulations means that the utilization of national genetic resources is not yet fully managed in a fair and sustainable manner.

The establishment of a national competent authority is needed to regulate access, licensing, and the sharing of economic benefits from the utilization of genetic resources and traditional knowledge of indigenous communities. The absence of such regulations risks biopiracy, where foreign parties access Indonesia's genetic resources without providing reciprocal benefits to the state and indigenous communities.

Globally, Indonesia has great potential as a megabiodiversity country to become a center for the development of biotechnology, pharmaceuticals, cosmetics, and functional foods(Johari & Rahmawati, 2023; Prasetyo et al., 2025). However, without strengthening the implementation of the Nagoya Protocol, national genetic resources could be exploited exclusively by global industries without state sovereignty control.

3.4 IMPACT ANALYSIS

a. Ecological Impacts of Biodiversity Loss

Biodiversity loss has highly complex ecological impacts on ecosystem stability. One direct consequence of the loss of key species such as pollinating insects, e.g., bees, or natural predators is the disruption of population balance in the food chain. This imbalance triggers ecological system instability, where the uncontrolled growth of pest populations or invasive species can occur, exacerbating ecosystem degradation.

Furthermore, biodiversity loss directly impacts ecological cycles, particularly nutrient cycles and water cycles (Shen et al., 2024). The loss of vegetation due to deforestation, for example, reduces the soil's ability to retain water, accelerates erosion rates, and increases the risk of natural disasters such as floods and landslides (McBride et al., 2013). Ecosystems that have been damaged become vulnerable to climate disturbances and extreme weather shifts, such as prolonged droughts or flash floods that damage natural support systems.

Population imbalances among species also create a domino effect from the loss of one or more important species. When natural predators decline, plant pest populations can grow rapidly without natural control. This situation not only threatens food security but also encourages humans to use pesticides intensively, which in turn worsens environmental pollution.

b. Social, Economic, and Policy Impacts

Biodiversity loss also produces measurable socio-economic impacts. Recent national and global reports indicate that approximately 40–45% of rural and indigenous communities in Indonesia depend directly on ecosystem services for food security, traditional medicine, and local income, making them highly vulnerable to ecosystem degradation (MoEF, 2024). At the macro level, the United Nations Environment Program (UNEP, 2023) estimates that biodiversity and ecosystem degradation could result in economic losses of up to USD 10 trillion per year globally, equivalent to around 2–4% of global GDP. Furthermore, the Ministry of Environment and Forestry reports that limited implementation of access and benefit-sharing (ABS) mechanisms has constrained community-level economic returns from genetic resources, despite Indonesia's high biodiversity potential (KLHK, 2024).

The impacts of biodiversity loss are not limited to ecological aspects but also have significant social and economic consequences(Callicott et al., 1999). Local communities that have long relied on biological resources for food, traditional medicine, and economic income face serious threats to the sustainability of their livelihoods. Dependence on local biodiversity places indigenous communities and rural communities in a vulnerable position when natural resources decline due to ecosystem degradation (Cutter-Mackenzie & Smith, 2003)

Additionally, the risk of biopiracy increases when genetic resource management systems are not optimally regulated. Uncontrolled access by foreign parties can lead to the loss of traditional community ownership rights over genetic resources, while also hindering the potential for long-term economic benefits for both the nation and local communities. In the context of global policy, the Nagoya Protocol serves as an important instrument regulating the mechanism for access and benefit sharing (ABS) of genetic resources in a fair and legal manner. The implementation of the Nagoya Protocol in Indonesia opens strategic opportunities to empower local communities, prevent illegal exploitation practices, and create new funding sources to support sustainable conservation programs.

However, the implementation of the Nagoya Protocol in Indonesia still faces many challenges. Some of the obstacles include bureaucratic complexity, limited human resources with an understanding of the ABS framework, a lack of supporting infrastructure, and difficulties in mapping and documenting genetic resource areas that are widely scattered across the archipelago. National regulations such as Law No. 11 of 2013 provide a legal framework, but its implementation is still not optimal and is not evenly distributed nationwide.

c. Opportunities for Innovation and Improvement in Conservation

Despite the challenges faced, there are vast opportunities for innovation in strengthening conservation policies in Indonesia (Yulia & Zainol, 2014). The development of an information and communication technology-based biodiversity monitoring system is an important step in overcoming data and genetic resource documentation constraints. Digital platforms such as the Biodiversity Information System can accelerate the process of registration, reporting, and supervision of genetic resource utilization at the national level.

In addition, the development of conservation strategies based on local research enables the development of more adaptive management approaches in line with the characteristics of local ecosystems. The involvement of academics in biodiversity research can provide a strong scientific basis for government policymaking at the national and regional levels (Butchart et al., 2010).

Cross-sector collaboration between the government, academics, non-governmental organizations, and local communities also needs to be strengthened. Collaborative management models such as community-based biodiversity management have proven effective in empowering communities while protecting biodiversity in a sustainable manner. This synergy between ecological, social, and economic interests will strengthen the resilience of national ecosystems amid the threats of global climate change and pressure from natural resource exploitation.

4. CONCLUSION

Biodiversity is a critical foundation for ecosystem stability and human well-being, providing essential ecological services, economic resources, and social benefits. However, this analysis shows that biodiversity loss continues to intensify due to anthropogenic pressures such as deforestation, habitat degradation, climate change, pollution, overexploitation, and invasive species, leading to ecosystem imbalance and increasing socio-ecological vulnerability. Beyond ecological impacts, biodiversity decline also threatens the economic resilience and genetic resource sovereignty of local and indigenous communities, while weak governance increases the risk of biopiracy. As a mega-biodiversity country, Indonesia has demonstrated commitment through strengthened legal frameworks, conservation policies, and green economy strategies, including PES schemes, low-carbon development, and renewable energy transitions. Nevertheless, challenges persist in policy implementation, institutional capacity, and biodiversity information management. Therefore, integrated and collaborative governance combining ecological, economic, social, legal, and technological approaches is essential to ensure sustainable biodiversity management. Biodiversity conservation should thus be viewed not only as an environmental imperative but as a strategic pillar of national resilience and Indonesia's contribution to global sustainability.

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