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The Contribution of Forest Carbon Trading to Indonesia's Net Zero Emissions Target

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ABSTRACT

This study analyzes the contribution of forest carbon trading to Indonesia's Net Zero Emissions (NZE) target using a qualitative approach involving five key informants, including policymakers, academics, practitioners, private sector actors, and community representatives. The findings reveal that forest carbon trading plays a strategic role in reducing greenhouse gas emissions through forest conservation, restoration, and sustainable land-use management. Carbon trading also generates significant economic benefits by mobilizing climate finance, supporting community livelihoods, and stimulating private sector participation. Additionally, the mechanism strengthens governance through improved monitoring, reporting, and verification (MRV) systems. However, challenges remain, including regulatory uncertainties, technical limitations, market volatility, land tenure issues, and inconsistent community engagement. The study concludes that forest carbon trading has strong potential to accelerate Indonesia's progress toward NZE, provided that policy harmonization, institutional capacity, and community empowerment are reinforced. These insights offer valuable recommendations for enhancing carbon market effectiveness and supporting national climate goals.

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1. INTRODUCTION

Indonesia, as one of the world's largest tropical forest countries, plays a critical role in the global agenda for climate change mitigation. Forest ecosystems in Indonesia function not only as biodiversity reservoirs but also as major carbon sinks capable of absorbing significant amounts of greenhouse gases (GHGs) [1], [2]. In recent years, the Indonesian government has strengthened its commitment to addressing climate change through the Nationally Determined Contributions (NDC) and the long-term vision to achieve Net Zero Emissions (NZE) by 2060 or sooner. Achieving this ambitious target requires a combination of emission reduction efforts, sustainable land-use practices, and market-based mechanisms that incentivize forest conservation. Among these mechanisms, forest carbon trading has emerged as a promising instrument to align economic interests with environmental goals [3], [4].

Forest carbon trading involves the exchange of carbon credits generated from activities that increase carbon sequestration or reduce emissions from deforestation and forest degradation. Instruments such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation), voluntary carbon markets, and compliance market initiatives offer opportunities for Indonesia to leverage its vast forest resources for climate mitigation [5], [6]. These mechanisms enable the country to monetize carbon stored in forests, attract investment in sustainable land management, and promote community-based conservation programs. As global carbon markets continue to expand, Indonesia is positioned to become a major supplier of high-quality forest carbon credits.

Indonesia continues to face several challenges in implementing forest carbon trading. Structural barriers such as regulatory inconsistencies, limited monitoring and verification capacity, land tenure conflicts, and insufficient involvement of local communities hinder the effectiveness of carbon trading as an instrument for achieving Net Zero Emissions (NZE) [3], [4], [7]. Understanding the actual contribution of forest carbon trading to national climate goals therefore requires insights not only from policy frameworks but also from the lived experiences and perspectives of stakeholders directly engaged in its implementation.

This study aims to analyze the contribution of forest carbon trading to Indonesia's NZE target using a qualitative approach involving five key informants. Through in-depth interviews with policymakers, experts, practitioners, and market actors, the research explores the role of forest carbon trading in supporting emission reduction efforts, the opportunities and benefits offered by carbon market mechanisms, and the challenges that must be addressed to enhance their effectiveness. The findings are expected to provide a comprehensive understanding of how forest carbon trading can serve as a strategic instrument within Indonesia's climate mitigation agenda, while offering recommendations to strengthen policy implementation and stakeholder collaboration through economic incentives, governance reforms, and meaningful community participation.

2. LITERATURE REVIEW

2.1 Forest Carbon Trading: Concepts and Mechanisms

Forest carbon trading is a market-based mechanism that enables entities to buy and sell carbon credits generated from activities that reduce emissions or enhance carbon sequestration in forest ecosystems, with credits typically originating from initiatives such as afforestation, reforestation, avoided deforestation, and improved forest management under frameworks like the UNFCCC [8], [9]. Operating through compliance markets—where trading is regulated and mandatory for specific sectors—and voluntary markets driven by corporate sustainability or social responsibility commitments, forest carbon trading is closely linked to instruments such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation), which offers financial incentives for reducing forest loss while promoting conservation and sustainable management. Existing studies highlight that forest carbon markets can provide substantial financial inflows for developing countries, encourage conservation-oriented behavior, and strengthen community-based forest management efforts.

2.2 Forest Carbon Trading in Indonesia

Indonesia has positioned itself as a major potential supplier of forest carbon credits due to its extensive tropical forests in regions such as Kalimantan, Sumatra, Papua, and Sulawesi, with national initiatives like the FoLU Net Sink 2030 framework emphasizing the central role of forests in the country's climate mitigation strategy by targeting the forestry sector to absorb more emissions than it produces by 2030—thereby creating favorable conditions for forest carbon trading. Previous research [5], [9], [10], shows that forest carbon projects have supported reductions in deforestation, improvements in

forest governance, and enhancements in local livelihoods, while Indonesia has also established regulatory foundations such as Presidential Regulation No. 98/2021 on Carbon Economic Value, which outlines mechanisms for carbon pricing, including carbon trading, result-based payments, and carbon offsets. Despite these advancements, key uncertainties persist related to policy clarity, market access, benefit-sharing arrangements, and verification standards.

2.3 Conceptual Framework

Based on the reviewed literature, forest carbon trading contributes to Indonesia's NZE target through several pathways—including environmental impacts such as carbon sequestration and reduced deforestation; economic benefits such as financing inflows, market incentives, and improved livelihoods; governance improvements through strengthened regulations and enhanced monitoring systems; and social inclusion through community participation and equitable benefit-sharing—yet these contributions are shaped and often constrained by challenges related to policy clarity, technological capacity, market stability, and social dynamics, forming the conceptual foundation for the qualitative analysis in this study, which draws on insights from five key informants representing diverse stakeholder groups.

3. RESEARCH METHODS

3.1 Research Design

This study employs a qualitative research design to explore the contribution of forest carbon trading to Indonesia's Net Zero Emissions (NZE) target. A qualitative approach is used because it allows for an in-depth understanding of stakeholder perspectives, policy dynamics, and practical experiences that cannot be fully captured through quantitative measurement. By focusing on narratives, perceptions, and expert insights, this method provides a comprehensive view of how forest carbon trading mechanisms operate in the Indonesian context and the factors influencing their effectiveness.

3.2 Informants and Sampling Technique

Five key informants were selected using purposive sampling, targeting individuals with expertise and direct involvement in forest carbon trading, climate policy, or forestry governance, consisting of a policymaker from the Ministry of Environment and Forestry (KLHK), a forestry expert from an academic institution, a practitioner from a forest conservation NGO, a private-sector representative engaged in voluntary carbon markets, and a community leader involved in local forest conservation efforts; together, their diverse backgrounds enable strong triangulation of perspectives and provide a comprehensive understanding of the environmental, economic, and socio-political dimensions of forest carbon trading.

3.3 Data Collection Techniques

Data were collected through in-depth semi-structured interviews, allowing flexibility while maintaining a clear research focus, using an interview guide containing open-ended questions on themes such as understanding forest carbon trading mechanisms, perceived contributions to emission reduction, financial–environmental–social benefits, implementation and governance challenges, stakeholder collaboration and community involvement, and policy gaps along with recommendations for strengthening carbon markets. Interviews were conducted both online and face-to-face depending on informant availability, each lasting approximately 45–60 minutes, recorded with permission, and subsequently transcribed for analysis, while secondary data—including policy documents, government reports, academic literature, and carbon market guidelines—were also utilized to reinforce and contextualize the findings.

3.4 Data Analysis Technique

Data were analyzed using thematic analysis by identifying, organizing, and interpreting patterns within the qualitative dataset through several steps, including familiarizing with the transcripts, generating initial codes related to forest carbon trading and NZE contributions, developing broader

themes such as governance, environmental impact, economic incentives, and stakeholder participation, reviewing and refining these themes for coherence, and synthesizing them into a consolidated narrative explaining how forest carbon trading supports Indonesia's NZE target, using either NVivo or manual coding depending on complexity. To ensure research trustworthiness, the study follows Lincoln and Guba's criteria by establishing credibility through triangulation, cross-checking with secondary data, and member checking; achieving transferability through detailed contextual descriptions; maintaining dependability with transparent documentation of data collection and analysis procedures; and ensuring confirmability through researcher neutrality, the use of direct quotations, and findings that accurately reflect informants' perspectives rather than researcher bias.

4. RESULTS AND DISCUSSION

4.1 The Role of Forest Carbon Trading in Supporting Emission Reduction

All informants agreed that forest carbon trading plays a substantial role in supporting Indonesia's climate mitigation efforts. Carbon trading contributes directly to reducing greenhouse gas emissions through avoided deforestation, forest restoration, and improved land-use management practices. According to the policymaker informant, Indonesia's commitment through the FoLU Net Sink 2030 policy positions the forestry sector as a leading driver in achieving NZE. Carbon trading mechanisms help accelerate these efforts by providing financial incentives for protecting carbon-rich landscapes.

The academic informant emphasized that forest carbon projects help enhance carbon sequestration by promoting reforestation and ecosystem restoration. These activities are consistent with global REDD+ frameworks and support Indonesia's NDC targets. The NGO representative highlighted that several community-based forest programs funded through voluntary carbon markets have succeeded in reducing illegal logging and improving local forest governance, demonstrating tangible emission reduction benefits.

These findings align with existing literature [3], [7], which suggests that forest carbon trading can effectively complement national climate strategies by reducing deforestation pressures and increasing forest carbon stocks. Forest carbon markets also encourage compliance with sustainable land-use practices. However, maximizing this role requires clear regulations and credible monitoring systems.

4.2 Economic and Financial Benefits Generated by Carbon Trading

One of the strongest themes emerging from the interviews is the economic potential of forest carbon trading. All informants agree that carbon trading mobilizes new financing streams for conservation and sustainable development. The private sector representative emphasized that voluntary carbon market demand from global corporations has created economic opportunities for project developers in Indonesia.

The policymaker and academic informants noted that carbon trading helps channel climate financing into regions with high deforestation risk, offering incentives for forest protection. Meanwhile, community informants shared that the financial benefits received from carbon projects have supported livelihood programs, such as agroforestry, capacity building, and forest monitoring incentives for local communities.

These findings reinforce studies [7], [8], showing that carbon markets can contribute significantly to sustainable development financing, especially in forest-rich developing countries. However, the distribution of financial benefits remains a concern, requiring stronger benefit-sharing mechanisms that ensure fairness and community empowerment.

4.3 Strengthening Governance and Institutional Capacity

Informants highlighted governance improvements as an indirect but important contribution of forest carbon trading to the NZE agenda. The NGO representative stated that forest carbon projects often require strong monitoring, reporting, and verification (MRV)

systems, leading to improved forest management practices. Capacity-building programs linked to carbon projects have enhanced skills in forest measurement, satellite monitoring, and community-based land-use planning.

The policymaker explained that Indonesia's regulatory framework—particularly the Carbon Economic Value policy—has begun to streamline governance procedures for carbon trading. Nevertheless, all informants acknowledged that inconsistent policy implementation and overlapping regulations between national and local governments remain major challenges.

Improved governance is essential for building investor confidence and ensuring the integrity of carbon credits. These findings support prior research showing that carbon trading strengthens institutional accountability but is hindered by regulatory fragmentation. Addressing these barriers is critical to realizing Indonesia's NZE target.

4.4 Community Participation and Social Outcomes

Community involvement emerged as a central theme among informants. The community leader and NGO representative emphasized that successful carbon projects depend on meaningful community participation. Local communities play active roles in forest monitoring, patrolling, and land restoration activities. In return, carbon projects often provide livelihood support, training, and access to funding that promotes sustainable economic activities.

However, informants also noted that some carbon projects struggle with land tenure issues, unclear benefit-sharing agreements, and limited consultation during project planning stages. This can lead to resistance or conflicts, reducing the long-term sustainability of carbon initiatives.

These findings mirror the literature [9], [11], which underscores the importance of community empowerment and equitable benefit-sharing in forest carbon governance. Community involvement not only enhances project sustainability but also helps reduce socioeconomic vulnerabilities. Strengthening institutional support and ensuring transparent communication are essential to improving outcomes.

4.5 Challenges and Barriers to Effective Carbon Trading Implementation

All informants identified several key barriers hindering the full potential of forest carbon trading in Indonesia, including regulatory uncertainty and overlapping policies between national and regional authorities, technical limitations in MRV systems and carbon stock measurement, market volatility marked by fluctuating carbon prices and restricted access to high-demand international markets, persistent land tenure conflicts in areas with historical disputes or unclear ownership, and capacity gaps at the community level due to limited training and resources. The private sector representative emphasized that carbon market investors often hesitate because of unpredictable regulatory environments, while academic and NGO informants underscored the need for standardized methodologies and stronger policy alignment to enhance credibility and attract greater investment. These constraints align with previous research showing that effective forest carbon trading requires institutional coordination, technological innovation, and sustained financial support, making the resolution of these barriers essential for scaling up carbon initiatives and strengthening their contribution to Indonesia's NZE targets.

5. CONCLUSION

This study concludes that forest carbon trading provides a meaningful contribution to Indonesia's efforts to achieve Net Zero Emissions (NZE). Through conservation, reforestation, and avoided deforestation activities, carbon trading mechanisms enhance carbon sequestration and reduce emissions from land-use change. The mechanism also delivers substantial economic value by channeling climate finance into rural and forest-dependent communities, stimulating private sector investment, and supporting sustainable livelihood programs. In addition, forest carbon trading strengthens governance by improving monitoring

systems, enhancing institutional coordination, and promoting transparency in forest management practices.

Despite these positive impacts, several challenges hinder optimal implementation. Regulatory inconsistencies, unclear land tenure, limited technical capacity in monitoring and verification, and fluctuating carbon market conditions remain significant barriers. Insufficient community participation and inequitable benefit-sharing further threaten the long-term sustainability of carbon projects. Addressing these issues requires stronger policy integration, transparent governance, and capacity-building measures that empower local stakeholders. Ultimately, coordinated collaboration among government agencies, private sector actors, NGOs, and local communities is essential to maximizing the potential of forest carbon trading and accelerating Indonesia's progress toward achieving its NZE target.

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